Santa Ana River Watershed Bacteria Monitoring Program

Quality Assurance Project Plan

Prepared by

On Behalf of
Santa Ana Watershed Project Authority

Version 3.0
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Group A: Project Management

1. Approval Sheet

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2. Table of Contents

Quality Assurance Project Plan (QAPP) Sections

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Acronym List

AgSEP	Agricultural Source Evaluation Plan
AgSEMP	Agricultural Source Evaluation Monitoring Program
Basin Plan	Water Quality Control Plan for the Santa Ana River Basin
BASMP	Bacteria Indicator Agriculture Source Evaluation Plan
BMP	best management practice
BPA	Basin Plan amendment
°C	degrees Celsius
CBRP	Comprehensive Bacteria Reduction Plan
CEDEN	California Environmental Data Exchange Network
cfs	cubic feet per second
cfu	colony forming unit
COC	chain of custody
DPD	N,N-Diethylparaphenylenediamine
E. coli	*Escherichia coli*
EPA	Environmental Protection Agency
ft	feet
Los Angeles Water Board	Los Angeles Regional Water Quality Control Board
MBAS	Methylene blue active substances
mL	milliliters
mg/L	Milligram/liter
mg/mL	milligrams/milliliter
MP	Monitoring Plan
MPN	most probable number
mS/cm	millisiemens/centimeter
MS4	Municipal Separate Storm Sewer System
MSAR	Middle Santa Ana River
MSAR Bacteria TMDL	MSAR Bacterial Indicator TMDL
MSAR TMDL Task Force	MSAR Watershed TMDL Task Force
NTU	Nephelometric Turbidity Unit
OCC	Orange County Coastkeeper
OCWD	Orange County Water District
PPE	Personal protection equipment
ppth	Parts per thousand
Project ID	Project Identification Number
Q	flow
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
qPCR	
REC1	water contact recreation
REC2	non-contact water recreation
RMP	Regional Monitoring Program

Sample ID	Sample Identification Number
SAR Bacteria Monitoring Plan	Santa Ana River Watershed Bacteria Monitoring Plan
SAR Bacteria Monitoring Program	Santa Ana River Watershed Bacteria Monitoring Program
Santa Ana Water Board	Santa Ana Regional Water Quality Control Board
SAR	Santa Ana River
SAWPA	Santa Ana Watershed Protection Authority
Site ID	Site Identification Number
SM	Standard Method
State Water Board	State Water Resources Control Board
SWAMP	Surface Water Ambient Monitoring Program
t	Time (seconds)
TMDL	Total Maximum Daily Load
TSS	total suspended solids
UAA	use attainability analysis
USEP	Urban Source Evaluation Plan

3. Distribution List

Table 3-1 identifies the entities that shall receive a copy of a final approved QAPP. These same entities shall participate in revisions to this document. It will be up to each entity or agency to distribute copies of the QAPP within their organizations, where needed.

Table 3-1. QAPP distribution list[1]

Role	Entity/Agency	Position	Contact Name, Tel. No., Email	QAPP Code
Monitoring Plan & QAPP Oversight	Santa Ana Watershed Project Authority (SAWPA)	Project Director	Rick Whetsel, 951-354-4222, rwhetsel@sawpa.org	SAR BACT Monitoring
	Santa Ana Regional Water Quality Control Board (Santa Ana Water Board)	Project Manager	Barbara Barry, 916-248-0375, Barbara.Barry@waterboards.ca.gov	SAR BACT Monitoring
	State Water Resources Control Board	QA Officer		SAR BACT Monitoring
Responsible Agencies or Designee	Agriculture/Dairy Representative	Project Manager	Pat Boldt, 951-808-8631, mpboldt@aol.com	SAR BACT Monitoring
		Project QA Officer		SAR BACT Monitoring
	City of Claremont	Project Manager	Loretta Mustafa, 909-399-5475, lmustafa@ci.claremont.ca.us	SAR BACT Monitoring
		Project QA Officer	Kimberly Colbert, 310-729-8031, Kimberly@ColbertGroup.com	SAR BACT Monitoring
	City of Newport Beach	Project Manager	John Kappelar, 949-644-3218, jkappelar@newportbeachca.gov	SAR BACT Monitoring
		Project QA Officer	Bob Stein, 949-644-3322, rstein@newportbeachca.gov	SAR BACT Monitoring
	City of Pomona	Project Manager	Julie Carver, 909-620-3628, Julie_carver@ci.pomona.ca.us	SAR BACT Monitoring
		Project QA Officer	Rae Beimer, 714-788-6936, raebeimer@caaprofessionals.com	SAR BACT Monitoring
	Orange County Watersheds (Orange County Public Works)	Project Manager[2]	James Fortuna, 714-955-0680, James.Fortuna@ocpw.ocgov.com	SAR BACT Monitoring
		Project QA Officer	Michael Mori, 714-955-0686, michael.mori@ocpw.ocgov.com	SAR BACT Monitoring
	Riverside County Flood Control & Water Conservation District	Project Manager[2]	Rebekah Guill, 951-955-2901 rguill@rivco.org	SAR BACT Monitoring
		Project QA Officer		SAR BACT Monitoring
	San Bernardino County Flood Control District	Project Manager[2]	Arlene Chun, 909-387-8109, arlene.chun@dpw.sbcounty.gov	SAR BACT Monitoring
		Project QA Officer		SAR BACT Monitoring
	CDM Smith (Designee)	Project Manager[2]	Steve Wolosoff, 617-452-6396, swolosoff@cdmsmith.com	SAR BACT Monitoring
		Project QA Officer	Bernadette Kolb, 617-452-6236, kolbbh@cdmsmith.com	SAR BACT Monitoring
		Project Task Manager	Paul Caswell, 213-457-2170, caswellpb@cdmsmith.com	SAR BACT Monitoring
	CWE (Designee)	Project Manager[2]	Vik Bapna, 714-526-7500, VBapna@cwecorp.com	SAR BACT Monitoring

Table 3-1. QAPP distribution list[1]

Role	Entity/Agency	Position	Contact Name, Tel. No., Email	QAPP Code
		Project QA Officer	Ryan Kearns, 714-526-7500, rkearns@cwecorp.com	SAR BACT Monitoring
Contract Laboratory	Orange County Public Health Laboratory	Laboratory Manager/Director[3]	Joseph Guzman, 949-219-0424, jguzman@ocha.com	SAR BACT Monitoring
		Laboratory QA Officer		SAR BACT Monitoring
	Orange County Water District	Laboratory Manager/Director[3]	Prem Parmar, 714-378-3200, pparmar@ocwd.com	SAR BACT Monitoring
		Laboratory QA Officer	Megan Plumley, 714-378-3200, mplumley@ocwd.com	SAR BACT Monitoring
	Babcock Laboratories, Inc.	Laboratory Manager/Director[3]	Amanda Porter, 951-653-3351, x249, aporter@babcocklabs.com	SAR BACT Monitoring
		Laboratory QA Officer	Stacey Fry, 951-653-3351, sfry@babcocklabs.com	SAR BACT Monitoring

[1] Table information will be periodically reviewed and updated to reflect program changes.
[2] Project Manager or Project QA Officer within a Responsible Agency or its designee is responsible for distributing QAPP to other project participants including the Monitoring and Data Managers and Sampling Personnel (see Figure 4-1).
[3] Laboratory Manager is responsible for ensuring laboratory staff are provided a copy of the QAPP.

4. Project/Task Organization

4.1 Overview

Figure 4-1 provides the organizational structure for implementation of the Santa Ana River (SAR) Watershed Bacteria Monitoring Program ("SAR Bacteria Monitoring Program"). The SAR Watershed Bacteria Monitoring Plan ("SAR Bacteria Monitoring Plan") will be implemented by a number of Responsible Agencies under the direction of a Project Director and the Santa Ana Water Board, which provide oversight of the SAR Bacteria Monitoring Plan and QAPP. Within each Responsible Agency specific positions are shown; however, each agency may combine positions if more efficient for implementation.

The following subsections describe the responsibilities associated with various roles and positions shown in Figure 4-1. While the Project Director and Responsible Agencies are ultimately responsible for collection of water quality data and preparation of annual reports to fulfill the requirements of the SAR Bacteria Monitoring Plan and QAPP, some of the specific roles and responsibilities described below may be fulfilled through the use of contractors.

4.2 Monitoring Plan and QAPP Oversight

Two positions have been established to provide oversight to implementation of the SAR Bacteria Monitoring Plan and QAPP.

4.2.1 Project Director

The Project Director for the SAR Bacteria Monitoring Program is SAWPA. Table 4-1 summarizes Project Director's overall responsibilities. While SAWPA will manage the overall program, SAWPA may contract portions of the work assigned to the Project Director position, e.g., preparation of the Annual Report.

4.2.2 Santa Ana Water Board

The Santa Ana Water Board is responsible for providing regulatory guidance for the implementation of the SAR Bacteria Monitoring Program. Specifically, the Santa Ana Water Board shall provide guidance to the parties implementing the SAR Bacteria Monitoring Plan and QAPP with regards to the requirements of the 2012 adoption of the Basin Plan Amendment (BPA) to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region* (see Section 5 additional information). Accordingly, the Santa Ana Water Board has a Project Manager assigned to oversee implementation and that Project Manager will work with the State Water Resources Control Board's (State Water Board) QA Officer to ensure the program, as described, is consistent with California Surface Water Ambient Monitoring Program (SWAMP) requirements.

Following approval of the SAR Bacteria Monitoring Plan and QAPP, the Santa Ana Water Board Project Manager and QA Officer shall be responsible for approvals of subsequent modifications to the SAR Bacteria Monitoring Plan and/or QAPP. The process for modifications of these documents is discussed in Section 1.4 of the SAR Bacteria Monitoring Plan.

4.3 Responsible Agency

For the purposes of this QAPP a Responsible Agency is an agency that is responsible for the collection of water quality data from at least one priority monitoring site and/or collection of water quality data to fulfill additional monitoring requirements established by a Total Maximum Daily Load (TMDL).

Implementation of the SAR Bacteria Monitoring Plan and QAPP shall be completed by the following Responsible Agencies:

- Agricultural/Dairy Representative
- City of Claremont
- City of Pomona
- Orange County Watersheds (Orange County Public Works)
- Riverside County Flood Control and Water Conservation District
- San Bernardino County Flood Control District
- Others, as needed[1]

For the purposes of this QAPP, Table 4-2 identifies the Responsible Agencies for implementation of water quality data collection at Regional Monitoring Program (RMP) priority monitoring sites and water quality data collection to fulfill additional TMDL monitoring requirements. It should be noted that two Priority 1 sites (SAR at MWD Crossing and SAR at Pedley Avenue) and three Priority 2 sites (Mill-Creek [Prado Area], Chino Creek at Central Avenue and Prado Park Lake) are shown as the responsibility of multiple entities. The Responsible Agencies for these sites will work collaboratively with the Project Director to determine final responsibility for collection of samples from these sites (e.g., by one of the Responsible Agencies, the Project Director, or a designated contractor) and establish any necessary cost-sharing agreements.

Within each Responsible Agency, five key positions have been identified to fulfill the requirements of the SAR Bacteria Monitoring Plan: Project Manager, Project QA Officer, Monitoring Manager, Data Manager and Sampling Personnel. Table 4-1 describes the duties assigned to each of the positions identified within each Responsible Agency. Where appropriate, a Responsible Agency may choose to combine two or more positions into a single position, e.g., combining Data Manager and Monitoring Manager activities. The Project QA Officer within each Responsible Agency shall ensure that the Quality Assurance and Quality Control (QA/QC) procedures contained herein are implemented as required within their area of responsibility.

Table 3-1 identifies the key roles and positions within each of the Responsible Agencies and the contact information for that position.

4.4 Contract Laboratory

The Responsible Agencies shall select contract laboratories that have the capabilities to meet the requirements of this QAPP. Table 4-1 describes the responsibilities of each contract laboratory. The

[1] Two monitoring sites in Orange County are surrounded by private or state lands. The agency that will be responsible for sampling these sites is still being determined.

Laboratory Manager of each contract laboratory will be responsible for ensuring that Laboratory Personnel implement the requirements of this QAPP.

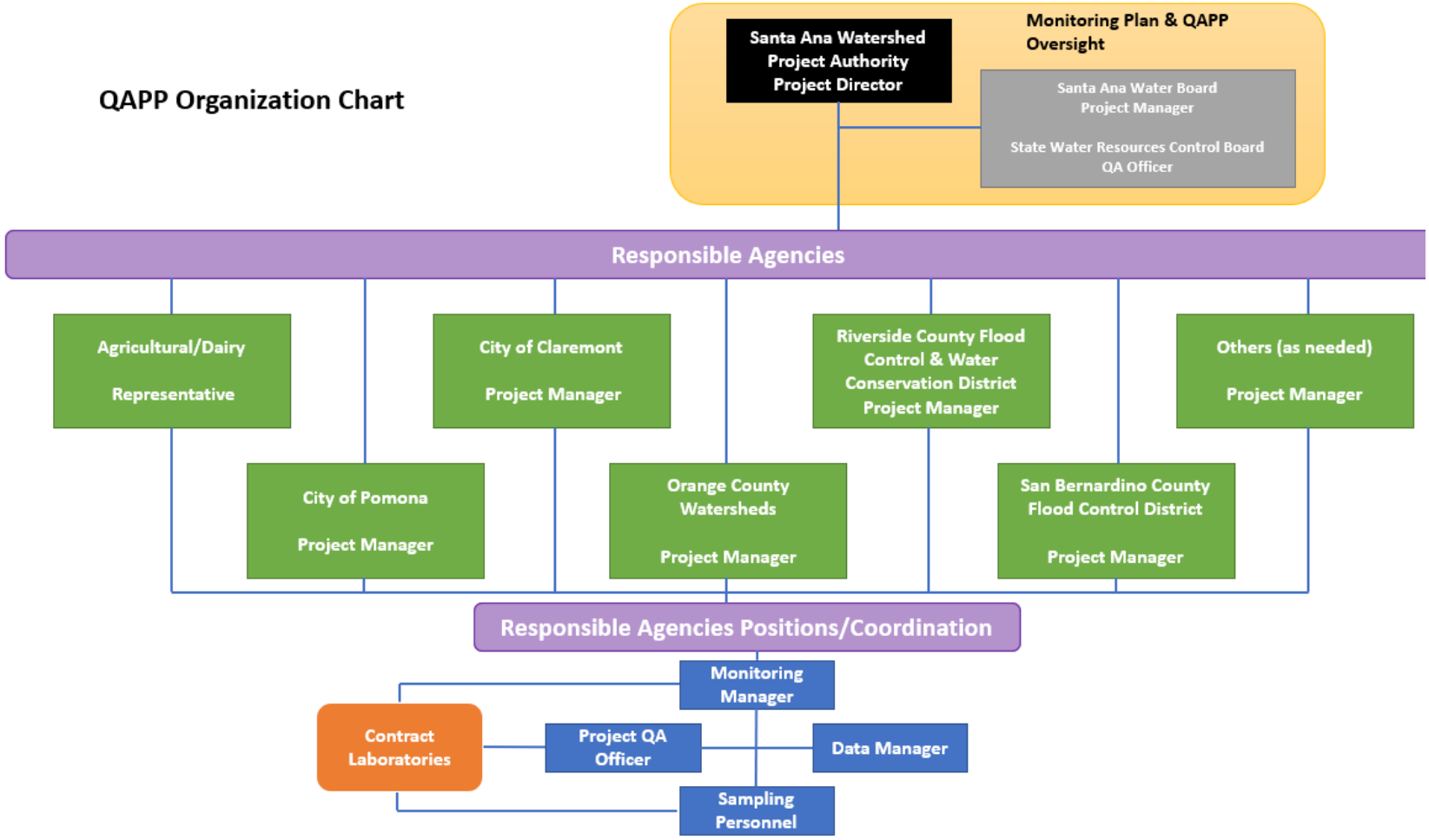


Figure 4-1. SAR Bacteria Monitoring Program organization chart

Table 4-1. Key positions & primary responsibilities for implementation of SAR Bacteria Monitoring Program

Position	Primary Responsibilities

Project Director	• Coordinate with Responsible Agencies to ensure that all monitoring sites shown in Table 4-2 are sampled annually as required by the Monitoring Plan and QAPP
	• Administration
	  ○ Annual budget development and management
	  ○ Establish/manage agreements/contracts, including cost share agreements where needed, taking into account which Responsible Agencies are collecting samples and where monitoring contracts need to be established
	  ○ Coordination/communication with Regional Board, Counties, stakeholders
	• Reporting
	  ○ Obtain all information/data results needed to prepare Annual Report
	  ○ Complete data analyses as required
	  ○ Prepare Annual Report; oversee review and revision process
	  ○ Address data/information requests
	• Data Management
	  ○ Provide database/spreadsheet template to Responsible Agencies for data entry during a sample year
	  ○ Receive data transfers from Responsible Agencies
	  ○ Conduct final data QA/QC
	  ○ Upload dataset from previous sample quarter to California Environmental Data Exchange Network (CEDEN)
	• Oversee updates to the SAR Bacteria Monitoring Plan and QAPP, when required, and ensure appropriate approvals are obtained by Santa Ana Water Board

Santa Ana Water Board	• Provide guidance to the Project Manager and program management regarding the implementation of the SAR Bacteria Monitoring Plan and QAPP and the requirements set forth in the BPA to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region* (approved by USEPA 2015) • Provide guidance to the Project Manager and program management with regards to California SWAMP requirements • Review and approval of revisions to originally approved SAR Bacteria Monitoring Plan and QAPP
Responsible Agency Project Manager	• Overall program management responsibility for the Responsible Agency • Coordinate with Project Director • Manage work of key positions within the Responsible Agency - either with in-house personnel or a contractor • Establish/manage contracts, as needed, to support monitoring activities • Invoice payment (e.g., contract laboratories/sampling, where contractors used) • Ensure sampling schedule is met (see Tables 10-1 and 10-2) • Ensure sufficient Sampling Personnel resources available • Address/solve programmatic issues as they arise • Manage project files while samples collected during a sample year • Ensure data uploaded into database/spreadsheet template provided by Project Director; at the end of a sample year, transmit all relevant project files/data to the Project Director • Coordinate with Project QA Officer; address/solve QA/QC issues as they arise • Make sure staff are properly trained

Table 4-1. Key positions & primary responsibilities for implementation of SAR Bacteria Monitoring Program

Position	Primary Responsibilities
Responsible Agency Project QA Officer	• Verify that the QA/QC procedures contained herein are implemented as required within their area of responsibility. • Verify QA/QC activities completed on data collected by a Responsible Agency before it is submitted to the Project Director and used to support development of the Annual Report. • The QA Officer may stop all actions, including those conducted by any subcontractor if there are significant deviations from required practices or if there is evidence of a systematic failure. Coordinate with Project Manager, Santa Ana Water Board and Project Director, as needed.
Responsible Agency Monitoring Manager	• Manage sampling personnel ○ Coordinate Sampling Personnel (in-house staff or contractors) to be sure sampling schedule for priority sites is met (see Tables 10-1 and 10-2) ○ If applicable – ensure TMDL-specific monitoring occurs as required, e.g., TMDL wet weather event ○ Conduct sample/equipment training as required ○ Ensure Sampling Personnel have all necessary equipment, forms, etc. to be successful • Manage equipment ○ Manage any equipment needs (e.g., flow meters, multi-parameter or similar instruments) ○ Ensure pre-field equipment procedures followed • Laboratory services ○ Coordinate sample collection with appropriate laboratories ○ If couriers used for sample delivery, coordinate courier scheduling ○ Ensure holding times are met ○ Ensure chain of custody (COC) forms properly managed • QA/QC ○ Coordinate with Project QA Officer to verify QA/QC procedures are followed, including equipment use, field blanks and replicates ○ Review field and COC forms for completeness ○ Work with Sampling Personnel, Contract Laboratories and Project QA Officer to resolve any issues of concern • Data Management ○ Receive data results from laboratories - verify completeness of results and conduct QA/QC check of laboratory results ○ Submit all field and laboratory documentation to Data Manager for data entry and filing
Responsible Agency Data Manager	• Enter field and laboratory data into database/spreadsheet template provided by Project Director • Conduct QA/QC of data entry process • Submit final dataset from a sample year to the Project Manager for transmittal to the Project Director

Table 4-1. Key positions & primary responsibilities for implementation of SAR Bacteria Monitoring Program

Position	Primary Responsibilities
Responsible Agency Sampling Personnel	• Trained in sample collection procedures and QAPP requirements • Complete field instrument pre- and post-sample collection calibrations • Collect field data and water sample as directed per the Monitoring Plan and QAPP • Complete COC forms and submit samples to the laboratory within holding times (including coordination with couriers if needed)
Contract Laboratories Laboratory Personnel	• Provide the necessary containers, preservatives (if required), COC forms to support sample collection • Analyze the samples for constituents as indicated in this QAPP and requested by the Monitoring Manager • Operate according to laboratory QA/QC program in accordance with guidelines established by the State of California and the U.S. Environmental Protection Agency (EPA) • Provide data in electronic and hard copy format to the Responsible Agency Monitoring Manager that submitted samples for analysis • Work with the Project QA Officers and Monitoring Manager for each Responsible Agency to resolve sample or data analysis issues when they arise

Table 4-2. Responsible agencies for RMP priority sites and additional TMDL monitoring

Responsible Agency	Monitoring Type	Monitoring Sites
Agricultural & Dairy	Priority 1	• SAR at MWD Crossing (also Priority 2) • SAR at Pedley Avenue (also Priority 2)
	Priority 2	• Chino Creek at Central Avenue • Mill Creek (Prado Area) • Prado Park Lake
	Priority 3	None
	Priority 4	None
	TMDL Specific	• Middle Santa Ana River Bacteria TMDL – Wet Weather Event
City of Claremont	Priority 1	• SAR at MWD Crossing (also Priority 2) • SAR at Pedley Avenue (also Priority 2)
	Priority 2	• Chino Creek at Central Avenue • Mill Creek (Prado Area) • Prado Park Lake
	Priority 3	None
	Priority 4	None
	TMDL Specific	• Chino Creek at Central Avebue – Wet Weather Event
City of Newport Beach	Priority 1	None
	Priority 2	None
	Priority 3	• Los Trancos Creek • Morning Canyon Creek
	Priority 4	None
	TMDL Specific	None
City of Pomona	Priority 1	• SAR at MWD Crossing (also Priority 2) • SAR at Pedley Avenue (also Priority 2)
	Priority 2	• Chino Creek at Central Avenue • Mill Creek (Prado Area) • Prado Park Lake
	Priority 3	None
	Priority 4	None
	TMDL Specific	• Middle Santa Ana River Bacteria TMDL – Wet Weather Event
Orange County Watersheds (Orange County Public Works)	Priority 1	None
	Priority 2	None
	Priority 3	• Borrego Canyon Wash • Serrano Creek

Table 4-2. Responsible agencies for RMP priority sites and additional TMDL monitoring

Responsible Agency	Monitoring Type	Monitoring Sites
	Priority 4	Santa Ana Delhi Channel
	TMDL Specific	None
Riverside County Flood Control & Water Conservation District	Priority 1	• Canyon Lake • Lake Elsinore • Perris Lake • SAR at MWD Crossing (also Priority 2) • SAR at Pedley Avenue (also Priority 2)
	Priority 2	• SAR at MWD Crossing (also Priority 2) • SAR at Pedley Avenue (also Priority 2)
	Priority 3	• Goldenstar Creek • San Timoteo Creek, Reach 3
	Priority 4	• Temescal Creek Reaches 1a and 1b
	TMDL Specific	• Middle Santa Ana River Bacteria TMDL – Wet Weather Event
San Bernardino County Flood Control District	Priority 1	• SAR at MWD Crossing (also Priority 2) • SAR at Pedley Avenue (also Priority 2) • Big Bear Lake at Swim Beach • Mill Creek Reach 2 • Lytle Creek, Middle Fork
	Priority 2	• Chino Creek at Central Avenue • Mill Creek (Prado Area) • Prado Park Lake
	Priority 3	• SAR above S. Riverside Avenue Bridge • San Timoteo Creek, Reach 1A • San Timoteo Creek, Reach 2 • Warm Creek
	Priority 4	• Cucamonga Creek, Reach 1
	TMDL Specific	• Middle Santa Ana River Bacteria TMDL – Wet Weather Event
Others, as needed	Priority 1	None
	Priority 2	None
	Priority 3	None
	Priority 4	None
	TMDL Specific	None

5. Problem Definition/Background

Bacterial indicator monitoring is conducted in the Santa Ana River watershed for three key purposes:

- Fulfill the monitoring and surveillance requirements for the 2012 adopted BPA to Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region;
- Conduct sampling to support implementation of the Middle Santa Ana River (MSAR) Bacterial Indicator TMDL ("MSAR Bacteria TMDL"); and
- Support any additional bacterial indicator monitoring that may be conducted in the watershed to support regional regulatory activities.

5.1 Regulatory Background

This QAPP supports the implementation of several regulatory related activities associated with the protection of recreational uses in the Santa Ana River Watershed. The following subsections describe these activities and their regulatory importance.

5.1.1 Basin Plan Amendment

On June 15, 2012, the Santa Ana Water Board adopted the BPA to Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region[2]. This BPA resulted in the following modifications to the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) for the Santa Ana region[3]:

- Addition of "Primary Contact Recreation" as an alternative name for the REC1 (water contact recreation) beneficial use;
- Addition of narrative text clarifying the nature of REC1 activities and the bacteria objectives established to protect these activities.
- Differentiation of inland surface REC1 waters on the basis of frequency of use and other characteristics for the purposes of assigning applicable single sample maximum values.
- Revision of REC1/REC2 (non-contact water recreation) designations for specific inland surface waters based on the results of completed Use Attainability Analyses.
- Revised water quality objectives to protect the REC1 use of inland freshwaters
- Identification of criteria for temporary suspension of recreation use designations and objectives (high flow suspension)

Santa Ana Water Board staff developed this BPA in collaboration with the Stormwater Quality Standards Task Force, comprised of representatives from various stakeholder interests, including SAWPA; the counties of Orange, Riverside, and San Bernardino; Orange County Coastkeeper; Inland

[2] Santa Ana Water Board Resolution: R8-2012-0001, June 15, 2012
[3] Page 2 of Attachment 2 to the Santa Ana Water Board Resolution: R8-2012-0001, as approved on June 15, 2012 and corrected on February 12, 2013 and November 15, 2013.

Empire Waterkeeper; and EPA Region 9. The BPA was approved by the State Water Board on January 21, 2014[4] and the Office of Administrative Law on July 2, 2014[5]. The EPA issued its findings by letter on April 8, 2015 and provided a letter of clarification on August 3, 2015.

The BPA requires establishment of a comprehensive monitoring program to support implementation of the changes to the Basin Plan[6]. This QAPP and its accompanying SAR Bacteria Monitoring Plan is submitted to the Santa Ana Water Board for approval.

5.1.2 Statewide Bacteria Provisions

On August 7, 2018, the State Water Resources Control Board adopted Bacteria Provisions and a Water Quality Standards Policy for Inland Surface Waters, Enclosed Bays, and Estuaries of California (Statewide Bacteria Provisions).[7] The Statewide Bacteria Provisions developed new statewide numeric water quality objectives for bacteria to protect primary contact recreation beneficial use, as follows:

- *E. coli*: For all waters where the salinity is equal to or less than 1 part per thousand (ppth) 95 percent or more of the time, a six-week rolling geometric mean not to exceed 100 cfu/100mL, calculated weekly, and a statistical threshold value (STV) of 320 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.

- *Enterococci*: For all waters where the salinity is greater than 1 ppth 95 percent or more of the time, a six-week rolling geometric mean not to exceed 30 cfu/100mL, calculated weekly, and a STV of 110 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.

The Statewide Bacteria Provisions supersede numeric water quality objectives (WQOs) for REC1 use contained in regional Basin Plans, expect for cases involving a site-specific standard (only anti-degradation targets exist within the SAR watershed) or if an existing TMDL was developed with targets based on prior regional Basin Plan REC1 WQOs (such as the MSAR Bacteria TMDL). The following section describes the MSAR Bacteria TMDL and associated numeric targets, which differ from those included in the Statewide Bacteria Provisions. The Regional Bacteria Monitoring Program is revised to facilitate data collection needed to evaluate both TMDL wasteload allocations and load allocations (WLAs/LAs) and Statewide Bacteria Provisions WQOs for the TMDL waters. Compliance metrics will be based solely on the TMDL WLAs/LAs.

Lastly, the Statewide Bacteria Provisions do not supersede narrative WQOs in regional Basin Plans. The BPA to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region* is comprised of predominantly narrative criteria, which remain in effect for the Santa Ana region. The narrative criteria in the BPA are largely consistent with narrative criteria contained in the Statewide Bacteria Provisions.

5.1.3 Bacteria TMDLs

[4] State Water Board Resolution: 2014-0005, January 21, 2014
[5] Office of Administrative Law: #2014-0520 -02 S; July 2, 2014
[6] Page 76 of Attachment 2 to the Santa Ana Water Board Resolution: R8-2012-0001, as corrected
[7] State Water Board Resolution: 2018-0038, August 7, 2018

Currently, there is one bacteria TMDL adopted for freshwaters in the Santa Ana River Watershed: MSAR Bacteria TMDL, which became effective in May 2007. Following is a brief summary of the establishment of this TMDL.

In 1994 and 1998, because of exceedances of the fecal coliform objective established to protect the REC1 use, the Santa Ana Water Board added the following waterbodies in the MSAR watershed to the state 303(d) list of impaired waters:

- Santa Ana River, Reach 3 – Prado Dam to Mission Boulevard
- Chino Creek, Reach 1 – Santa Ana River confluence to beginning of hard lined channel south of Los Serranos Road
- Chino Creek, Reach 2 – Beginning of hard lined channel south of Los Serranos Road to confluence with San Antonio Creek
- Mill Creek (Prado Area) – Natural stream from Cucamonga Creek Reach 1 to Prado Basin
- Cucamonga Creek, Reach 1 – Confluence with Mill Creek to 23rd Street in City of Upland
- Prado Park Lake

The Santa Ana Water Board adopted the MSAR Bacteria TMDL in 2005[8]; it was subsequently approved by the EPA on May 16, 2007. The TMDL established compliance targets for both fecal coliform and (*Escherichia coli*) *E. coli*:

- Fecal coliform: 5-sample/30-day logarithmic mean less than 180 organisms/100 milliliters (mL) and not more than 10 percent of the samples exceed 360 organisms/100 mL for any 30-day period.
- *E. coli*: 5-sample/30-day logarithmic mean less than 113 organisms/100 mL and not more than 10 percent of the samples exceed 212 organisms/100 mL for any 30-day period.

Per the TMDL, the above compliance targets for fecal coliform become ineffective upon EPA approval of the BPA[9].

To focus MSAR Bacteria TMDL implementation activities, stakeholders established the MSAR Watershed TMDL Task Force (MSAR TMDL Task Force) to coordinate TMDL implementation activities designed to manage or eliminate sources of bacterial indicators to waterbodies listed as impaired. The MSAR TMDL Task Force includes representation by key watershed stakeholders, e.g., urban stormwater dischargers, agricultural operators, and the Santa Ana Water Board.

The MSAR Bacteria TMDL required urban and agricultural dischargers to implement a watershed-wide bacterial indicator compliance monitoring program by November 2007[10]. Stakeholders worked

[8] Santa Ana Water Board Resolution: R8-2005-0001, August 26, 2005
[9] Page 3 of 15 of Attachment A to Santa Ana Water Board Resolution R8-2005-0001.
[10] Page 6 of 15, Table 5-9y of Attachment A to Santa Ana Water Board Resolution R8-2005-0001

collaboratively through the MSAR TMDL Task Force to develop this program and prepared a Monitoring Plan and QAPP for submittal to the Santa Ana Water Board. The MSAR TMDL Task Force implemented the monitoring program in July 2007 following Santa Ana Water Board approval of monitoring program documents[11]. The Monitoring Plan and QAPP have been updated as needed since 2007 with the most recent update occurring in 2022[12].

The MSAR Bacteria TMDL also required the development and implementation of plans by urban and agricultural dischargers within six months of the TMDL effective date:

- *Urban Dischargers* – Municipal Separate Storm Sewer System (MS4) permittees in Riverside and San Bernardino Counties within the MSAR watershed were required to submit a bacterial indicator Urban Source Evaluation Plan (USEP) within six months of the TMDL effective date. The purpose of this program was to identify activities, operations, and processes in urban areas that contribute bacterial indicators to MSAR watershed waterbodies.

  The USEP was submitted to the Santa Ana Water Board in November 2007 and approved April 18, 2008[13]. The USEP was replaced by Comprehensive Bacteria Reduction Plans (CBRP) prepared by Riverside and San Bernardino MS4 permittees to fulfill 2010 MS4 Permit requirements applicable to urban dischargers subject to the MSAR Bacteria TMDL requirements. The Santa Ana Water Board approved the CBRPs for these counties on February 10, 2012[14]. To fulfill 2012 MS4 Permit requirements, additional CBRPs were completed by the Cities of Pomona and Claremont for the portions of their cities that are within the MSAR watershed and subject to MSAR Bacteria TMDL requirements. These CBRPs were approved by the Santa Ana Water Board on March 14, 2014[15]. All CBRPs completed by MS4 dischargers include monitoring activities that to date have been covered by the Monitoring Plan and QAPP prepared by the MSAR TMDL Task Force (see above).

- *Agricultural Dischargers* – Agricultural operators in the MSAR watershed were required to submit an Agricultural Source Evaluation Plan (AgSEP) within six months of the TMDL effective date. The purpose of the AgSEP was to identify activities, operations, and processes in agricultural areas that contribute bacterial indicators to MSAR watershed waterbodies. The AgSEP included monitoring activities that have been covered by the Monitoring Plan and QAPP prepared by the MSAR TMDL Task Force (see above).

  The AgSEP was submitted to the Santa Ana Water Board in November 2007 and approved April 18, 2008[16]. Currently, a Bacterial Indicator Agricultural Source Management Plan (BASMP) is under development. Once completed and approved by the Santa Ana Water Board, the BASMP will replace the AgSEP.

[11] Santa Ana Water Board Resolution: R8-2008-0044, April 18, 2008
[12] See http://www.sawpa.org/collaboration/projects/tmdl-taskforce/; under the Monitoring tab
[13] Santa Ana Water Board Resolution: R8-2008-0044, April 18, 2008
[14] Santa Ana Water Board Resolutions: R8-2012-0015 (Riverside County MS4 Program; R8-2012-0016 (San Bernardino County MS4 Program)
[15] Santa Ana Water Board Resolution: R8-2014-0030 (City of Claremont); R8-2014-0031 (City of Pomona)
[16] Santa Ana Water Board Resolution: R8-2008-0044, April 18, 2008

This QAPP incorporates all existing MSAR Bacteria TMDL QAPP requirements as described above. Accordingly, upon execution of the RMP, this QAPP replaces the existing MSAR Bacteria TMDL QAPP.

5.1.4 Waters Impaired for Bacterial Indicators

The State Water Board periodically publishes a list of impaired waters for the State of California, which is prepared according to the requirements of the State Water Board's *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List*[17]. Subject to EPA Region 9 approval, the most recently approved 303(d) List is contained within the State Water Board's 2018 Integrated Report[18]. The State Water Board's 2018 Integrated Report website provides an estimated date for development of a TMDL for each listed waterbody. Any bacteria-related monitoring activities conducted in these 303(d) listed waterbodies are covered by this QAPP and accompanying Monitoring Plan.

5.2 Watershed Description

The Santa Ana River watershed covers an area of approximately 2,650 square miles and includes portions of Orange, Riverside, and San Bernardino County, and a small portion of Los Angeles County (see Figure 2-1 in the SAR Bacteria Monitoring Plan). The mainstem Santa Ana River is the primary waterbody in the watershed. It flows in a generally southwest direction nearly 100 miles, from its headwaters to the Pacific Ocean. The watershed can be generally divided into three major geographic areas:

- *San Jacinto River and Temescal Creek Region* – This area covers much of the south central and southeastern portions of the watershed and is located mostly within Riverside County. The San Jacinto River drains an area of approximately 780 square miles to Canyon Lake and Lake Elsinore. Often flows from the upper San Jacinto River watershed are captured by Mystic Lake, which is a natural sump or hydrologic barrier to flows moving further downstream to Canyon Lake or Lake Elsinore. Downstream of Lake Elsinore, Temescal Creek carries surface flow, when it occurs, from below Lake Elsinore to its confluence with Prado Basin.

- *Santa Ana River above Prado Dam and Chino Basin Region* – This area includes much of the north central and northeastern portions of the watershed and is located mostly within San Bernardino County. This region drains to Prado Basin where Prado Dam captures all surface flows from this region and the Temescal Creek watershed. The Santa Ana River headwaters are located in the San Bernardino Mountains in the northeastern part of the watershed. Major tributaries to the Santa Ana River in this region include Warm Creek, Lytle Creek, and San Timoteo Creek. In the north central portion several major Santa Ana River tributaries arise in the San Gabriel Mountains and drain generally south into the Chino Basin before their confluence with the Santa Ana River, including Day Creek, Cucamonga Creek and San Antonio Creek. Many of these drainages carry little to no flow during dry conditions because of the presence of extensive recharge basins in this region. Prado Basin above Prado Dam is a flood control basin that captures all flows from the

[17] https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2015/020315_8_amendment_clean_version.pdf

[18] Final EPA approval – June 9, 2021; list of impaired waters in California , by region: https://www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/2018_integrated_report.html

upper part of the Santa Ana River Watershed. For the most part the basin is an undisturbed, dense riparian wetland.

- *Santa Ana River below Prado Dam and Coastal Plains Region* – This area covers the western portion of the Santa Ana River watershed and includes coastal waterbodies that are not part of the Santa Ana River drainage area. This area is located within Orange County. Below Prado Dam the Santa Ana River flows through the Santa Ana Mountains before crossing the coastal plain and emptying into the Pacific Ocean near Huntington Beach. Groundwater recharge areas near the City of Anaheim capture water in the Santa Ana River and the Santa Ana River is often dry below this area. Other watersheds on the Coastal Plain include Newport Bay, Anaheim Bay-Huntington Harbour and Coyote Creek.

5.3 Purpose of the QAPP

This QAPP supports the SAR Bacteria Monitoring Plan which was prepared to fulfill three objectives:

(a) Fulfill the monitoring and surveillance requirements for the 2012 adopted BPA to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region*;

(b) Conduct sampling to support implementation of the MSAR Bacteria TMDL, including requirements to implement a watershed-wide compliance monitoring program and source evaluation programs for urban and agricultural dischargers; and

(c) Support any additional bacterial indicator monitoring that may be conducted in the watershed to support regional regulatory activities.

6. Project/Task Descriptions

6.1 Work Statement and Produced Products

The following Regional and TMDL Bacteria Monitoring Programs are addressed by this QAPP:

- Regional Monitoring Program
  - Priority 1 – Actively used recreational waters
  - Priority 2 – Waterbodies with an Adopted TMDL
  - Priority 3 - 303(d) Listed Waterbodies without an Adopted TMDL
  - Priority 4 – REC2 Only Waterbodies
- TMDL Monitoring Programs
  - MSAR Bacteria TMDL Wet Weather Event Monitoring
  - Urban Source Evaluation Monitoring Program
  - Agricultural Source Evaluation Monitoring Program (AgSEMP)

Following is a description of the monitoring activities associated with each program.

6.2 Regional Monitoring Program

6.2.1 Priority 1 Waters

6.2.1.1 Introduction

The purpose of Priority 1 waters monitoring is to assess compliance with REC1 use water quality objectives for *E. coli*, and where required due to high specific conductivity, Enterococci. The potential for human health impacts as a result of exposure to pathogens is highest in these REC1 waters where water contact recreational activities are most likely to occur.

6.2.1.2 Monitoring Sites

Table 6-1 identifies eight waterbodies as Priority 1 waters (Table 6-1). These waterbodies include four lakes: Big Bear Lake, Lake Perris, Canyon Lake, and Lake Elsinore, and four flowing water sites, Santa Ana River Reach 3 (two sites), Lytle Creek (Middle Fork) and Mill Creek Reach 2. Eight sample sites were selected to assess water quality on these waterbodies, with one site per waterbody except for Santa Ana River Reach 3 where two stations were selected. Five sites are located in Riverside County and three sites are located in San Bernardino County (Figure 6-1).

The two Priority 1 Santa Ana River sites (MWD Crossing and Pedley Avenue) are also MSAR Bacteria TMDL compliance sites (Table 6-1). Data collected from these sites will also be used for evaluating compliance with the MSAR Bacteria TMDL.

Table 6-1. Priority 1 monitoring sites

Site ID	Site Description	RMP Priority	Latitude	Longitude
P1-1	Canyon Lake at Holiday Harbor	1	33.6808	-117.2724
P1-2-ELM	Lake Elsinore (Elm Grove Beach)	1	33.6664	-117.3356

P1-3	Lake Perris	1	33.8614	-117.1908
P1-4	Big Bear Lake at Swim Beach	1	34.2482	-116.9034
P1-5	Mill Creek Reach 2	1	34.0891	-116.9247
P1-6	Lytle Creek (Middle Fork)	1	34.2480	-117.5110
WW-S1	Santa Ana River Reach 3 at MWD Crossing	1	33.9681	-117.4479
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	1	33.9552	-117.5327

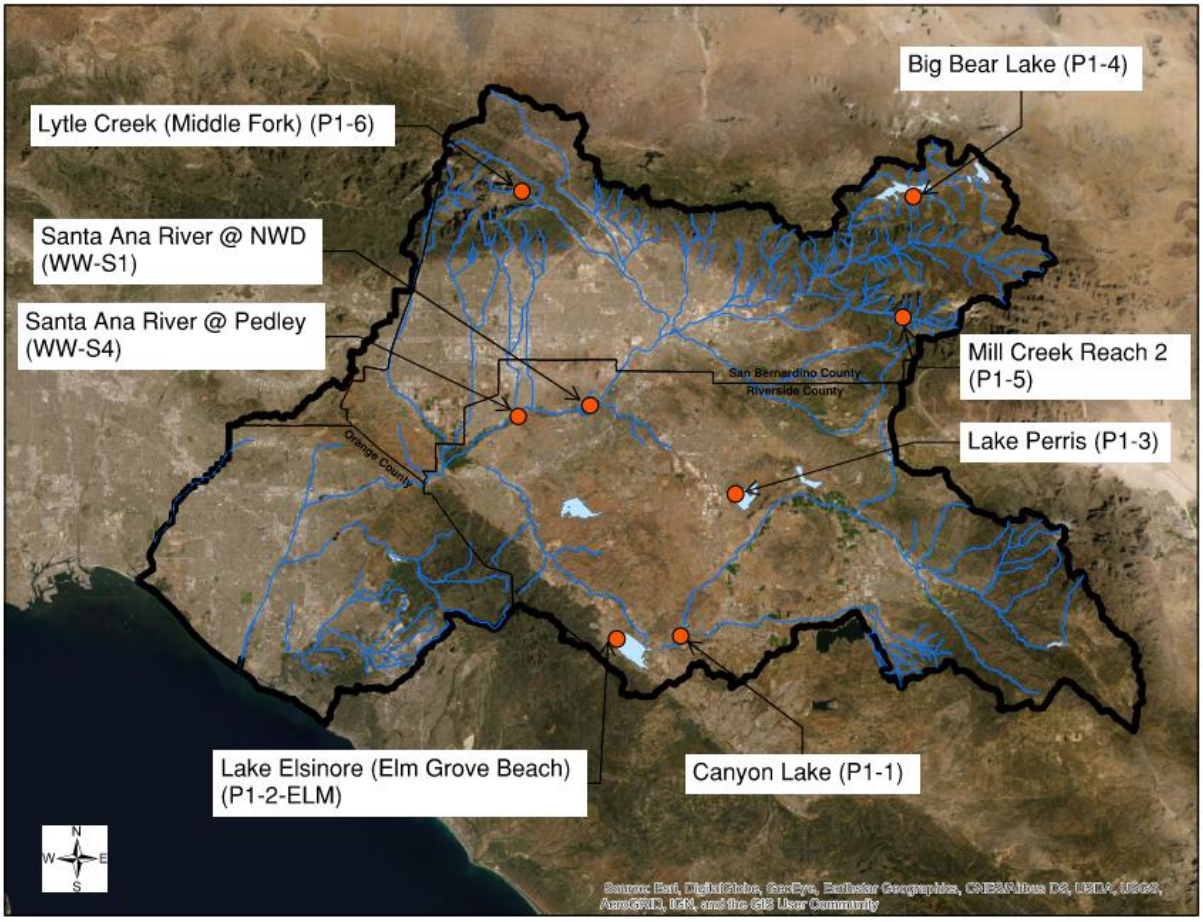


Figure 6-1. Priority 1 monitoring sites

6.2.1.3 Sample Frequency[19]

Priority 1 sample sites will be sampled weekly during dry weather (defined as no measurable rainfall within a 72-hour period prior to sampling) for a 20-week period during the warmest part of the year between May 1 and September 30. In addition, Priority 1 sample sites will also be sampled during one 5-week period from end of October through most of November each year during the cooler season. The resulting dataset will include 25 samples each year from each site and provide sufficient data to calculate 15 geometric means during the 20-week sample period and one geometric mean during the cool season.

Samples from all Priority 1 sites will be analyzed for *E. coli*. Samples from Lake Elsinore (P1-2) will also be analyzed for Enterococci based on conductivity results from 2016 through 2018, which suggest exceedance of the 1 ppth salinity threshold specified in the Statewide Bacteria Provisions.

Data will be used to evaluate compliance with:

- Santa Ana region *E. coli* WQO: 5-sample minimum/6-week geometric mean of < 100 organisms/100 mL and not more than 10% of the samples to exceed the statistical threshold value (STV) of 320 organisms per 100 mL in a calendar month.
- Santa Ana region Enterococci WQO: 5-sample minimum/6-week geometric mean of < 30 organisms/100 mL and not more than 10% of the samples to exceed the statistical threshold value (STV) of 110 organisms/100 mL in a calendar month.
- MSAR Bacteria TMDL dry weather WLAs for *E. coli*: 5-sample/30-day geometric mean < 113 organisms/100 mL and not more than 10 percent of the samples exceed 235 organisms/100 mL for any 30-day period. The MSAR Bacteria TMDL requires compliance with the dry weather WLAs by December 31, 2015.

While it is unlikely that ice conditions will occur during each year's cool season sample period, if ice conditions prevent sampling at a Priority 1 site, that finding will be documented on the field form and photo documentation will be provided.

6.2.2 Priority 2 – Waterbodies with an Adopted TMDL

6.2.2.1 Introduction

The purpose for monitoring Priority 2 waters is to evaluate attainment of water quality objectives in waters that have an adopted bacteria TMDL. Currently, only one bacteria TMDL has been adopted for inland waters in the watershed: MSAR Bacteria TMDL. Dry weather sampling has been ongoing in these waters since 2007 to satisfy TMDL implementation requirements. This dry weather sampling will continue as described in this section of the RMP; any other monitoring necessary to satisfy TMDL requirements, e.g., wet weather event sampling is described in Section 6.3.1.

[19] EPA, in the California Toxics Rule, defined that freshwater quality criteria apply to waters where salinity is less than or equal to 1 ppth (~1400 uS/cm of specific conductivity) 95 or more percent of the time; and salt water criteria apply where salinity in equal to or greater than 10 ppth 95 or more percent of the time; and for waters with salinities in the range between 1 ppth and 10 ppth, the more stringent of saltwater or freshwater criteria apply, unless a scientifically defensible and site specific demonstration is made to show the biology of the waterbody is dominated by freshwater or saltwater aquatic life (Federal Register, V65, No97, May 18 2000). Given this, changes to applicable criteria for inland waters in the SAR region may be developed based on aquatic biology. In the event that such demonstrations are made, this Monitoring Program will be updated to focus on the criteria that are determined to be applicable on a waterbody specific basis.

6.2.2.2 Monitoring Sites

Monitoring for Priority 2 waters will occur at the same five monitoring sites previously established for evaluating compliance with the WLAs in the MSAR Bacteria TMDL: Two Santa Ana River Reach 3 sites (@ MWD Crossing and @ Pedley Avenue), and one site each on Mill-Cucamonga Creek, Chino Creek, and Prado Park Lake[20] (Table 6-2; Figure 6-2). As discussed in Section 6.2.1.2, the two Santa Ana River sites are also Priority 1 waters, locations where the risk of exposure to pathogens during recreational activities is highest. Both Figure 6-2 and Table 6-2 indicate the dual designation for these sites. With the exception of the Mill-Cucamonga Creek monitoring site, the location of each sample site remains the same as previously sampled under the MSAR Bacteria TMDL. The Mill-Cucamonga Creek site has been moved to take into account changes in the local area, resulting from the completion of the Mill Creek Wetlands. Santa Ana River at Mission Blvd. Bridge was added to the sampling schedule to characterize in river bacteria fluctuations with the absence of MS4 inputs. MISSION is not monitored for TMDL compliance assessment.

Table 6-2. Priority 2 monitoring sites (Note that WW-S1 and WW-S4 sites are also Priority 1 sites)

Site ID	Site Description	RMP Priority	Latitude	Longitude
WW-M6	Mill-Cucamonga Creek below Wetlands	2	33.9268	-117.6250
WW-C7	Chino Creek at Central Avenue	2	33.9737	-117.6889
WW-C3	Prado Park Lake	2	33.9400	-117.6473
WW-S1	Santa Ana River Reach 3 at MWD Crossing	1,2	33.9681	-117.4479
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	1,2	33.9552	-117.5327
MISSION	Santa Ana River at Mission Blvd. Bridge	NA*	33.9906	-117.3951

* Additional mainstem sampling site was added beginning the 2020-2021 sampling season to support source tracking analysis.

[20] See Monitoring Plan Section 4.1.1 for the original basis for the selection of these monitoring sites.

Figure 6-2. Priority 2 monitoring sites (note that the two monitoring sites on the Santa Ana River are also Priority 1 sites, see text for explanation)

6.2.2.3 Sample Frequency

The sampling frequency for dry weather (defined as no measurable rainfall within a 72-hour period prior to sampling) for Priority 2 waters is the same as described for Priority 1 waters in Section 6.2.1.3. Any additional monitoring required to satisfy MSAR Bacteria TMDL-specific requirements, e.g., wet weather event monitoring, is described in Section 6.3.1 below.

6.2.3 Priority 3 – 303(d) Listed Waterbodies without Adopted TMDL

6.2.3.1 Introduction

Priority 3 waters are those that have been listed as impaired for bacterial indicators and have been placed on the state's 303(d) List, but do not have an adopted TMDL. The most recent EPA-approved list of impaired waters is based on the State Water Board's 2018 Integrated Report[21]. These waters can be removed from the 303(d) List (per the requirements of the State Water Board's Listing Policy) if water quality data indicate that removal from the list is appropriate; otherwise, a TMDL will be established for Priority 3 waters in the future. The purpose for monitoring these waters is to gather data to support eventual regulatory decisions regarding the degree of impairment in each Priority 3 waterbody (e.g., to support a delisting decision). For some waters, monitoring will stop because sufficient data has been collected to support the Regional Board decisions in the 2022 water quality assessment in Santa Ana region. The Task Force will coordinate with the Regional Board to interpret

[21] The final list which includes waterbodies added to the list by EPA Region 9 is found here: https://www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/2018_integrated_report.html

the long-term data from all priority 3 monitoring locations and identify potential delisting or supplemental monitoring needs to support water quality improvement efforts.

6.2.3.2 Monitoring Sites

In the Santa Ana River watershed 23 waterbodies are currently on the 303(d) List with no adopted TMDL: twelve in Orange County; four in Riverside County, and five in San Bernardino County (see Table 1.1 in the Monitoring Plan). The following waterbodies have not been included in this RMP as Priority 3 waterbodies for the following reasons:

- The 303(d) listing for Knickerbocker Creek in San Bernardino County is being addressed through that county's MS4 Permit (R8-2010-0036); recent studies have shown that impairment is due to wildlife concentration.
- Mill Creek Reach 1 is an old listing and there is no data available that provides the original basis for its current listing as impaired. In addition, this reach is designated with an intermittent REC1 beneficial use and a recent reconnaissance found no surface water. Given the likelihood that REC1 activity would be limited in this reach and more likely to occur in the upstream Reach 2, this waterbody was not included as a Priority 3 waterbody.
- Mountain Home Creek and Mountain Home Creek, East Fork listings are based on outdated data.
- Huntington Harbour, Seal Beach, Little Corona del Mar, and Newport Slough are marine waters and are not included in the RMP.
- Lake Fulmor and Santa Ana River Reach 2, in Riverside County and Orange County, respectively, were delisted from the 2014/2016 303(d) List of Impaired Waters and have been removed from the monitoring program beginning with the 2019-2020 monitoring period.

Figure 6-3 shows the general location for each of Priority 3 waterbody in each county. Selection of a sample site for each waterbody relied on the following criteria:

- One sample site per waterbody, unless there is a compelling need for a second site, e.g., significant differences exist in the waterbody's characteristics in different reaches;
- Site should be close to areas of existing or potential water contact recreational activities;
- For sites near the Pacific Ocean, site is upstream of the tidal prism; and
- If possible, maintain historical monitoring sites.

6.2.3.3 Sample Frequency

Water quality samples will be collected during dry weather (defined as no measurable rainfall within a 72-hour period prior to sampling) according to the frequency shown in Table 10-2. The overall sample schedule for these sites overlaps with the Priority 1 & 2 sample site schedule to maximize efficiency with the collection of samples. The resulting dataset for these sites will consist of a minimum of five samples per year from each site. Data from each year will represent a different five- or six-week period.[22]

[22] For Priority 3 sites, the monitoring period for the first three years of the program (2016-2018) was five weeks. Per the Regionwide Bacteria Monitoring Plan Amendment letter dated November 5, 2018 (2018 Monitoring Plan Amendment) from

For sites where 50 percent or more of the conductivity results from 2016 through 2018 suggest exceedance of the 1 ppth salinity threshold (~1400 uS/cm of specific conductivity) specified in the Statewide Bacteria Provisions, samples will be analyzed for Enterococci in addition to *E. coli*. This includes:

- Riverside County: Goldenstar Creek (P3-RC1)
- Orange County: Los Trancos Creek (P3-OC5) and Morning Canyon Creek (P3-OC6)

6.2.4 Priority 4 – REC2 Only Waterbodies

6.2.4.1 Introduction

Priority 4 waters are those where the REC1 beneficial use has been removed as a result of an approved use attainability analysis (UAA). The applicable *E. coli* or Enterococci water quality objectives for these waters are based on antidegradation targets established by the BPA[23]. Currently, there are four inland freshwaters with a REC2 only designation: Temescal Creek (Reaches 1a and 1b; Riverside County); Santa Ana Delhi Channel (Tidal Prism and Reaches 1 and 2; Orange County): Greenville-Banning Channel (Tidal Prism Reach, Orange County); and Cucamonga Creek (Reach 1, San Bernardino County).

the Santa Ana Water Board, the monitoring period was increased to six weeks to be consistent with the Statewide Bacteria Objectives.

[23] The BPA presents antidegradation targets and describes the statistical methodology employed to develop the numeric values. In short, historical data was fitted to a lognormal distribution, and the 75th percentile of the fitted lognormal distribution was selected as the antidegradation target. Accordingly, the 75th percentile of the fitted log-normal distribution for a newly acquired dataset with comparable spatial (within reach) and temporal (seasonal) variability, should be less than or equal to that of the historical dataset.

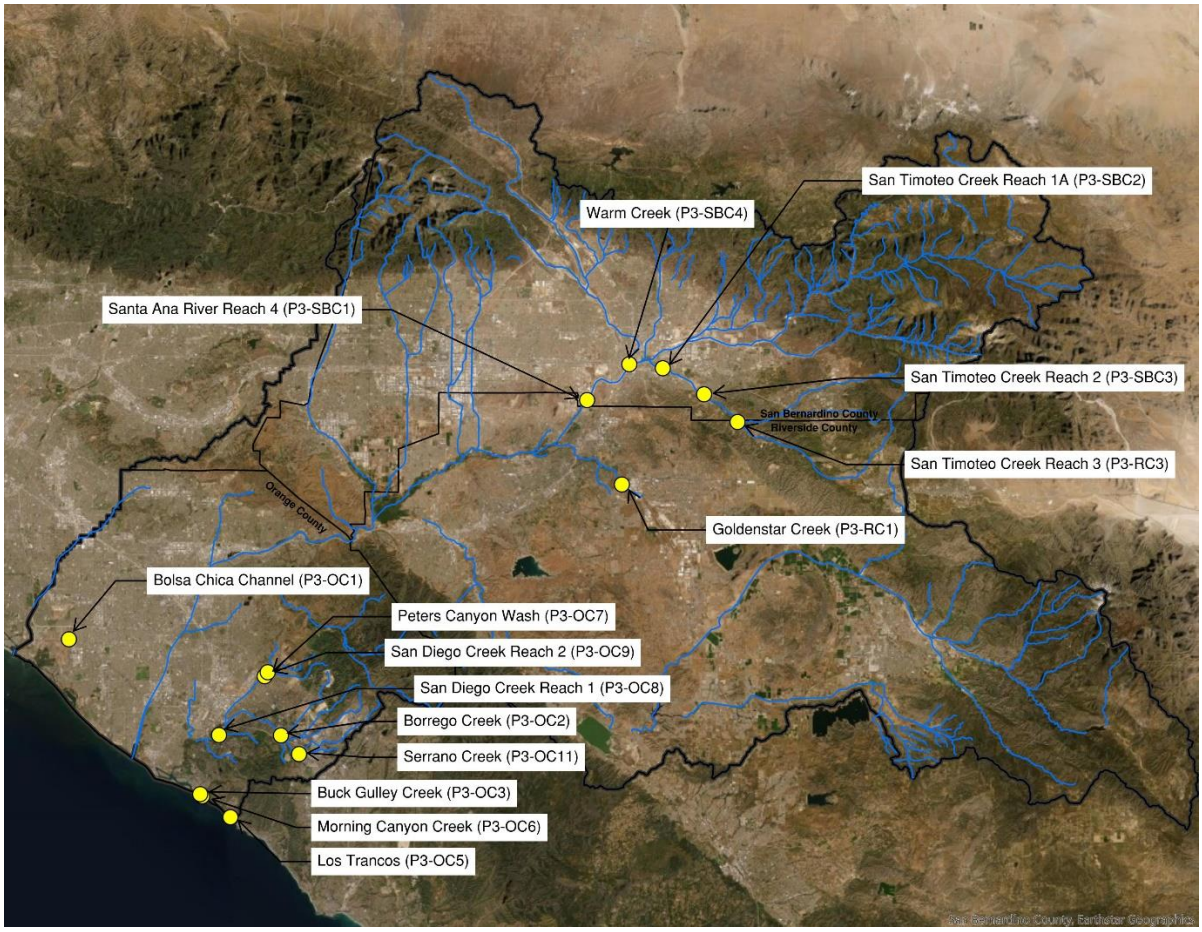


Figure 6-3. Priority 3 monitoring sites by County within the Santa Ana River watershed.

Table 6-3. Priority 3 monitoring sites and the basis for 303(d) listing.

Site ID	Site Description	Latitude	Longitude	Frequency of *E. coli* Exceedance[1,2]	Comments[2]
P3-OC1	Bolsa Chica Channel upstream of Westminster Blvd/Bolsa Chica Rd	33.75958	-118.04295	*E. coli* 49/63	Based on Orange County Coastkeeper Coastal Watersheds Project Report. Data collected between March 31, 2004 and March 30, 2006 from two sites: "bc1" – in Cypress in the upper Bolsa Chica Channel at Warland Street Bridge; "bc2" – in Huntington Beach in the lower Bolsa Chica Channel at the intersection of Bolsa Chica Rd. and Rancho Rd.
P3-OC2	Borrego Creek upstream of Barranca Parkway	33.65457	-117.73213	*E. coli* 37/43	Based on Orange County Coastkeeper Coastal Watersheds Project Report. Data collected between March 11, 2004 and March 29, 2006 from two sites: "bor1" – in Foothill Ranch in upper Borrego Channel on Town Center Dr.; "bor2" – in Irvine in the lower Borrego Channel on Barranca Pkwy next to the train station.
P3-OC3	Buck Gully Creek Little Corona Beach at Poppy Avenue/Ocean Blvd	33.59000	-117.86841	*E. coli* 23/68	303(d) list states that listing is for reach downstream of Pacific Coast Highway; state website states that listing decision made prior to 2006 and there is no information in state assessment database. However, Orange County Coastkeeper (OCC) database shows two sites labeled "bg1" 'and "bg2" that were sampled from March 8, 2004 to April 13, 2006 (exceedance frequency in this table based on those results); no information in OCC database regarding where sites are located.
P3-OC5	Los Trancos Creek at Crystal Cove State Park	33.57601	-117.84062	Fecal coliform 5/9	303(d) list states that listing is for reach downstream of Pacific Coast Highway; state website states that listing decision made prior to 2006 and there is no information in state assessment database. However, data obtained from Regional Board shows three sample locations sampled for fecal coliform in July and September in 2000. All exceedances (5 of 9) occurred at a sample site adjacent to the most upstream golf cart bridge of the Pelican Hill Golf Course
P3-OC6	Morning Canyon Creek at Morning Canyon Beach	33.58759	-117.86575	*E. coli* 17/61	Based on Orange County Coastkeeper Coastal Watersheds Project. Data collected between March 8, 2004 and April 10, 2006 from two sites: "mc1" – in Newport Beach in the upper part of Morning Canyon Creek at Surrey street; "mc2" – in Newport Beach in the lower part of Morning Canyon Creek at Morning Canyon Beach.
P3-OC7	Peters Canyon Wash downstream of Barranca Parkway	33.69076	-117.82404	*E. coli* 40/66	Based on Orange County Coastkeeper Coastal Watersheds Project. Data collected between March 9, 2004 and March 29, 2006 from two sites: "pc1" – in Irvine in upper Peter's Canyon Channel on Bryan Street between Jamboree Rd. and Culver Dr.; "pc2" – in Irvine in lower Peter's Canyon Channel on Barranca Pkwy between Jamboree Rd. and Harvard Ave.
P3-OC8	San Diego Creek downstream of Campus Drive (Reach 1)	33.65530	-117.84535	*E. coli* 33/84	State website states that listing decision made prior to 2006 and there is no information in state assessment database. However, based on Orange County Coastkeeper Coastal Watersheds Project, data was collected between October 22, 2002 and June 21, 2004 from three sites: "sd4", "sd5", and "sd6". Exceedance frequency shown in this table is from OCC report; no information available on specific sample locations.

Table 6-3. Priority 3 monitoring sites and the basis for 303(d) listing.

Site ID	Site Description	Latitude	Longitude	Frequency of *E. coli* Exceedance[1,2]	Comments[2]
P3-OC9	San Diego Creek at Harvard Avenue (Reach 2)	33.689772	117.8186854	*E. coli* 31/64	Based on Orange County Coastkeeper Coastal Watersheds Project. Data collected between October 22, 2002 and June 21, 2004 from three sites: "sd1" – Bake Parkway, site is located off of Irvine Center Dr. on the right hand side before Wild Rivers water park; "sd2" – 133 Fwy, the 133 Fwy is located off of Pacifica and Alton in the dead end down the ramp in the riverbed; and "sd3"- Sand Canyon, site is located off of the 405 Fwy at Sand Canyon Avenue past Alton at the bridge on the NE corner of Barranca and Sand Canyon Avenue.
P3-OC11	Serrano Creek upstream of Barranca/Alton Parkway	33.6483	-117.7248	*E. coli* 35/68	Based on Orange County Coastkeeper Coastal Watersheds Project. Data collected between March 11, 2004 and March 29, 2006 from two sites: "ser1" – in Forest Grove in the upper Serrano Channel in Trabuco Rd and Peachwood under the bridge; "ser2" – in Irvine in the lower Serrano Channel, next to the Alton/Barranca intersection.
P3-RC1	Goldenstar Creek at Ridge Canyon Drive	33.8964	-117.3586	*E. coli* 19/79	Based on Orange County Coastkeeper Coastal Watersheds Project. Data collected between October 29, 2002 and June 3, 2004 from three sites: "gs1" – near the intersection of Van Buren Boulevard and Wood Road in City of Riverside; "gs2" – located at the end of Ridge Run Road in City of Riverside; and "gs3" – downstream of Golden Star Creek Road in City of Riverside. Exceedances at gs1 and gs2 only.
P3-RC3	San Timoteo Creek Reach 3	34.0025	-117.1645	*E. coli* 30/43	This site was added during the 2014/16 303(d) Listing. Data was collected from 2008-2009 with 30/43 samples exceeding the geomean target of 126 org/100 mL and 31/58 exceeding the single sample target of 235 org/100 mL.
P3-SBC1	Santa Ana River Reach 4 above S. Riverside Avenue Bridge	34.0248	117.3628	Data unavailable	State website states that listing decision made prior to 2006 and there is no information in state assessment database.
P3-SBC2	San Timoteo Creek Reach 1A	34.0615	-117.2629	*E. coli* 30/42	This site was added during the 2014/16 303(d) Listing. Data was collected from 2008-2009 with 30/42 samples exceeding the geomean target of 126 org/100 mL and 38/57 exceeding the single sample target of 235 org/100 mL.
P3-SBC3	San Timoteo Creek Reach 2	34.0615	-117.2629	*E. coli* 35/35	This site was added during the 2014/16 303(d) Listing. Data was collected from 2008-2009 with 35/35 samples exceeding the geomean target of 126 org/100 mL and 45/52 exceeding the single sample target of 235 org/100 mL.
P3-SBC4	Warm Creek	34.0646	-117.3072	*E. coli* 42/70	This site was added during the 2014/16 303(d) Listing. Data was collected from 2008-2009 with 42/70 samples exceeding the geomean target of 126 org/100 mL and 49/102 exceeding the single sample target of 235 org/100 mL.

[1] X/Y = First number is the number of exceedances; the second number is the number of samples.
[2] Source for information regarding exceedances is (a) the State Water Board's website for 2010 Integrated Report: (find the relevant waterbody and click on the specific pollutant for summary of available data and listing history.; (b) Santa Ana River Citizen Monitoring Project Final Report ("Orange County Coastkeeper Coastal Watersheds Project", November 2004); (c) the State Water Board's website for 2014/16 Integrated Report: https://www.waterboards.ca.gov/water_issues/programs/tmdl/2014_16state_ir_reports/category5_report.shtml.
[3] Although located in Orange County, the City of Newport Beach is responsible for monitoring at Buck Gully Creek, Los Trancos Creek, and Morning Canyon Creek.

6.2.4.2 Monitoring Sites

The monitoring sites for each Priority 4 waterbody are as follows (see Table 6-4, Figure 6-4 and SAR Bacteria Monitoring Plan, Section A.4 in Attachment A for additional location information):

- *Santa Ana Delhi Channel* – The Santa Ana Delhi Channel has two reaches that are REC2 only: (a) Reach 2 is within the City of Santa Ana, Orange County, CA and extends from Sunflower Avenue upstream to Warner Avenue, a distance of approximately 1 mile; (b) Reach 1 is within the cities of Costa Mesa and Newport Beach, CA and extends from the tidal prism upstream to Sunflower Avenue, a distance of approximately 2.5 miles. Two monitoring sites have been selected for the Santa Ana Delhi Channel to provide sample results from freshwater and tidal prism areas: (a) Upstream of Irvine Avenue; and (b) within the tidal prism at the Bicycle Bridge.
- *Greenville-Banning Channel Tidal Prism Segment*– This segment of the Greenville-Banning channel is designated REC2 only. It begins at its confluence with the Santa Ana River and extends upstream approximately 1.2 mile to the inflatable rubber dam operated by the Orange County Public Works Department. The monitoring site is located at an access ramp approximately 60 meters downstream of the trash boom below the rubber diversion dam.
- *Temescal Creek* – Temescal Creek has two reaches that are REC2 only: (a) Reach 1a is within the City of Corona, Riverside County and extends from Lincoln Avenue to confluence with Arlington Channel, a distance of approximately 3 miles; (b) Reach 1b within City of Corona and extends from Arlington Channel confluence to 1400 feet (ft) upstream of Magnolia Avenue (City of Corona). The monitoring site for Temescal Creek is located upstream of Lincoln Avenue.
- *Cucamonga Creek Reach 1* – Cucamonga Creek Reach 1 extends from the confluence with Mill Creek in the Prado area to near 23rd Street in the City of Upland. The monitoring site for Cucamonga Creek Reach 1 is at Hellman Road.

6.2.4.3 Sample Frequency

Water quality samples will be collected during dry weather (defined as no measurable rainfall within a 72-hour period prior to sampling) at different frequencies based on site as follows:

- Temescal Creek (P4-RC2), Santa Ana Delhi Channel (P4-OC1 and P4-OC2), Greenville-Banning Channel (P4-OC3): once per year during dry weather until an *E. coli* or Enterococci result exceeds the antidegradation target threshold value for the site (equal to the 75th percentile of the lognormal distribution fitted to historical data); and
- Cucamonga Creek (P4-SBC1): once per month year-round under dry weather conditions.[24]

For Temescal Creek, Santa Ana Delhi Channel, and Greenville-Banning Channel sites, if an exceedance of the antidegradation target is observed, additional bacterial indicator samples will be collected once/month for the three following months. If any of the follow-up samples exceed the antidegradation target, then sampling will continue on a monthly basis until source(s) of the increased bacterial indicator concentration is identified and mitigated and *E. coli* or Enterococci levels return to below the antidegradation target in three of four samples collected over three consecutive months.

[24] Per the 2018 Monitoring Plan Amendment, Cucamonga Creek will be monitored monthly in an effort to develop a new dataset for future revision of the antidegradation target.

This trigger for additional Priority 4 monitoring does not apply to San Bernardino County as the Cucamonga Creek site will already be monitored monthly.

Table 6-4. Priority 4 monitoring sites

Site ID	Site Description	RMP Priority	Latitude	Longitude
P4-RC2	Temescal Creek at Lincoln Avenue	4	33.8941	-117.5772
P4-OC1	Santa Ana Delhi Channel Upstream of Irvine Avenue	4	33.6602	-117.8810
P4-OC2	Santa Ana Delhi Channel in Tidal Prism	4	33.6529	-117.8837
P4-OC3	Greenville-Banning Channel in Tidal Prism	4	33.6594	-117.9479
P4-SBC1	Cucamonga Creek at Hellman Avenue	4	33.9493	-117.6104

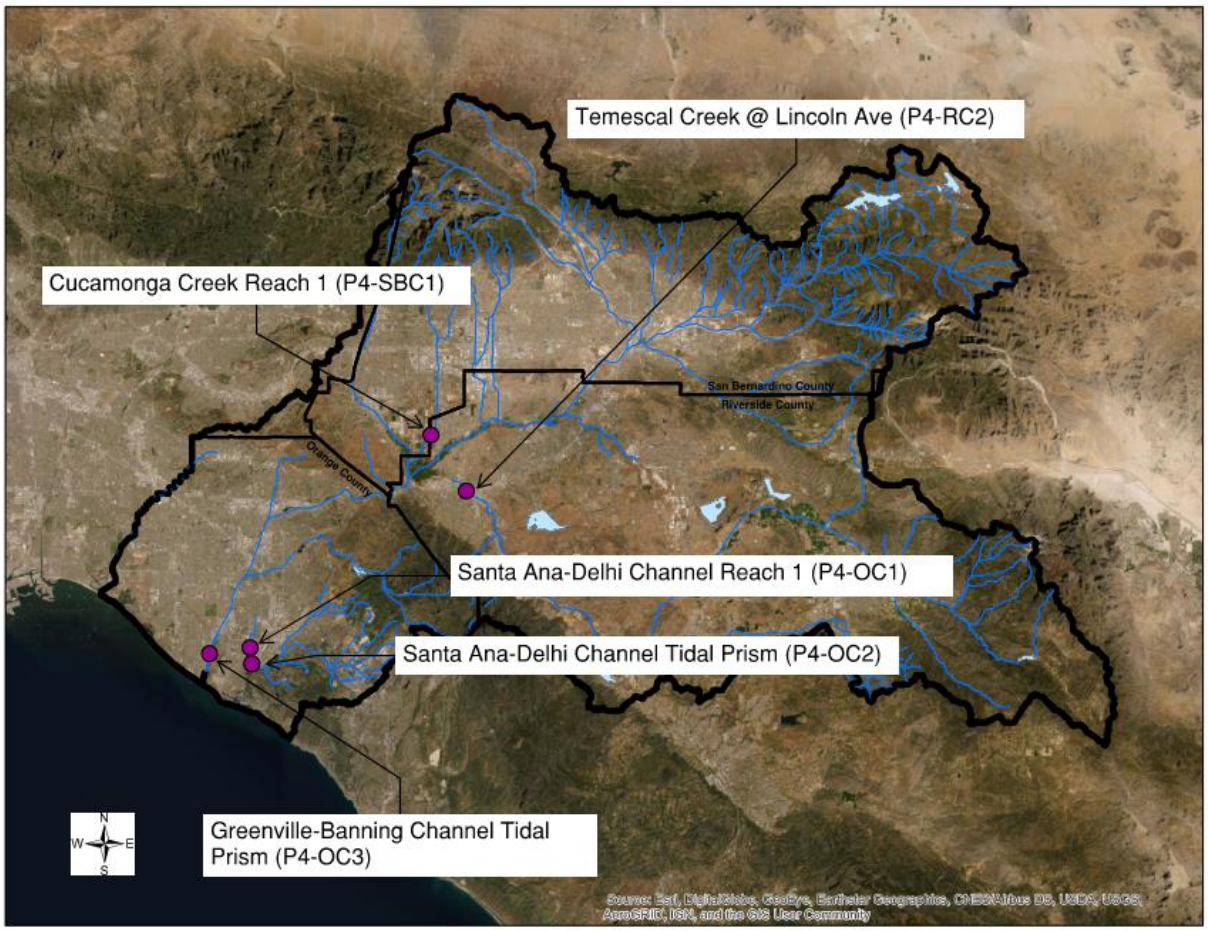


Figure 6-4. Priority 4 monitoring sites by County within the Santa Ana River watershed.

6.3 TMDL Monitoring Program

6.3.1 MSAR Bacteria TMDL Wet Weather Event Monitoring

6.3.1.1 Introduction

The purpose of the MSAR Bacteria TMDL watershed-wide compliance monitoring program is to assess compliance with wasteload allocations in the MSAR Bacteria TMDL (see Section 5.1.2). Compliance monitoring for the MSAR Bacteria TMDL during dry weather is addressed by monitoring conducted for Priority 1 and Priority 2 (described above in Sections 6.2.1 and 6.2.2, respectively). The MSAR Bacteria TMDL also requires the collection of bacteria water quality samples during one wet weather event each year. Monitoring for one storm event per wet season is carried out as a component of the TMDL Monitoring Program.

The same concentration based TMDL wasteload and load allocations for *E. coli* apply to both wet weather and dry weather conditions:

- *MSAR Bacteria TMDL wet weather WLAs/LAs for E. coli:* 5-sample/30-day geometric mean < 113 organisms/100 mL and not more than 10 percent of the samples exceed 235 organisms/100 mL for any 30-day period.

Per the MSAR Bacteria TMDL, compliance with these WLAs/LAs during wet weather shall be achieved by December 31, 2025. The TMDL allowed for an extended compliance timeline for wet weather conditions, because of the "expected increased difficulty in achieving compliance under [wet weather] conditions"[25].

6.3.1.2 Monitoring Sites

Table 6-5 and Figure 6-5 identify the monitoring sites for evaluating compliance with MSAR Bacteria TMDL WLAs/LAs during wet weather.

6.3.1.3 Sample Approach and Frequency

One wet weather event is targeted for sampling each wet season, defined as November 1 through March 31 in the MSAR Bacteria TMDL. The goal of wet weather event sampling is to collect bacterial indicator data during the rising and falling limbs of the hydrograph. To accomplish this goal, a wet weather sample event requires the collection of four samples over an approximately four day period:

- *Sample 1* – Target sample collection on the day of the storm event when it is apparent that flow within the channel is elevated above typical dry weather conditions as a result of rainfall induced runoff.
- *Sample 2* – Collect samples approximately 24 hours after collection of Sample 1.
- *Sample 3* – Collect samples approximately 48 hours after collection of Sample 1.
- *Sample 4* – Collect samples approximately 72 hours after collection of Sample 1.

The decision whether to conduct wet weather sampling will be made by implementing the following steps:

[25] Page 3 of 15, Attachment A to Santa Ana Water Board Resolution R8-2005-0001

- *Step 1* - Prepare to deploy the sampling team if rain is forecast (National Weather Service forecast on http://www.Accuweather.com), i.e., the sample teams are put on stand-by;
- *Step 2* - If rain develops, monitor rain gauges in the area (Riverside Municipal Airport and Ontario International Airport); and

Table 6-5. MSAR Bacteria TMDL wet weather event monitoring sites

Site ID	Site Description	Latitude	Longitude
WW-M6	Mill-Cucamonga Creek below Wetlands	33.9410	-117.6209
WW-C7	Chino Creek at Central Avenue	33.9737	-117.6889
WW-C3	Prado Park Lake	33.9400	-117.6473
WW-S1	Santa Ana River Reach 3 at MWD Crossing	33.9681	-117.4479
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	33.9552	-117.5327

Coordinates are shown as Geographic WGS 1984 World Datum

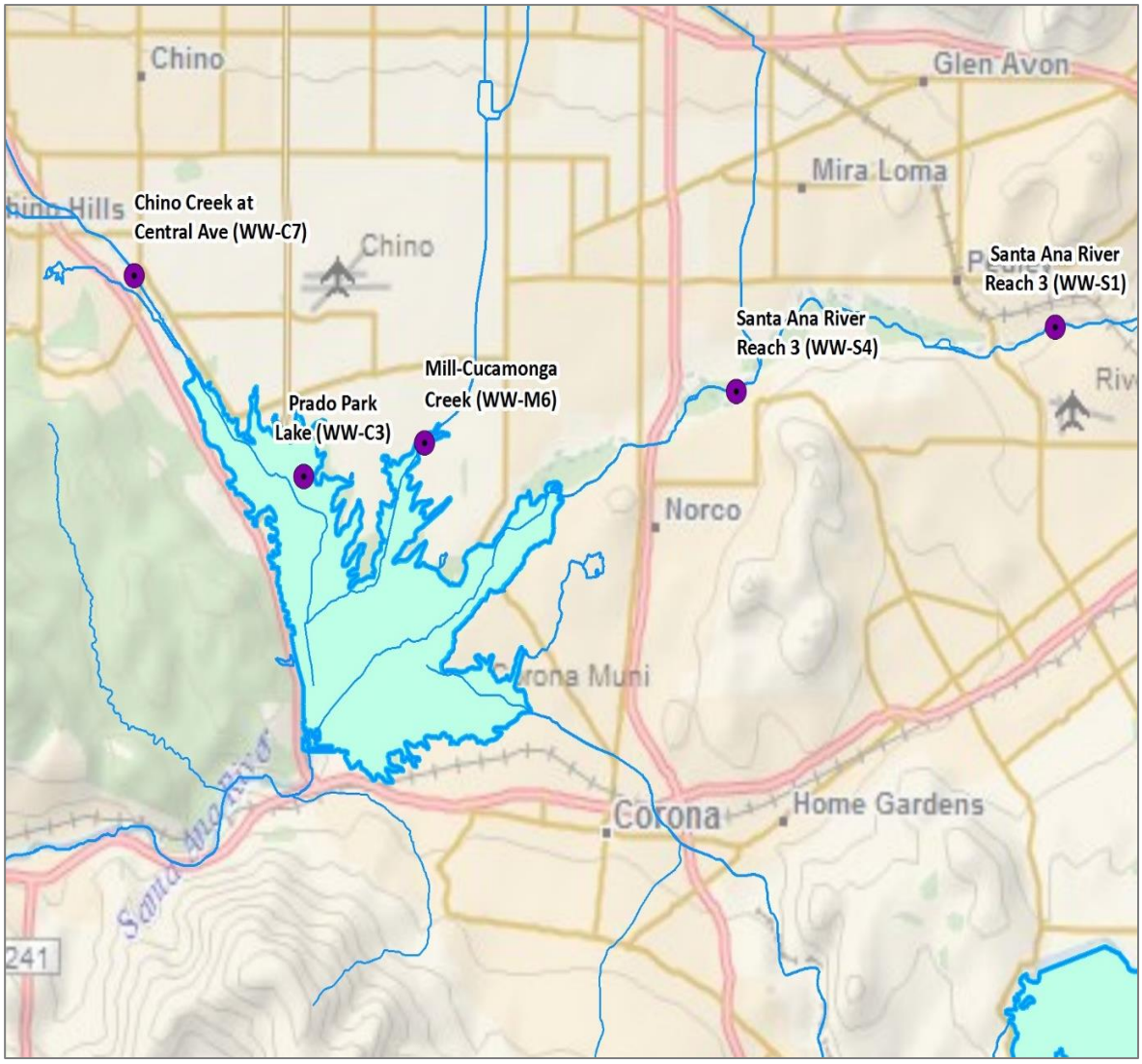


Figure 6-5. MSAR Bacteria TMDL wet weather event monitoring sites

- *Step 3* - Mobilize sampling crews at first daylight on the appropriate morning for sampling based upon the time that rainfall is expected. For instance, if rainfall onset is predicted for 0400 hours, samplers will be mobilized so that they arrive at sampling sites by daylight on the day of the predicted rainfall. If rainfall is predicted for 1300 hours, then samplers will mobilize at daylight of the next morning. Regardless of when rainfall begins, mobilization of sample teams is limited to first daylight to meet two sampling requirements:
  - For safety purposes, sampling may only be conducted during daylight hours; and
  - Samples must be dropped off at the laboratory, typically no later than 1500 hours to comply with laboratory processing procedures and to meet holding times.

Samples shall not be collected if conditions are determined to be unsafe by an on-site assessment conducted by the field team leader. If a wet weather event occurs during weekends or holidays, then additional coordination with the laboratory will be necessary to ensure water samples can be accepted for processing.

6.3.2 Urban Source Evaluation Program

6.3.2.1 Introduction

The MSAR Bacteria TMDL required MS4 dischargers to develop a USEP by November 30, 2007, six months after EPA approval of the MSAR TMDL. The purpose of the USEP was to identify specific activities, operations, and processes in urban areas that contribute bacterial indicators to waterbodies under the MSAR Bacteria TMDL. Prepared through the MSAR TMDL Task Force, the USEP was submitted to the Santa Ana Water Board in a timely manner and formally approved on April 18, 2008[26]. The approved USEP included the following objectives:

- Describe an Urban Source Evaluation Monitoring Program to be implemented to identify urban bacterial indicator sources;
- Establish a risk-based framework for evaluating water quality data obtained with regards to human illness from the Urban Source Evaluation Monitoring Program;
- Identify investigative activities that may be implemented to the maximum extent practicable based on water quality data; and
- Provide a schedule for USEP implementation with contingencies built in to allow for consideration of new data, modified regulations, changed priorities, or new technologies.

On January 29, 2010 the Santa Ana Water Board adopted new MS4 permits for Riverside and San Bernardino Counties. These permits required that each County develop a CBRP to meet MSAR TMDL wasteload allocations for the dry season. The source evaluation activities described in the USEP were incorporated into the CBRP. Accordingly, following Santa Ana Water Board approval of the CBRPs for each County on February 10, 2012[27], the CBRPs superseded the previously approved USEP and became the basis for bacterial indicator urban source evaluation activities carried out in the MSAR

[26] Santa Ana Water Board Resolution: R8-2008-0044; April 18, 2008
[27] Santa Ana Water Board Resolutions: R8-2012-0015 (Riverside County MS4 Program; R8-2012-0016 (San Bernardino County MS4 Program)

watershed (see page A-11 in the Riverside County CBRP; similar language is contained in the San Bernardino County CBRP)[28].

The Los Angeles Regional Water Quality Control Board (Los Angeles Water Board) adopted a new Los Angeles County MS4 Permit in 2012 that became effective December 28, 2012[29]. This permit required the Cities of Pomona and Claremont to develop CBRPs for the portions of their cities that are within the MSAR watershed[30]. Because the Santa Ana Water Board oversees MSAR Bacteria TMDL implementation, the Santa Ana Water Board oversaw development of the CBRPs for these cities. The Santa Ana Board approved the CBRPs for the Cities of Pomona and Claremont on March 14, 2014[31].

The primary goal of the source evaluation monitoring program is to guide efforts to identify and where possible mitigate controllable sources of bacterial indicator derived from discharges covered by MS4 permits. Source evaluation activities seek to answer the following questions:

- Which subwatershed areas are hydrologically connected to the waterbodies listed as impaired (in particular the Santa Ana River) by the MSAR Bacteria TMDL during dry flow conditions?
- What is the concentration of *E. coli* and rate of urban dry weather flow from MS4 facilities outfalls to a downstream TMDL compliance monitoring sites?
- What is the running geometric mean of *E. coli* in water samples collected from MS4 facilities?

The CBRPs establish an implementation approach to address these questions through source evaluation monitoring and elimination of controllable bacteria sources.

6.3.2.2 CBRP Implementation Approach

The MS4 permittees in each county implement source evaluation activities using a comprehensive, methodical approach that provides data to make informed decisions regarding the potential for an MS4 outfall or group of outfalls to discharge controllable sources of bacterial indicators. This approach relies on the following activities:

- *Tier 1 Reconnaissance* – Tier 1 sites are defined as sites where urban sources of dry weather flow may directly discharge to a downstream watershed-wide compliance site (see Table 6-6). Some of the Tier 1 sites are at the same sites sampled as part of implementation of the USEP in 2007-2008. Additional Tier 1 sites were included, where needed, to supplement existing information. Some Tier 1 locations were dry or had minimal dry weather flow, or in some instances were hydrologically disconnected to downstream waters. The data collected during Tier 1 was used to determine each outfall's potential to contribute controllable sources of bacterial indicators.
- *Prioritization of MS4 Drainage Areas* – Based on the findings from Tier 1 reconnaissance activities, MS4 drainage areas with potentially controllable urban sources of bacterial indicators are prioritized based on factors such as the magnitude of bacterial indicator concentrations and

[28] CBRPs available at http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/msar_tmdl.shtml
[29] Los Angeles Water Board Resolution R4-2012-0175
[30] See Attachment R, Los Angeles Water Board Resolution R4-2012-0175
[31] Santa Ana Water Board Resolution: R8-2014-0030 (City of Claremont); R8-2014-0031 (City of Pomona)

results from source tracking analyses. Areas with controllable sources of bacteria (as determined through the use of *Bacteroides* testing for human marker) receive the highest priority for action.

- *Tier 2 Source Evaluation* – Source evaluation activities are being implemented first in the MS4 drainage areas with the highest priority Tier 1 sites. These activities include a strategically timed mix of field reconnaissance, secondary screening tool deployment, and bacterial water quality sample collection. Tier 2 sites are tributary to a Tier 1 site. Implementation of source evaluation activities at Tier 2 sites can be unique and is tailored for each drainage area. This ensures that source evaluation activities are as effective as possible given the large number of potential monitoring sites within large urbanized drainage areas to an MS4 outfall. Methods for conducting Tier 2 source evaluation studies are provided in Section 11 of this QAPP.

The frequency of sample collection at any Tier 1 or Tier 2 site is determined by the need for source evaluation data to identify controllable sources of bacterial indicators.

6.3.2.3 Monitoring Sites

Table 6-6 lists the 34 Tier 1 locations that comprise all of the MS4 outfalls with existing or potential dry weather flow (Figure 6-6). These sites were recommended for sampling in the CBRPs prepared for Riverside and San Bernardino Counties, and the Cities of Pomona and Claremont, located in Los Angeles County.

For Tier 2, the selection of sample sites is determined by the characteristics of the drainage area upstream of the prioritized MS4 outfalls. As a consequence, there is no list of specific sites for Tier 2 source evaluations. Based on the Tier 1 reconnaissance in 2019-2020, the subwatersheds to the Tier 1 sites shown in Table 6-6 were the subject of Tier 2 source evaluation in the 2020 and 2021 dry seasons. Future Tier 2 source evaluation will be conducted as the MS4 Permittees continue the process of tracking down controllable sources of bacterial indicators within MS4s.

6.3.2.4 Sampling Frequency

Within the MS4 drainage areas there is a vast drainage system that would be nearly impossible to completely monitor in a timely basis using water quality sample collection and analysis alone. To optimize resources, alternative monitoring methods have been identified that are recommended for use to track controllable sources of human fecal bacteria in prioritized MS4 drainage areas. Many of these methods are adapted from a Center for Watershed Protection guidance document[32].

Two bacteria source evaluation approaches are available for use by any MS4 permittee within any high priority drainage area, referred to as broad-brush or subregional approaches. The difference in these approaches involves the order of different types of investigation and the number of sites and frequency of water quality sample collection. Each approach is described below.

[32] Brown, E., Caraco, D., Pitt, R. 2004. *Illicit Discharge Detection and Elimination: Technical Appendices*. Center for Watershed Protection, Ellicott City, MD & University of Alabama, Tuscaloosa, AL.

Table 6-6. Tier 1 sample sites in the MSAR watershed[1]

Site ID	Site Description	Longitude	Latitude
Riverside County			
T1-64ST	64th Street Storm Drain (SAR Reach 3)	-117.488532	33.970798
T1-ANZA	Anza Drain (SAR Reach 3)	-117.463100	33.95869
T1-BXSP	Box Springs Creek @ Tequesquite Ave	-117.403599	33.975899
T1-CREST	City of Riverside Outfall (Crest/Ontario) (SAR Reach 3)	-177.476290	33.963361
T1-IDST	City of Riverside (Industrial/Freemont) (SAR Reach 4)	-117.436110	33.967330
T1-EVAN	City of Riverside Outfall (Lake Evans) (SAR Reach 4)	-117.381757	33.997002
T1-RBDX	City of Riverside Outfall at Rubidoux (SAR Reach 3)	-117.410220	33.968060
T1-DAY	Day Creek	-117.532980	33.975010
T1-EVLD	Eastvale MDP Line D (SAR Reach 3)	-117.579781	33.946701
T1-EVLE	Eastvale MDP Line E (SAR Reach 3)	-117.553434	33.950298
T1-MCSD	Magnolia Center SD (SAR Reach 3)	-117.415473	33.965599
T1-PHNX	Phoenix Storm Drain (SAR Reach 3)	-117.427128	33.963600
T1-SSCH	San Sevaine Channel	-117.506433	33.974300
T1-SNCH	Sunnyslope Channel	-117.427180	33.976200
T1-WLSD	Wilson Storm Drain (SAR Reach 4)	-117.372187	34.018700
San Bernardino County			
T1-SACH	San Antonio Channel @ SR 60	-117.72811	34.02470
T1-BRSC	Boys Republic South Channel @ confluence with Chino Creek	-117.72611	34.00208
T1-PPLN	Pipeline Ave 84" RCP outlet under bridge	-117.71506	33.98930
T1-CCCH	Carbon Canyon Creek @ Pipeline Ave	-117.71543	33.98620
T1-YRBA	Chino Creek, @ Yorba Ave ext., large outlet to SE of extension	-117.70192	33.98362
T1-LLSC	Lake Los Serranos Channel @ Red Barn Court crossing, above confluence with Chino Creek	-117.69106	33.97542
T1-CBLD	Chino Creek/San Antonio Creek @ ext. of Flowers St., behind Big League Dreams	-117.67493	33.95864
T1-CYP	Cypress Channel @ Kimball Avenue	-117.66039	33.96860
T1-RISD	SW of Riverside Avenue @ SAR - City S.D.	-117.36447	34.02774
Los Angeles County			
CHINOCRK	Chino Creek upstream of San Antonio Channel	-117.73057	34.01343

[1] Coordinates are shown as Geographic WGS 1984 World Datum

Table 6-7. Relative Rank Results for each Prioritization Criterion and the Final Composite Score for each included in 2019 Synoptic Study

Tier 1 Site	Relative Rank (0 to 100) for Prioritization Criteria				Composite BFS
	Criterion 1 DWF (gal/acre/day) Weight = 0.3	Criterion 2 *E.Coli* Loading (MPN/Day) Weight = 0.3	Criterion 3 *Bacteroides Amplification Frequency (%) Weight = 0.3*	Criterion 4 Risk of Exposure Weight = 0.1	
T1-MCSD	38	85	100	100	77
T1-SNCH	77	62	67	100	72
T1-ANZA	100	69	17	100	66[1]
T1-CUCAMONGA	69	92	17	100	63
T1-SSCH	85	100	17	0	60
T1-BRSC	62	54	83	0	60
T1-BXSP	31	38	83	100	56
T1-CHINOCRK	54	77	17	0	44
T1-DAY	46	46	0	100	38
T1-CCCH	92	31	0	0	37
T1-PHNX	23	23	0	100	24
T1-SACH	8	15	0	0	7
T1-LLSC	15	8	0	0	7
T1-CYP	0	0	0	0	0

[1] Given the closeness of this score (66) to the high priority category (67-100), this site is categorized as high priority

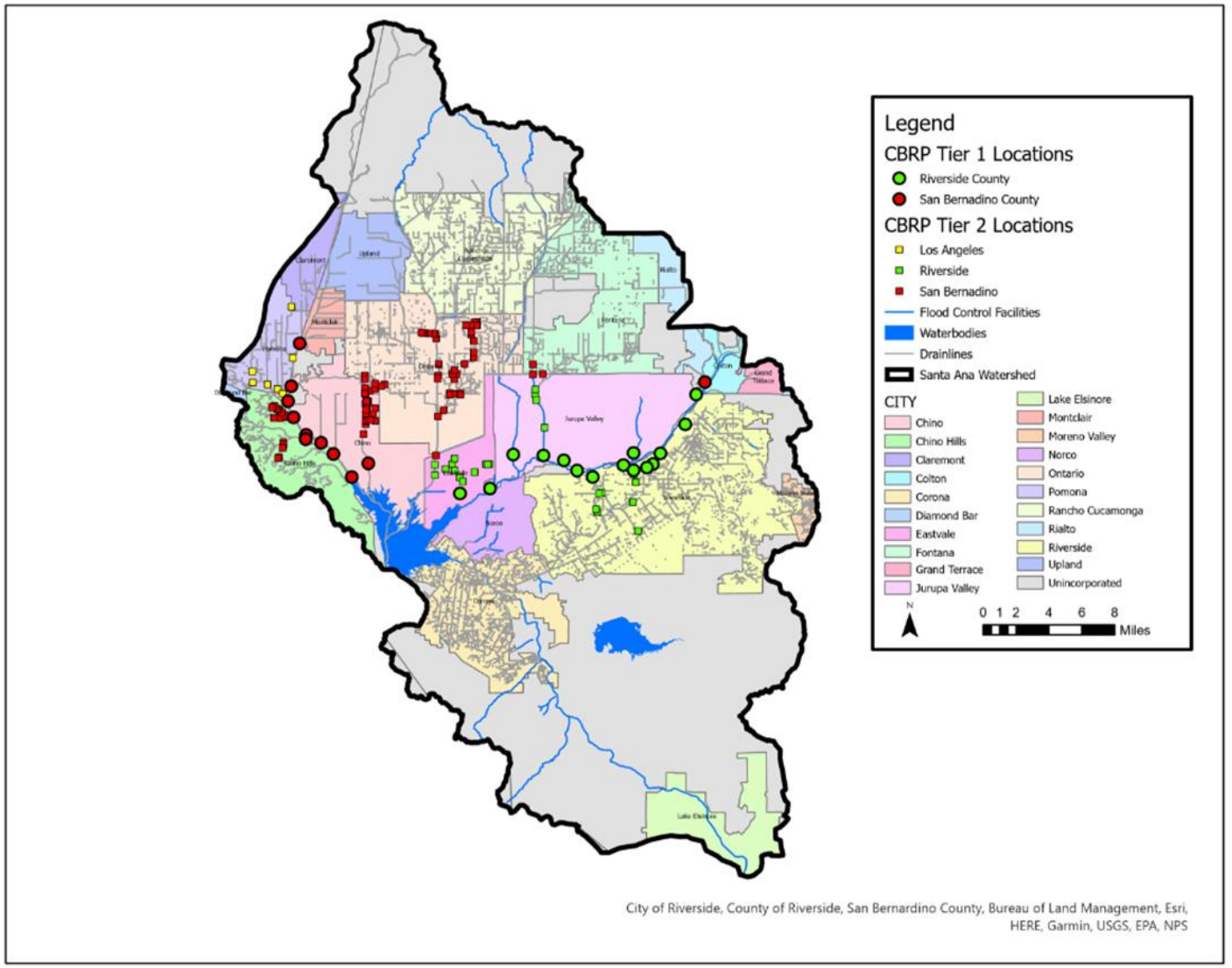


Figure 6-6. Tier 1 source evaluation Sites in the MSAR watershed to support implementation of the MSAR Bacteria TMDL

Broad-brush Approach

The broad-brush approach attempts to identify specific sources of human fecal bacteria by initially performing extensive field reconnaissance and screening investigations. These relatively low cost activities include field reconnaissance and deployment of secondary screening tools and can be implemented at a large number of Tier 2 sites (see Section 11.4.2).

Results from field reconnaissance and secondary screening tool deployment are used to identify Tier 2 sites for bacterial water quality sample collection. On days when samples are collected from Tier 2 sites within the MS4s, samples are also collected from downstream Tier 1 sites to assess the relative role of the Tier 2 measurements in downstream bacteria characteristics.

The broad-brush approach provides a spatially robust dataset and has the potential to pinpoint specific management actions at an individual property scale to eliminate bacteria sources. MS4 permittees use results from field reconnaissance, secondary screening, and bacterial water quality analysis to guide implementation of short term management actions that address bacteria sources of concern. At the end of the dry season, a follow-up snapshot survey can be performed to determine the effectiveness of any management actions implemented.

The risk associated with this approach stems from the temporal variability in human *Bacteroides* detection, which was typically less than 40 percent of samples in the 2012 dry season at the downstream Tier 1 sites. Accordingly, there is a greater chance of missing the human fecal bacteria signal taking an approach with a single snapshot survey.

Subregional Approach

The subregional approach attempts to develop a better understanding of dry weather flow and water quality from subareas within the prioritized Tier 1 MS4 drainages. This approach involves weekly sample collection from the downstream Tier 1 site and at one or more major trunk confluences within the MS4 drainage system (Tier 2 sites). Samples are analyzed for *E. coli* to develop a baseline longitudinal characterization. Secondary screening tools are used in 5 of the 10 weeks to assess water quality at Tier 2 sites selected for source evaluation in neighborhood scale subareas upstream of each baseline bacterial water quality site. Field reconnaissance is important to identify the Tier 2 sites for baseline characterization in the initial weeks, and then to aid in selection of Tier 2 sites for source evaluation incorporating secondary screening tracer sample collection in the middle of the dry season. Lastly, in the latter portion of the dry season, samples are collected and analyzed for human *Bacteroides* at a subset of the Tier 2 sites based on information gathered from secondary screening and field reconnaissance. MS4 permittees use results from all phases of the source evaluation to guide implementation of short term management actions that address bacteria sources of concern.

The risk associated with this approach stems from the aggregation of large spatial areas, which may not provide the resolution needed to identify specific sources for focusing or targeting short-term management actions. However, since the Tier 2 source evaluations occur over two dry seasons, a subregional approach in the first year could be followed by adopting the broad-brush approach in smaller more manageable subareas in the second year of the program.

6.3.3 AgSEP Monitoring Program

6.3.3.1 Introduction

With EPA approval of the MSAR Bacteria TMDL in May 2007, agricultural dischargers (as defined by the TMDL) were required to complete specific implementation activities either in collaboration with other TMDL responsible parties or separately. Specifically, agricultural discharges were required to complete the following activities:

- Implement a watershed-wide compliance monitoring program (currently being implemented in collaboration with urban dischargers; see Section 6.3.1);
- Develop an AgSEP by November 30, 2007; and
- Develop a BASMP.

Agricultural Source Evaluation Plan

The purpose of the AgSEP was to identify specific activities, operations and processes in agricultural areas that contribute bacterial indicators to MSAR watershed waterbodies. The plan was to include a proposed schedule for the steps identified and include contingency provisions as needed to reflect any uncertainty in the proposed steps or schedule. Information from implementation of the AgSEP would be used by the Santa Ana Water Board and agricultural stakeholders to support development of the BASMP.

The AgSEP was submitted to the Santa Ana Water Board by November 30, 2007; it was approved on April 18, 2008[33]. A component of the AgSEP involved implementation of an AgSEMP at key sites to gather bacterial indicator data. Monitoring was conducted during wet weather in the 2008-2009 wet season at four monitoring sites and included collection of field parameters, bacterial indicator data, and microbial source identification analyses (Table 6-8 and Figure 6-7). No additional sample collection from the AgSEP sample sites is currently planned. More details on the AgSEP program implementation are provided in Section 4.1.3.2 of the SAR Bacteria Monitoring Plan.

Bacterial Indicator Agricultural Source Management Plan

Per the MSAR Bacteria TMDL, the BASMP should include, plans and schedules for the following:

- Implementation of bacteria indicator controls, Best Management Practices (BMPs) and reduction strategies designed to meet load allocations;
- Evaluation of effectiveness of BMPs; and
- Development and implementation of compliance monitoring program(s).

A BASMP is currently under development by agricultural dischargers in the MSAR watershed. When complete it is expected to replace the AgSEP. Because this document is still under development, this section will be updated once the BASMP is finalized. Moreover, the final BASMP may include monitoring requirements designed to support implementation of the BASMP. If included in the final program, then these monitoring requirements will be incorporated into the SAR Bacteria Monitoring Plan and QAPP.

Table 6-8. AgSEMP monitoring sites

[33] Santa Ana Water Board Resolution: R8-2008-0044; April 18, 2008

Site ID	Site Description	Longitude	Latitude
Prado Park Lake Drainage Area			
AG-G2	Grove Avenue Channel at Merrill Avenue	-117.37685	33.58986
AG-G1	Eucalyptus Avenue at Walker Avenue	-117.37163	33.59425
AG-E2	Euclid Avenue Channel at Pine Avenue	-117.38926	33.57220
Cucamonga Creek, Reach 1 Drainage Area			
AG-CL1	Eucalyptus Avenue at Cleveland Avenue (*Backup to Walker Avenue, depending on flow conditions)* (CL1)	-117.34031	33.59405
Chino Creek, Reach 1 Drainage Area			
AG-CYP1	Cypress Channel at Kimball Avenue (*dual site; same as USEP site US-CYP*)	-117.66043	33.96888

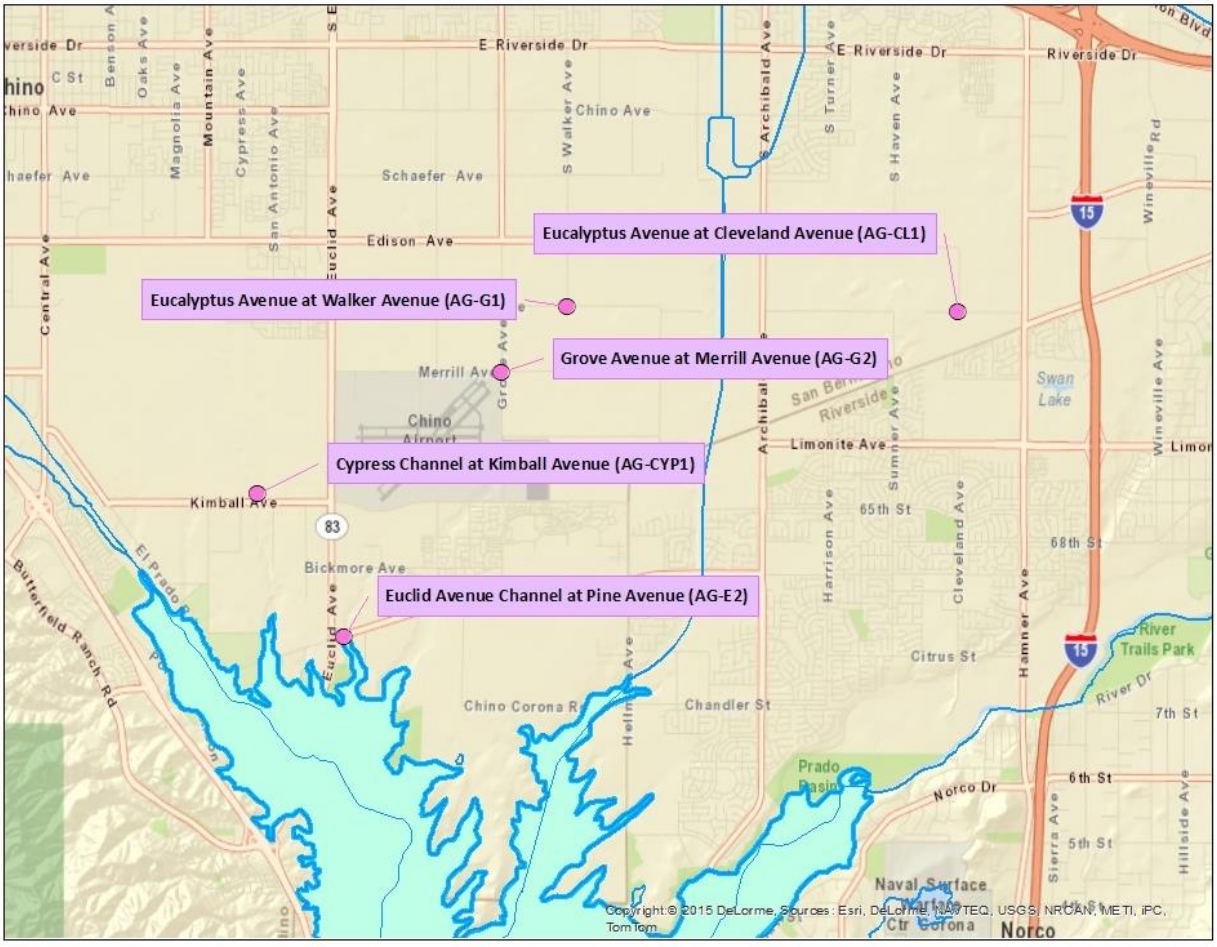


Figure 6-7. Location of AgSEMP sites sampled in 2008-2009.

6.4 Constituents to be Monitored and Measurement Techniques

The following water quality indicators will be measured at the Regional Monitoring Program (Section 6.2), watershed-wide wet weather (Section 6.3.1), Urban Source Evaluation (Section 6.3.2), and Agricultural Source Evaluation (Section 6.3.3.) monitoring sites, respectively.

6.4.1 Regional Monitoring Program Monitoring Sites

The following water quality indicators will be analyzed in water samples collected at each priority monitoring site on each sample date:

- *Field Analysis*: Temperature, conductivity, pH, dissolved oxygen, and turbidity will be measured with a Horiba multi-parameter probe or related instrument.
- *Flow*: During each time a site is sampled, if conditions are safe, flow will be characterized using a either a volumetric, cross-section velocity profile, or a visual estimate method.
- *Water Quality Analysis*: *E. coli* and/or Enterococci, and total suspended solids (TSS) concentrations in grab samples will be analyzed by a qualified laboratory as follows:

Table 6-9. Grab sample constituents to be monitored

Site	*E. coli*	Enterococci	TSS
All Priority 1 sites except P1-2; All Priority 2 sites; P3-SBC1, P3-OC2, and P3-OC11; All Priority 4 sites except P4-OC2 and P4-OC3	Yes	No	Yes
P1-2; P3-RC1, P3-OC1, P3-OC3, P3-OC5, P3-OC6, P3-OC7, P3-OC8, and P3-OC9	Yes	Yes [1]	Yes
P4-OC2 and P4-OC3	No	Yes	Yes

[1] EPA has defined salinities less than 1 ppt as freshwater and salinities greater than 10 ppt as saltwater; and for waters with salinities in the range between 1 ppt and 10 ppt, the more stringent of saltwater or freshwater criteria apply, unless a scientifically defensible and site specific demonstration is made to show the biology of the waterbody is dominated by freshwater or saltwater aquatic life (Federal Register, V65, No97, May 18 2000). Given this, changes to applicable criteria for inland waters in the SAR region may be developed based on aquatic biology. In the event that such demonstrations are made, this Monitoring Program will be updated to focus on the criteria that are determined to be applicable on a waterbody specific basis.

6.4.2 MSAR Bacteria TMDL Wet Weather Event Monitoring

Consistent with the MSAR Bacteria TMDL, the following water quality indicators will be analyzed in water samples collected at each site on each sample date:

- *Field Analysis*: Temperature, conductivity, pH, dissolved oxygen, and turbidity will be measured with a Horiba multi-parameter probe or related instrument.
- *Flow*: During each time a site is sampled, if conditions are safe, flow will be characterized using a either a volumetric, cross-section velocity profile, or a visual estimate method.
- *Water Quality Analysis*: *E. coli*, and TSS concentrations in grab samples will be analyzed by a qualified laboratory included in this QAPP (see appendices).

6.4.3 Urban Source Evaluation Monitoring Program

The following data will be collected when each Tier 1 or Tier 2 site is sampled:

- *Field Analysis*: Temperature

- *Water Quality Analysis*: *E. coli*, TSS, and *Bacteroides* analysis will be analyzed by a qualified laboratory included in this QAPP (see appendices).
- *Flow*: During each time a site is sampled, if conditions are safe, flow will be characterized using a volumetric, cross-section velocity profile, or visual estimate method
- *Bacteroides Analysis*: OCWD or qualified laboratory will use a quantitative polymerase or (qPCR) or digital droplet (ddPCR) method to analyze for human, pig, horse, canine, bird, and rumen source *Bacteroides*.

In addition to measuring flow at Tier 1 sites, samplers assess the hydrologic connectivity of the surface flow at each site to the downstream impaired waterbody (Santa Ana River Reach 3, Mill-Cucamonga Creek, and Chino Creek Reach 1 and 2) to evaluate if the tributary drain is actually discharging any runoff to the downstream waterbody. Under dry weather conditions, many Tier 1 locations, particularly along Santa Ana River Reach 3 are likely to not have hydrologic connectivity due to the long distance between Tier 1 discharge outfalls and the Santa Ana River. If there is no connection of surface waters, then the flow rate is assumed to be zero for that date only; collection of a water sample for laboratory analysis is optional, depending on the need for the data.

A variety of water quality screening tools can be effective at identifying specific MS4 sources of bacterial contamination with limited resources. These tools will be employed for Tier 2 bacteria source evaluation and are described in more detail in Section 11 of this QAPP:

- Ammonia Testing
- Potassium Testing
- Chlorine Test Strips
- Copper Test Strips
- Surfactant/Detergent Screening
- Canine scent tracking

6.4.4 Agricultural Source Evaluation Monitoring Program

The following data will be collected when each site is sampled:

- *Field Analysis*: Temperature, conductivity, pH, dissolved oxygen, and turbidity will be measured with a Horiba Multi-parameter probe or related instrument.
- *Water Quality Analysis*: *E. coli*, and TSS concentrations in grab samples will be analyzed by a qualified laboratory included in this QAPP (see appendices).
- *Flow*: During each time a site is sampled, if conditions are safe, flow will be characterized using a visual estimate method.

- *Bacteroides Analysis*: A qualified laboratory will assay water grab samples for *Bacteroides* host-specific markers for humans, ruminant, and domestic canine to determine if they are present and to provide a quantitative estimate of their relative abundance.

6.5 Constraints to Monitoring

Under some circumstances, collection of water samples or field measurements may not be possible. For example, if flow in the channel is elevated, conditions may be too dangerous for taking a flow measurement by developing a cross section velocity profile. Another potential constraint would occur if the channel is dry, thus making it impossible to collect surface water samples. The field team will document any constraints in the field on the Field Data Forms. The data manager will incorporate observational data from these site visits into the water quality database, indicating the reason why data were not collected at a given site.

6.6 Project Schedule

The project schedule is documented in in the SAR Bacteria Monitoring Plan and in Section 10 of this QAPP.

7. Quality Objectives and Criteria for Measurement Data

Table 7-1 summarizes the applicable data quality objectives for the types of measurements or analyses conducted under this project. Tables 7-2 and 7-3 summarize the specific data quality objectives for field measurements or constituents measured in the laboratory, respectively.

Table 7.1. Project data quality objectives

Measurement or Analyses Type	Applicable Data Quality Objective
Field Measurements	Accuracy, Precision, Completeness
Bacterial Analyses	Precision, Presence/Absence, Completeness
Water Quality Analyses, Surfactant Analyses	Accuracy, Precision, Recovery, Completeness

Accuracy will be determined by measuring one or more selected from performance testing samples or standard solutions from sources other than those used for calibration. Accuracy criteria for bacterial testing will be based on presence/absence testing rather than numerical limits owing to the difficulty in preparing solutions of known bacterial concentration.

Precision measurements will be determined on both field and laboratory replicates. The number of replicates for field measurements will be three, the number for TSS and bacteria testing will be 5 percent of total samples collected in sampling year.

Recovery measurements will be determined by laboratory spiking of a replicate sample with a known concentration of the analyte. Control spike should have a recovery value within 80-120 percent. The target level of addition is at least twice the original sample concentration and is applicable to TSS, ammonia, potassium, and surfactant analyses.

Completeness is the number of analyses generating useable data for each analysis divided by the number of samples collected for that analysis.

Method sensitivity is dealt with by the inclusion of the required SWAMP Target Reporting Limits, where such values exist. Target Reporting Limits exist for *E. coli*, Enterococci, TSS, and ammonia.

No Target Reporting Limits were set for the potassium and surfactant laboratory analyses, or for the field analyses.

Table 7-2. Data quality objectives for field measurements

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Completeness
Field Measurements	Conductivity	± 5%	± 5%	NA	NA	90%
Field Measurements	Dissolved Oxygen	± 0.5 milligrams/Liter (mg/L)	± 0.5 or 10%; whichever is greater	NA	NA	90%
Field Measurements	pH	± 0.5 units	± 0.5 or 5%, whichever is greater	NA	NA	90%
Field Measurements	Temperature	± 0.5ºC	± 0.5 or 5%, whichever is greater	NA	NA	90%
Field Measurements	Turbidity	± 10% or 0.1 NTU, whichever is greater	± 10% or 0.1 NTU, whichever is greater	NA	NA	90%
Field Measurements	Flow (visual estimate)	± 25%	± 25%	NA	NA	90%
Field Measurements	Flow (via flow instruments)	± 10%	± 10%	NA	NA	90%
Field Measurements	Ammonia	± 20%	± 10%	NA	NA	90%
Field Measurements	Chlorine	± 20%	± 10%	NA	NA	90%
Field Measurements	Copper	± 20%	± 10%	NA	NA	90%
Field Measurements	Detergents/ Surfactants	± 20%	± 10%	NA	NA	90%
Field Measurements	Canine Scent Tracking	± 20%	± 10%	NA	NA	90%

Table 7-3. Data quality objectives for laboratory measurements

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Bacterial Analyses	*E. coli*	Positive results for target organisms. Negative results for non-target organisms	R_{log} within 3.27*mean R_{log} (reference is section 9020B 18th, 19th, or 20th editions of *Standard Methods*)	NA	Varies[1]	90%
	Enterococci	Positive results for target organisms. Negative results for non-target organisms	R_{log} within 3.27*mean R_{log} (reference is section 9020B 18th, 19th, or 20th editions of *Standard Methods*)	NA	Varies[1]	90%
Bacteria Source Analyses	Genetic markers for human and canine (*Bacteroides thetaiotaomicron*), horse (*Bacteroides* spp.), bird (*Heliobacter*), pig (*Bacteroidales spp.*) and rumen (*Prevotella*)	Positive results for target organisms.	NA	NA	Gene copies/100 mL	90%
Conventional Constituents in Water	TSS	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available, then with 80% to 120% of true value	Blind field duplicate and Laboratory duplicate, or MS/MSD 25% RPD	Matrix spike 80% - 120% or control limits at ± 3 standard deviations based on actual lab data, whichever is more stringent	1.0 mg/L	No SWAMP requirement; will use 90%
Nutrients in Water	Ammonia	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available, then with 80% to 120% of true value	Blind field duplicate and Laboratory duplicate, or MS/MSD 25% RPD	Matrix spike 80% - 120% or control limits at ± 3 standard deviations based on actual lab data, whichever is more stringent	0.1 mg/L	No SWAMP requirement; will use 90%
Inorganic Analytes in Water	Potassium	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available, then with 80% to 120% of true value	Blind field duplicate and Laboratory duplicate, or MS/MSD 25% RPD	Matrix spike 80% - 120% or control limits at ± 3 standard deviations based on actual lab data, whichever is more stringent	NA	No SWAMP requirement; will use 90%
Detergents/ Surfactants in Water	MBAS	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available, then with 80% to 120% of true value	Blind field duplicate and Laboratory duplicate, or MS/MSD 25% RPD	Matrix spike 80% - 120% or control limits at ± 3 standard deviations based on actual lab data, whichever is more stringent	NA	No SWAMP requirement; will use 90%

[1] The target reporting limits are dependent on analytical methods and sample dilutions conducted by laboratories

8. Special Training Needs/Certification

All persons involved in the field sampling activities to implement the SAR Bacteria Monitoring Plan will be trained prior to any field sampling. Training will take place to ensure that sampling field members are familiar with the protocols and sampling sites.

All individuals that participate in sampling activities are required to have attended (at a minimum) the "4-hour Basic Site Safety Training" provided by an appropriately qualified trainer and/or contractor of the Health and Safety branch of the State, and/or equivalent university training. The training will cover the general health and safety issues associated with fieldwork, including sampling. The Project Manager for each Responsible Agency will provide specific training, pertinent to the details of a particular sampling program. This training will include, but not be limited to, proper use of field equipment, health and safety protocols, sample handling protocols, and chain of custody protocols.

Field staff training is documented and filed at the office of the Project Manager for each Responsible Agency. Documentation consists of a record of the training date, instructor, whether initial or refresher, and whether the course was completed satisfactorily.

All commercial laboratories will provide appropriate training to its staff as part of its Standard Operating Procedure. All laboratories will maintain their own records of its training that comply with OSHA requirements. Those records can be obtained, if needed, from each contract laboratory through their Quality Assurance Officer.

9. Documents and Records

The following documentation and records procedures will be followed (Table 9-1):

- A Final Annual Report will be submitted electronically to the Santa Ana Water Board by June 30th of each year to document the findings from the previous sample year.[34] Electronic copies will be provided to each Responsible Agency..
- Each Responsible Agency's Project Manager will maintain a record of all field data collection activities and samples collected and analyzed. All samples delivered to contract laboratories for analysis will include completed Field COC forms (Attachment E). Upon request, all contracted laboratories will generate records for sample receipt and storage, analyses, and reporting.
- Contract laboratories will submit the results of all laboratory analyses to the Responsible Agency Monitoring Manager that submitted the samples for analysis. Field data collected by each Responsible Agency will be maintained onsite and uploaded into a spreadsheet/database while sampling is ongoing within a sample year. The spreadsheet/database format will be provided to all Responsible Agency Project Managers by the Project Director.
- For each sample year, electronic records of field data and laboratory sample results, copies of COC and original field data sheets and flow measurement forms for sites where a velocity cross section profile method was used to measure flow will be kept on file by the Responsible Agency. By January 15th of each reporting year, all forms, data sheets, or electronic files associated with non-wet weather event sampling will be provided to the Project Director to support preparation of the Annual Report. Within 15 days after completion of wet weather event sampling, all forms, data sheets, or electronic files associated with the sampling event will be provided to the Project Director to support preparation of the Annual Report.
- Contract laboratories will maintain electronic or paper records pertinent to the implementation of the SAR Bacteria Monitoring Plan at the laboratory's main office for at least three years. By January 15th of each year, each contract laboratory will provide to the Project Director a QA/QC Report that assesses compliance with laboratory QA/QC protocols for dry weather samples processed during the previous sample year (generally May 1 through November 30). In addition, by April 15th of each year, each contract laboratory will provide to the Project Director a QA/QC Report that assesses compliance with laboratory QA/QC protocols for wet weather event samples processed during the previous sample year during the wet season (between November 1 and March 31). At any time, copies of records or QA/QC reports held by the contract laboratories will be provided to a Responsible Agency Project Manager (or Project QA Officer) or Project Director upon request.
- Each Responsible Agency's Data Manager will manage field and laboratory data results by ensuring that all such data are uploaded into a database or spreadsheet template provided by the Project

[34] A sample year is the period from May 1 through April 30 and includes the following sample activity: (a) collection of dry weather samples from Priority 1, 2, 3, and 4 sites from May through September; (b) collection of dry weather samples from Priority 1, 2 and 3 sites in late October through November; and (c) collection of samples from one wet weather event in the MSAR watershed between November 1 and March 31. See Section 10 for specific sample schedules for each priority site.

Director. By January 15th of each year, each Responsible Agency Project Manager will submit to the Project Director the database or spreadsheet file containing the previous sample year's field and laboratory data for dry weather samples collected during the previous sample year (generally May 1 through November 30). In addition, by April 15th of each year, each Responsible Agency Project Manager will submit to the Project Director the database or spreadsheet file containing the previous sample year's field and laboratory data for wet weather event samples collected during the previous sample year during the wet season (between November 1 and March 31).

- As part of the preparation of each Annual Report, the Project Director will ensure that all field data and laboratory data results (including QA/QC data) from each Responsible Agency are combined and uploaded to CEDEN. Data will be uploaded no later than 30 days after submittal of the Final Annual Report to the Santa Ana Water Board.

- Copies of this QAPP will be distributed to all Responsible Agencies involved with the SAR Bacteria Monitoring Program. Copies will be sent to each Contract Laboratory QA Officer for distribution to appropriate Laboratory Personnel. Any future amended QAPPs will be held and distributed in the same manner. All originals of this QAPP and its amendments will be held by the Project Director. Copies of versions, other than the most current, will be discarded so as not to create confusion.

- The Project Director will prepare a Draft Annual Report by April 30th of each year to reflect findings from sampling conducted during the previous sample year. This report will include findings from (a) all RMP sites; and (b) any required TMDL monitoring activities conducted to support implementation of a bacteria TMDL, e.g., wet weather sampling. After providing an opportunity for review of the Draft Annual Report and revising the draft report based on comments received, a Final Annual Report will be submitted electronically to the Santa Ana Water Board by June 30 of each year.

- At a minimum, the Final Annual Report will be electronically distributed to each Responsible Agency and the Santa Ana Water Board. The Final Annual Report will be made available to the public on either the Santa Ana Water Board or Project Director's website.

Table 9-1. Record retention, archival, and disposition information

Record Type	Document Type	Retention	Archival	Disposition
Sample Collection Records	Field Logs	Responsible Agency during sample year	Project Director	Project Director
Analytical Records	Laboratory results	Responsible Agency and Contract Laboratories during sample year	Project Director	Project Director
	COC Forms	Responsible Agency and Contract Laboratories during sample year	Project Director	Project Director
Assessment Reports	QA/QC Updates	Responsible Agency during sample year	Project Director	Project Director
	QA/QC Final Report	Responsible Agency during sample year	Project Director	Project Director
	Field Sampling Review	Responsible Agency Project QA Officer during sample year	Project Director	Project Director
	Internal Technical Audit of Database Management	Responsible Agency Data Manager during sample year	Project Director	Project Director
Reports	Santa Ana River Bacteria Monitoring Program Annual Report	Responsible Agency Project Manager	Project Director	Project Director and Santa Ana Water Board

Group B: Data Generation and Acquisition

10. Sampling Process Design

10.1 Regional Monitoring Program

For dry weather monitoring activities at RMP Sites (see Section 6.2), the sampling effort is generally described as follows (see Tables 10-1 and 10-2):

- *Priority 1 and 2 Sites*: Priority 1 and 2 sample sites will be sampled during dry weather (defined as no measurable rainfall within a 72-hour period prior to sampling) for a 20-week period during the warmest part of the year between May 1 and September 30. In addition, Priority 1 sample sites will also be sampled during one 5-week period from end of October through most of November each year during the cooler season. The resulting dataset will include 25 samples each year from each site and provide sufficient data to calculate 16 geometric means during the 20-week sample period and one geometric mean during the cool season. Table 10-1 provides a sampling schedule from January 1, 2016 through 2023.

- *Priority 3 Sites, (five-week sample events rotated on annual basis)*: Six monitoring sites are included in this Priority category. These sites have been grouped, generally by location, into five groups (Table 10-2). With the exception of Santa Ana River Reach 4, the goal is to collect five samples over a six week period during dry weather once each year. Accordingly, grouped sites will be sampled during dry weather (defined as no measurable rainfall within a 72-hour period prior to sampling) on a rotational basis over a period of a year so that all sites are sampled at least once each year (Table 10-2). The overall sample schedule for these sites overlaps with the Priority 1 & 2 sample site schedule to maximize efficiency with the collection of samples. In the first year of implementation, Groups 1 through 5 were sampled in order over a one year period. In subsequent years, the order of groups varies so that a Group's assigned 6-week sample period varies by season over the long-term (e.g., summer vs. fall or winter).

- *Priority 4 Sites, (once per year)*: Water quality samples will be collected during dry weather once per year and analyzed for *E. coli* or Enterococci to determine if the result exceeds the antidegradation target threshold value for the site (equal to the 75th percentile of the lognormal distribution fitted to historical data). If an exceedance of the antidegradation target is observed, additional *E. coli* or Enterococci samples will be collected once/month for the three following months. If any of the follow-up samples exceed the antidegradation target, then sampling will continue on a monthly basis until source(s) of the increased bacterial indicator concentration is identified and mitigated and bacterial indicator levels return to below the antidegradation target in three of four samples collected over three consecutive months. The annual dry weather sample will be collected during the summer season between June 21 and September 21 when REC2 activities are most likely to occur. If additional sampling is required due to an observed exceedance, the schedule will be determined based on the process described above.

10.2 TMDL Monitoring Programs

10.2.1 MSAR Bacteria TMDL Wet Weather Event Monitoring

One wet weather event is targeted for sampling each wet season, defined as November 1 through March 31 in the MSAR Bacteria TMDL. The goal of wet weather event sampling is to collect bacterial indicator data during the rising and falling limbs of the hydrograph. To accomplish this goal, a wet weather sample event requires the collection of four samples over an approximately four day period:

- Sample 1 – Target sample collection on the day of the storm event when it is apparent that flow within the channel is elevated above typical dry weather conditions as a result of rainfall induced runoff.
- Sample 2 – Collect samples approximately 24 hours after collection of Sample 1.
- Sample 3 – Collect samples approximately 48 hours after collection of Sample 1.
- Sample 4 – Collect samples approximately 72 hours after collection of Sample 1.

10.2.2 Urban Source Evaluation Monitoring Program

Tier 1 and 2 source evaluation activities contained in the CBRP schedule were completed during the period from 2012, 2014 and 2019. Additional site-specific monitoring activities are ongoing where needed to answer local questions (e.g. Cucamonga Creek 10-week longitudinal surveys, annually 2016-201). Any water quality samples collected as part of these activities are conducted according to the requirements of this QAPP.

10.2.3 Agricultural Source Evaluation Monitoring Program

Prior agricultural source evaluation monitoring occurred in 2008-2009. A BASMP is currently under development by agricultural dischargers in the MSAR watershed. The final BASMP may include monitoring requirements designed to support implementation of the management plan. If included in the final program, then the approach and schedule will be added to Section 10 of this QAPP.

Table 10-1. Sample schedule for Priority 1 and 2 waters during dry weather conditions (2016 - 2023)

Year	Sample Season	First Week of Sampling	Last Week of Sampling	Priority 1 Waters	Priority 2 Waters
2016	Warm Season	May 8	September 18	All Table 3.1 Waters	All Table 3.3 Waters
	Cool Season	October 30	November 27	All Table 3.1 Waters	All Table 3.3 Waters
2017	Warm Season	May 7	September 17	All Table 3.1 Waters	All Table 3.3 Waters
	Cool Season	October 29	November 26	All Table 3.1 Waters	All Table 3.3 Waters
2018	Warm Season	May 6	September 16	All Table 3.1 Waters	All Table 3.3 Waters
	Cool Season	October 28	November 25	All Table 3.1 Waters	All Table 3.3 Waters
2019	Warm Season	May 5	September 15	All Table 3.1 Waters	All Table 3.3 Waters
	Cool Season	October 20	November 24	All Table 3.1 Waters	All Table 3.3 Waters
2020	Warm Season	May 10	September 20	All Table 3.1 Waters	All Table 3.3 Waters
	Cool Season	October 18	November 22	All Table 3.1 Waters	All Table 3.3 Waters
2021	Warm Season	May 9	September 20	All Table 3-1 Waters	All Table 3-3 Waters
	Cool Season	October 17	November 22	All Table 3-1 Waters	All Table 3-3 Waters
2022	Warm Season	May 8	September 20	All Table 3-1 Waters	All Table 3-3 Waters
	Cool Season	October 16	November 22	All Table 3-1 Waters	All Table 3-3 Waters
2023	Warm Season	May 7	September 20	All Table 3-1 Waters	All Table 3-3 Waters
	Cool Season	October 15	November 22	All Table 3-1 Waters	All Table 3-3 Waters

Table 10-2. Sample schedule for Priority 3 waters during dry weather conditions (2020 - 2023)

Year	First Week of Sampling	Last Week of Sampling	Priority 3 Waters
2020	May 10	November 29	**Group 4**: Santa Ana River Reach 4
	May 10	June 7	**Group 5**: Goldenstar Creek
	June 14	July 12	**Group 6:** Warm Creek, San Timoteo Creek
	July 19	August 16	**Group 2**: Borrego Creek, Serrano Creek
	August 23	September 20	**Group 3**: Los Trancos Creek, Morning Canyon Creek, Buck Gully Creek
	October 25	November 29	**Group 1**: Bolsa Chica Channel
2021	June 13	July 11	Group 4: Santa Ana River Reach 4
	June 13	July 11	Group 5: Goldenstar Creek
	TBD	TBD	Group 1: Bolsa Chica
	August 22	September 19	Group 6: Warm Creek, San Timoteo Creek
	August 15	September 19	Group 2: Serrano Creek
2022	July 10	August 7	Group 1: Bolsa Chica
	August 14	September 11	Group 4: Santa Ana River Reach 4
	August 14	September 11	Group 5: Goldenstar Creek
	July 10	August 7	Group 6: Warm Creek, San Timoteo Creek
	May 29	June 26	Group 2: Serrano Creek
2023	May 21	June 18	Group 1: Bolsa Chica
	July 2	July 30	Group 5: Goldenstar Creek
	July 2	July 30	Group 4: Santa Ana River Reach 4
	May 14	June 11	Group 6: Warm Creek, San Timoteo Creek
	July 9	August 13	Group 2: Serrano Creek

11. Sampling Methods

11.1 Sample Collection

Dry weather sampling at priority sites should only occur under dry weather conditions defined as no measurable rainfall within a 72-hour period prior to sampling. During dry weather conditions, if flow is elevated due to non-wet weather sources, e.g., upstream dam releases or dewatering activities, sample collection should still occur as long as conditions are safe. The elevated water levels will be documented on the field data sheet and flow will be estimated (see Section 11.3).

11.1.1 Water Samples

In-stream sampling consists of grab samples collected approximately mid-stream and at the water surface during designated sample activities following sampling methods provided below. Water samples are best collected before any other work is done at the site. If other work is done prior to the collection of water samples (for example, flow measurements or other field measurements), bottom sediment may be disturbed into the water column, which many not reflect representative conditions for water chemistry and bacteria analyses.

To the extent practical, water samples are collected from a location in the stream (or storm drain as may be the case for urban or agricultural source evaluation activities) where the stream visually appears to be well-mixed and flowing. Ideally this would be at the centroid of the flow (*Centroid* is defined as the midpoint of that portion of the stream width that contains 50% of the total flow), but depth and flow do not always allow collection of samples from the centroid location. Ultimately, the selection of the best location to collect water samples is based on best professional judgment. In addition, the sample should be collected in an area free of debris or algae. Samples shall not be collected if conditions are determined to be unsafe during an on- site assessment by the field team leader. Photo documentation shall be provided to illustrate unsafe conditions and the specific issues of concern shall be noted on the field form.

For sites where the samples will be taken from a distance, a sampling pole will be used. This sampling pole is approximately 7 feet long and has a mechanism that holds the sample bottle in place. The mechanism should be sterilized in the field with a 70 percent ethanol solution prior to the collection of each sample. After being cleaned with ethanol (70%) the sampling pole should be rinsed thoroughly. Allow the pole to air-dry before the sample is taken. A similar sampling pole that extends to a greater height may be used for sites where sampling from a bridge is necessary.

Tables 11-1 and 11-2 summarizes information relevant to sample collection. The following text lists steps to take when collecting a water sample, (including, but not limited to steps from *EPA's Volunteer Stream Monitoring: A Methods Monitoring Manual*, EPA 841-B-97-003, November 1997):

(1) Label each sample container with a site identification number (Site ID), sample identification number (Sample ID), analysis information, project identification number (Project ID), date, and time (ideally, some of this information may be pre-labeled on the containers). After sampling, if waterproof labels are not used, secure the label by taping it around the bottle with clear packaging tape.

(2) For *E. coli* and Enterococci samples the sterilized bottle will contain sodium thiosulfate for chlorine elimination. For ammonia and potassium samples, the bottles will contain sulfuric acid and nitric acid for preservation, respectively. Therefore, the bottles for analysis of these constituents cannot be held under the water to collect a sample. In contrast, the sterilized TSS bottle contains no preservatives and no such restrictions exist.

(3) When wading (if applicable) to the sampling point, try not to disturb bottom sediment before collection of a sample.

a. To collect a water sample with a bottle containing a preservative, stand in the water facing upstream. Open the lid carefully; at all times, avoid touching the inside of the bottle or cap. If you accidentally touch the inside of the bottle or cap, use another bottle. The sample should be collected from the surface from your upstream side, i.e., in front of you, by holding the bottle at an angle so that the preservative does not flow out and sample does not overflow the bottle. Fill the bacteria bottle to the 100 or 125 mL mark. Do not overfill the sample bottles (so the sample can be shaken before analysis). Recap the bottle, remembering not to touch the inside.

b. To collect a water sample with a bottle without preservative, stand in the water facing upstream. The sample should be collected from the surface from your upstream side, i.e., in front of you, by holding the bottle upright under the surface while it is capped. Open the lid carefully to let the water run in. At all times, avoid touching the inside of the bottle or cap. If you accidentally touch the inside of the bottle or cap, use another bottle. Once the bottle is filled, recap the bottle, remembering not to touch the inside.

c. An alternative approach to (3).a and (3).b above is to use a separate sterilized bottle to collect a water sample to transfer to the sample containers with or without preservatives. If using a sterilized transfer vessel for both TSS and *E. coli* samples, water can then be decanted from this bottle (after shaking the sample) into the sample containers that will be submitted to the laboratory.

(4) When flow is too shallow to collect a surface sample, such as when there is sheet flow across a channel, the sample should be collected at a location where there is greater water depth, such as at a seam in the channel, or near an obstruction, or where the flow spills over a concrete apron or lip. Follow the sample collection procedures for bottles with and without preservative as described above.

If there are no features in the channel that increase water depth and it is not possible to fill the bottle directly from the flow, then carefully collect a sample as follows (adapted from *Standard Operating Procedure for the Collection of Bacteria Samples from Storm Drains and Receiving Waters (Creeks, lagoons, bays, and ocean) for the City of San Diego 2002-03 Coastal Monitoring Annual Report*):

Use a clean, sterile syringe to collect a water sample from the surface without sampling floating particulates, yet far enough away from the bottom to avoid suction of soil, silt, and organic matter. Care should be taken to not touch the tip of the syringe. Draw back the plunger slowly while monitoring the syringe for organic matter, silt, sand, and floating particulates. Without

touching the syringe to the sample bottle, dispense the sample into the sample bottle. Repeat until the sample bottle is full. Appropriately discard used syringe after each sample.

Alternatively, a sampler can deploy waddles to further channelize the flow and increase the depth available to sample from. When doing so, the sampler will ensure that the deployment of the waddles does not disturb the channel bed causing increased sedimentation in the sample collected. If sediment disturbance occurs, the sampler will wait until the channel returns to normal conditions prior to collecting the sample.

(5) Place the bottles in a resealable plastic bag in a cooler with cold packs for transport to the laboratory. The maximum holding time prior to water quality analysis for bacteria concentrations is 6 hours; the maximum holding time prior to *Bacteroides* analysis is 24 hours. Bottles will be provided by the laboratories for each sample and depending on the water quality analyses required may include:

(a) Water quality analysis laboratory – A single 100 to 125 mL bottle for *E. coli* or Enterococci, one 1,000 mL bottle for TSS, one 500 mL bottle for surfactants, a single 500 mL bottle for potassium, and a 100 mL bottle for ammonia

(b) OCWD – One 1,000 mL bottle for *Bacteroides* analysis

(6) Field QA Samples:

(a) *Field Equipment Blanks*

(i) *Regional Monitoring Program and TMDL Program Monitoring (wet weather and Tier 1)* - One set of field equipment blank samples (equal volume for each constituent) will be included for 5% of total samples collected in a sampling season.

- Sterile deionized (DI) water is poured through any equipment used to collect *E. coli* or Enterococci samples at the site where the field equipment blank is being collected and then into the 100 or 125 mL *E. coli* sample containers.

- For the *Bacteroides*/qPCR analysis equipment blanks, high purity water (in amber bottles) from an approved laboratory will be poured into the 1 liter sample bottle.

- For the TSS field equipment blank, distilled water is poured through any equipment used to collect the TSS sample at the site where the field equipment blank is being collected and then into the 1 liter TSS sample bottle. If no equipment is used to collect the TSS sample, then the distilled water is poured directly into the 1 liter TSS sample bottle.

- One set of field equipment blank samples will be collected for 5% of the total samples collected in a sampling season.Collection of blank samples will be selected on a rotational basis.

(ii) *Urban Source Evaluation Program Tier 2 Monitoring* – No field equipment blanks are collected.

(b) *Field Replicates* – Field replicates are taken by collecting two sets of samples at the same location within five minutes of each other. Field replicates are collected as follows:

(i) *Regional Monitoring Program Sites* – One set of field replicates will be collected at 5% of the total samples collected in a sampling season and will be conducted at Priority 1, 2, 3 or 4 sites. The site for collection of replicate samples will be selected on a rotational basis (if more than one site sampled during a sample event).

(ii) *MSAR Bacteria TMDL Wet Weather Event* – During the four day sample event, replicates are collected from one site on one day of collection. Site and day is randomly selected.

11.1.2 Sediment and Biofilm Samples

Sampling of sediment or biofilms may occur as part of Tier 1 or Tier 2 sampling events (see Section 6.3.2.2) to support TMDL-related source evaluation activities. Surface sediment and biofilm grab samples will be collected from the midpoint of shallow, wadable channel and stream widths. When multiple samples are collected along a transect of the stream, sample locations should reflect 25 percent, 50 percent, and 75 percent of the stream width. In cases where both water and samples are collected from the same study site, water should be collected first and care should be taken to not disturb the sediment.

The following lists contain specific steps to take when collecting a sediment sample (adapted from *EPA's Field Sampling Guidance Document #1215 for Sediment Sampling*, September 1999):

(1) Label each container with Site ID, Sample ID, analysis information, Project ID, date, and time (some of this information may be pre-labeled on the containers). After sampling, secure the label by taping it around the bottle with clear packaging tape.

(2) When wading (if applicable) to the sampling point, do not disturb bottom sediment.

(3) Stand in the water, facing upstream. Collect the sediment and biofilm sample on your upstream side, i.e., in front of you.

(4) Use a sterile stainless steel or plastic scoop or similar equipment type to scoop sediment along the bottom of the waterbody surface in the upstream direction. For biofilms, scoop along the surface the biofilms are attached to. Do not use plated scoops (e.g., garden spades) as they can result in contamination of samples.

(5) Decant excess water without loss of fine particles from the scoop and deposit sediment into sterile sample container. Avoid touching the inside of the bottle or cap with anything but sample material. If you accidentally touch the inside, use another bottle. Fill the bottle leaving a 1-inch air space.

(6) Carefully recap the bottle without touching the inside of the container.

(7) Place the bottles in a resealable plastic bag in a cooler with cold packs for transport to the laboratory. The maximum holding time prior to water quality analysis for *E. coli* bacteria concentrations is 6 hours; the maximum holding time prior to *Bacteroides* analysis is 24 hours. Bottles will include a single, sterile 50 mL tube for both *E. coli* and bacterial indicator source analyses.

(8) Field QA Samples

(a) *Field Blanks* – One set of field equipment blanks will be collected at 5% of total samples collected in a sampling season. The site for collection of blank samples will be selected on a rotational basis. After blanks have been collected from all monitoring sites, the rotation will start again with the first monitoring site. To collect the sample, sterile deionized water is poured through any equipment used to collect samples at the site where the field equipment blank is being collected and then into the respective sample containers for each constituent.

(b) *Field Replicates* – Field replicates are taken by collecting two sets of samples at the same location within five minutes of each other. Field replicates will be collected at 5% of total samples collected in a sampling season. The site for collection of replicate samples will be selected on a rotational basis. After replicates have been collected from all monitoring sites, the rotation will start again with the first monitoring site.

11.2 Field Measurements

Field measurements are required at all monitoring sites except Tier 2 sites. For Tier 2 sites, field measurements will be made on an as needed basis where necessary to support the purposes of monitoring activities at these sites.

After collecting the water samples, record the water temperature, pH, conductivity, turbidity, and dissolved oxygen concentration. These parameters as well as other field data are measured and recorded using a multi-parameter probe. When field measurements are made with a multi-parameter instrument, sufficient time should be allowed for the instrument to equilibrate in the water before field measurements are recorded.

Field measurements are made at the centroid of surface flow if the stream visually appears to be completely mixed from shore to shore. For routine field measurements, the date, time and depth are reported as a grab. To provide QA/QC of field instruments and sampling personnel, three replicates of each field measurement will be collected at each site and averaged for reporting. Below is a brief discussion of each field parameter to be measured:

- *Dissolved Oxygen* – Calibrate the dissolved oxygen sensor on the multi-probe instrument at the beginning of each day of field measurements. Preferably, dissolved oxygen is measured directly in-stream close to the flow centroid. The dissolved oxygen probe must equilibrate for at least 90 seconds before dissolved oxygen is recorded to the nearest 0.1 mg/L. Since dissolved oxygen takes the longest to stabilize, record this parameter after temperature, conductivity, turbidity, and pH.

- *pH* – Preferably, pH is measured directly in-stream close to the surface flow centroid. If the pH meter value does not stabilize in several minutes, out-gassing of carbon dioxide or hydrogen sulfide or the

settling of charged clay particles may be occurring. If out-gassing is suspected as the cause of meter drift, collect a fresh sample, immerse the pH probe and read pH at one minute. If suspended clay particles are the suspected cause of meter drift, allow the sample to settle for 10 minutes, and then read the pH in the upper layer of sample without agitating the sample. With care, pH measurements should be accurately measured to the nearest 0.1 pH unit.

- *Conductivity* – Preferably, specific conductance is measured directly in-stream close to the surface flow centroid. Allow the conductivity probe to equilibrate for at least one minute before specific conductance is recorded to three significant figures (if the value exceeds 100 µS/cm). The primary physical problem in using a specific conductance meter is entrapment of air in the conductivity probe chambers. The presence of air in the probe is indicated by unstable specific conductance values fluctuating up to ±100 µS/cm. The entrainment of air can be minimized by slowly, carefully placing the probe into the water; and when the probe is completely submerged, quickly move it through the water to release any air bubbles.

- *Temperature* - Temperature is measured directly in-stream close to the surface flow centroid. Measure temperature directly from the stream by immersing a multi-parameter instrument.

- *Turbidity* - Turbidity is measured directly in-stream close to the surface flow centroid. Measure turbidity directly from the stream by immersing a multi-parameter instrument or use of a Hach turbidimeter.

11.3 Instantaneous Flow Monitoring

With one exception, flow measurements will be recorded by field personnel for every site visited using one of the methods described below. The exception is monitoring sites near a stream gage station that provides representative flow data for the monitoring site. The data from the gage station may be used instead of estimating flow in the field.

11.3.1 Visual Flow Estimate

Flow estimate data may be recorded for a non-tidally influenced stream when it is not possible to measure flows by the volumetric or cross section velocity profile methods described above either because flows are too high or so shallow that obtaining a velocity measurement is difficult or impossible. Visual flow estimates are subjective measures based on field personnel's experience and ability to estimate distances, depths, and velocities.

(1) Observe the stream and choose a reach of the stream where it is possible to estimate the stream cross section and velocity. Estimate stream width (feet) at that reach and record.

(2) Estimate average stream depth (feet) at that reach and record.

(3) Estimate stream velocity (ft/s) at that reach and record. A good way to do this is to time the travel of a piece of floating debris. This can be done by selecting points of reference along the stream channel which can be used as upper and lower boundaries for an area of measurement. After establishing the boundaries, measure the length of the flow reach. One person stands at the upper end of the reach and drops a floating object and says “start.” A second person stands at the lower end of the reach and times the number of seconds for the floating object to float the reach. This measurement

is conducted three times and the three results are averaged. The velocity is the length of the reach in feet divided by the average time in seconds.

(4) If doing this method from a bridge (for example, because flows are too high to be in the channel), measure the width of the bridge. Have one person drop a floating object (something that can be distinguished from other floating material) at the upstream side of the bridge and say "start". The person on the downstream side of the bridge will stop the clock when the floating object reaches the downstream side of the bridge. Divide the bridge width by the number of seconds to calculate the velocity. The velocity should be measured at multiple locations along the bridge at least three times. These velocities are averaged.

(5) Multiply stream width (feet) by average stream depth (feet) to determine the cross sectional area (ft^2) which when multiplied by the stream velocity (ft/s) and a correction constant, gives an estimated flow (ft^3/s).

11.3.2 Measured Flow Estimate

Where possible, volumetric measurements will be collected according to the following procedures:

- *Volumetric Flow (Q) Estimate* - Where possible, a volumetric flow measurement approach will be used. This method shall not be used if conditions are determined to be unsafe by an on-site assessment by the field team leader. A volumetric flow measurement entails estimation of the time in seconds (*t*) required to fill a 5 gallon bucket with concentrated runoff. Sites with low flow and a free outfall would allow for this type of flow measurement. The following equation would then give the flow rate for a test with one 5-gallon bucket of volume captured, Q (cfs or ft^3/sec) = 0.67 * *t*. If there are multiple points where runoff is concentrated, then volumetric measurements can be made at each point along the stream and summed to provide total discharge. Alternatively, temporary sandbags or similar structures can be used to facilitate concentration of flow prior to volumetric flow measurements

  If volumetric measurements are not feasible at a site, then a depth-velocity estimate will be developed according to the cross-section velocity profile procedures.

  - *Float (Orange Peel) Velocity Method* – This methodology follows a similar approach as Visual Flow Estimate but is used when flows are not too high and it is safe to record stream cross section measurements.

    - Observe the stream and choose a reach of the stream where it is possible to measure the stream cross section and velocity. Measure stream width (feet) at that reach and record.

    - Measure average stream depth (feet) at that reach and record.

    - Estimate stream velocity (ft/s) at that reach and record. A good way to do this is to time the travel of a piece of floating debris. This can be done by selecting points of reference along the stream channel which can be used as upper and lower boundaries for an area of measurement. After establishing the boundaries, measure the length of the flow reach. One person stands at the upper end of the reach and drops a floating object and says "start." A second person stands at the lower end of the reach and times the number of seconds for the

floating object to float the reach. This measurement is conducted three times and the three results are averaged. The velocity is the length of the reach in feet divided by the average time in seconds. Alternatively, temporary sandbags or similar structures can be used to facilitate concentration of flow prior to volumetric flow measurements.

- Multiply stream width (feet) by average stream depth (feet) to determine the cross sectional area (ft^2) which when multiplied by the stream velocity (ft/s) and a correction constant, gives an estimated flow (ft^3/s).

- *Cross-Section Velocity Profile Flow Measurement* - The following steps guide the development of a velocity profile for a streamflow cross section. This approach will require that the field personnel be equipped with a Marsh-McBirney flow meter or equivalent, top-setting wading rod (preferably measured in tenths of feet), and a tape measure (with gradations every tenth of a foot). The following procedure is used to collect data:

  - The measuring tape across the stream at right angles to the direction of flow. When using an electronic flow meter, the tape does not have to be exactly perpendicular to the bank (direction of flow). Avoid measuring flow in areas with back eddies. The first choice would be to select a site with no back eddy development. However, this cannot be avoided in certain situations. Measure the negative flows in the areas with back eddies.

  - Record the following information on the flow measurement form (Attachment F):

    - Site Location and Site ID
    - Date
    - Time measurement is initiated and ended
    - Name of person(s) measuring flow
    - Note if measurements are in feet or meters
    - Total stream width and width of each measurement section
    - For each measurement section, record the mid-point, section depth, and flow velocity

  - Determine the spacing and location of flow measurement sections. Measurements will be taken at the midpoint of each of the flow measurement sections. Flow measurements will be taken at the following points at a stream site, as shown in Figure 5-4.

    - A point from the left bank representing 10% of the total width. This measurement will provide a velocity estimate for the section representing 0 % – 20% of the total width from the left bank;
    - A point from the left bank representing 50% of the total width. This measurement will provide a velocity estimate for the section representing 20 % – 80% of the total width from the left bank;

        - A point from the left bank representing 90% of the total width. This measurement will provide a velocity estimate for the section representing 80 % – 100% of the total width from the left bank;

    - Place the top setting wading rod at each flow measurement point.
    - Using a tape measure, measure the depth of water to the nearest ½ inch.
    - Adjust the position of the sensor to the correct depth at each flow measurement point. The purpose of the top setting wading rod is to allow the user to easily set the sensor at 20%, 60%, and 80% of the total depth. On the wading rod, each single mark represents 0.10 foot, each double mark represents 0.50 foot, and each triple mark represents 1.00 foot (Figure 5-3). Position the meter at 60% of the total depth from the water surface (if depth of flow is greater than 2.5 feet, then take two readings, at 20% and 80% of total depth).
    - Measure and record the velocity and depth. The wading rod is kept vertical and the flow sensor kept perpendicular to the cross section. Permit the meter to adjust to the current for a few seconds. Measure the velocity for a minimum of 20 seconds with the Marsh-McBirney meter. When measuring the flow by wading, stand in the position that least affects the velocity of the water passing the current meter. The person wading stands a minimum of 1.5 feet downstream and off to the side of the flow sensor.
    - Report flow values less than 10 ft^3/s to two significant figures. Report flow values greater than 10 ft^3/s to the nearest whole number, but no more than three significant figures.
    - Calculate flow by multiplying the width *x* depth (ft^2) to derive the area of each of the three flow measurement sections. The area of the section is then multiplied by the velocity (ft/s) to calculate the flow in cubic feet per second (cfs or ft^3/sec) for each flow measurement section. Do not treat cross sections with negative flow values as zero. Negative values obtained from areas with back eddies should be subtracted during the summation of the flow for a site. When flow is calculated for all of the measurement sections, they are added together for the total stream flow.

- *Continuous Flow Meter Deployment* – Flow sensing technologies are able to measure flow in pipes, natural channels, or lined channels without the need to develop a velocity-area profile. Deployment of flow sensors according to manufacturer specifications is another method that may be used to collect flow data from the monitoring stations.

Table 11-1. Sample collection for field measurements (see discussion in QAPP Section 10 or Monitoring Plan)

Sampling Location	Site ID Number	Matrix	Depth (units)	Analytical Parameter	No. Samples (w/replicates)	Sampling SOP	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ Analysis
QAPP Sections 6 & 10 or MP	See MP	Water	Centroid	Conductivity	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Centroid	Dissolved Oxygen	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Centroid	pH	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Centroid	Temperature	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Centroid	Turbidity	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Water surface	Flow	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Centroid	Ammonia	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Centroid	Chlorine	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Centroid	Copper	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Centroid	Surfactants	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement
QAPP Sections 6 & 10 or MP	See MP	Water	Water surface	Canine Scent Tracking	QAPP Sections 10 & 11 or MP	Section 11.2	Instream	NA	NA	NA: Site measurement

Table 11-2. Sample collection for constituents for laboratory analysis (also see discussion in QAPP Section 10 or Monitoring Plan)

Sampling Location	Site ID Number	Matrix	Depth (units)	Analytical Parameter	No. Samples (w/replicates)	Sampling SOP	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ Analysis
Laboratory Analyses										
QAPP Sections 6 & 10 or MP	See MP	Water	Water surface	*E. coli*	QAPP Sections 10 & 11 or MP	Section 11.1.1	100 or 125 mL	1 bottle, 125 mL, sterile plastic (high density polyethylene or polypropylene)	Sodium thiosulfate pre-added to containers in the laboratory (chlorine elimination). Cool to 4 °C; dark	6 hours at 4 °C, dark; laboratory must be notified well in advance
QAPP Sections 6 & 10 or MP	See MP	Water	Water surface	Enterococci	QAPP Sections 10 & 11 or MP	Section 11.1.1	100 or 125 mL	1 bottle, 125 mL, sterile plastic (high density polyethylene or polypropylene)	Sodium thiosulfate pre-added to containers in the laboratory (chlorine elimination). Cool to 4 °C; dark	6 hours at 4 °C, dark; laboratory must be notified well in advance
QAPP Sections 6 & 10 or MP	See MP	Sediment	Sediment surface	*E. coli*	QAPP Sections 10 & 11 or MP	Section 11.1.2	125 mL	10 grams	1 50 mL sterile conical tube	Cool to 4 °C, dark
QAPP Sections 6 & 10 or MP	See MP	Water	Water surface	TSS	QAPP Sections 10 & 11 or MP	Section 11.1.1	1000 mL	1 bottle, 1000 mL, cool to 4 °C, dark	Cool to 4 °C, dark	7 days at 4 °C, dark
QAPP Sections 6 & 10 or MP	See MP	Water	Water surface	Ammonia	QAPP Sections 10 & 11 or MP	Section 11.4.2	100 mL	1 bottle, 100 mL, cool to 4 °C, high density polyethylene, dark	Sulfuric acid pre-added to containers in the laboratory. Cool to 4 °C, dark	28 days at 4 °C, dark
QAPP Sections 6 & 10 or MP	See MP	Water	Water surface	Potassium	QAPP Sections 10 & 11 or MP	Section 11.4.2	500 mL	1 bottle, 100 mL, cool to 4 °C, high density polyethylene or glass, dark	Nitric acid pre-added to containers in the laboratory. Cool to 4 °C, dark	6 months at 4 °C, dark
QAPP Sections 6 & 10 or MP	See MP	Water	Water surface	Surfactants	QAPP Sections 10 & 11 or MP	Section 11.4.2	500 mL	1 bottle, 100 mL, cool to 4 °C, high density polyethylene or glass, dark	Cool to 4 °C, dark	48 hours at 4 °C, dark
Molecular Analyses										
QAPP Sections 6 & 10 or MP	See MP	Water	Water surface	*Genetic markers for human and canine (Bacteroides thetaiotaomicron), horse (Bacteroides spp.), bird (Heliobacter), pig (Bacteroidales spp.) and rumen (Prevotella)*	QAPP Sections 10 & 11 or MP	Section 11.1.1	Varies	1 bottle, 1000 mL, cool to 4 °C; dark	Cool to 4 °C; dark	24 hours at 4 °C, dark; laboratory must be notified in advance
QAPP Sections 6 & 10 or MP	See MP	Sediment	Sediment surface	*Genetic markers for human and canine (Bacteroides thetaiotaomicron), horse (Bacteroides spp.), bird (Heliobacter), pig*	QAPP Sections 10 & 11 or MP	Section 11.1.1	10 grams	1 50 mL sterile conical tube	Cool to 4 °C; dark	24 hours at 4 °C, dark; laboratory must be notified in advance

				(*Bacteroidales spp.*) and rumen (*Prevotella*)						

(1) Stretch the measuring tape across the stream at right angles to the direction of flow. When using an electronic flow meter, the tape does not have to be exactly perpendicular to the bank (direction of flow). Avoid measuring flow in areas with back eddies. The first choice would be to select a site with no back eddy development. However, this cannot be avoided in certain situations. Measure the negative flows in the areas with back eddies. If necessary and possible, modify the measuring cross section to provide acceptable conditions by building dikes to cut off dead water and shallow flows, remove rocks, weeds, and debris in the reach of stream one or two meters upstream from the measurement cross section. After modifying a streambed, allow the flow to stabilize before starting the flow measurement

(2) Record the following information on the flow measurement form (Attachment 3):

(a) Monitoring site and Site ID

(b) Date

(c) Time measurement is initiated and ended

(d) Name of person(s) measuring flow

(e) Note if measurements are in feet or meters

(f) Total stream width and width of each measurement section

(g) For each cross-section, record the mid-point, section depth, and flow velocity

(3) Determine the spacing and location of flow measurement sections. Measurements will be taken at the midpoint of each of the flow measurement sections. Flow measurements will be taken at the following locations:

(a) A point from the left bank representing 10 percent of the total width. This measurement will provide a velocity estimate for the section representing 0 percent – 20 percent of the total width from the left bank.

(b) A point from the left bank representing 50 percent of the total width. This measurement will provide a velocity estimate for the section representing 20 percent – 80 percent of the total width from the left bank.

(c) A point from the left bank representing 90 percent of the total width. This measurement will provide a velocity estimate for the section representing 80 percent – 100 percent of the total width from the left bank.

(4) Place the top setting wading rod at each flow measurement point.

(5) Using a tape measure, measure the depth of water to the nearest ½ inch.

(6) Adjust the position of the sensor to the correct depth at each flow measurement point. The purpose of the top setting wading rod is to allow the user to easily set the sensor at 20 percent, 60 percent, and 80 percent of the total depth. On the wading rod, each single mark represents 0.10 foot, each double mark represents 0.50 foot, and each triple mark represents 1.00 foot. Position the meter at 60 percent of the total depth from the water surface (if depth of flow is greater than 2.5ft, then take two readings, at 20 percent and 80 percent of total depth).

(7) Measure and record the velocity and depth. The wading rod is kept vertical and the flow sensor kept perpendicular to the cross section. Permit the meter to adjust to the current for a few seconds. Measure the velocity for a minimum of 20 seconds with the Marsh-McBirney meter. When measuring the flow by wading, stand in the position that least affects the velocity of the water passing the current meter. The person wading stands a minimum of 1.5 feet downstream and off to the side of the flow sensor.

(8) Report flow values less than 10 ft^3/s to two significant figures. Report flow values greater than 10 ft^3/s to the nearest whole number, but no more than three significant figures.

(9) Calculate flow by multiplying the width x depth (ft^2) to derive the area of each flow measurement section. The area of the section is then multiplied by the velocity (ft/s) to calculate the flow in cubic feet per second (cfs or ft^3/sec) for each flow measurement section. Do not treat cross sections with negative flow values as zero. Negative values obtained from areas with back eddies should be subtracted during the summation of the flow for a site. When flow is calculated for all of the measurement sections, they are added together for the total stream flow.

11.4 Secondary Screening Tools

The following is a summary of secondary screening tools that can be used while conducting Tier 2 source evaluation activities.

11.4.1 Storm Drain Visual Observations (including flow)

Determination of flow within a storm drain during dry weather can provide an understanding of the magnitude of a potentially illicit discharge during dry weather.

11.4.1.1 Manhole Cover Removal Procedures

Underground MS4 systems may require the removal of manholes to assess the presence of dry weather flow. The process for removing the manhole cover is based on the process described as follows (Center for Watershed Protection, *Illicit Discharge Detection and Elimination Guide* (2004):

(1) Locate the manhole cover to be removed.

(2) Divert road and foot traffic away from the manhole using traffic cones. For more information on traffic control, see the California Manual on Uniform Traffic Control Devices guideline for temporary traffic control (2006).

(3) Use the tip of a crowbar to lift the manhole cover up high enough to insert the gas monitor probe. Take care to avoid creating a spark that could ignite explosive gases that may have accumulated under the lid.

(4) Follow procedures outlined for the gas monitor to test for accumulated gases.

(5) If the gas monitor alarm sounds, close the manhole immediately. Do not attempt to open the manhole until sometime is allowed for gases to dissipate.

(6) If the gas monitor indicates the area is clear of hazards, remove the monitor probe and position the manhole hook under the flange. Remove the crowbar. Pull the lid off with the hook.

(7) When testing is completed and the manhole is no longer needed, use the manhole hook to pull the cover back in place. Make sure the lid is settled in the flange securely.

(8) Check the area to ensure that all equipment is removed from the area prior to leaving.

The following safety considerations should be taken into account when sampling from a manhole:

(1) Do not lift the manhole cover with your back muscles.

(2) Wear steel-toed boots or safety shoes to protect feet from possible crushing injuries that could occur while handling manhole covers.

(3) Do not move manhole covers with hands or fingers.

(4) Wear safety vests or reflective clothing so that the field crew will be visible to traffic.

(5) Manholes may only be entered by properly trained and equipped personnel and when all OSHA and local rules are followed.

References

California Department of Transportation (Caltrans). 2006. *California Manual on Uniform Traffic Control Devices for Streets and Highways, Part 6: Temporary Traffic Control*. Available online at: http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/pdf/camutcd/CAMUTCD-Part6.pdf

11.4.1.2 Storm Drain Visual Observations

Next, visually inspect inside the storm drain for the presence or absence of dry weather flow. If flow is present, other observations regarding the storm drain discharge may include presence of staining, odors, floatable materials, or colors. Record observations on field data sheet or log book.

11.4.1.3 Estimate Depth of Water in Storm Drain

If there appears to be a significant amount of flow, additional observations may be desired regarding the amount of water that is present within the storm drain. This procedure is loosely based on Oklahoma State Extension Service (2000) and US EPA (1989).

(1) Remove manhole as described in Section 11.4.1.1.

(2) Prepare steel measuring tape with lead weight at end or telescoping survey rod for use by running carpenter chalk along the last few feet of the tape or survey rod.

(3) Place the steel tape or survey rod into the manhole and ensure that they are completely submerged, reaching the bottom of the manhole. Care should be taken to ensure the steel tap or rod stay perpendicular to the bottom of the manhole and that the steel tape does not bend.

(4) Pull the tape or rod back up to ground surface and observe the point at which a color change between dry and wet chalk occurs. This line denotes the length of tape/road that was immersed in water.

(5) Record the depth measurement on field sheet or log book.

References

Center for Watershed Protection. 2004. *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*. Available online at: http://cfpub.epa.gov/npdes/docs.cfm?program_id=6&view=allprog&sort=name#iddemanual

Oregon State Extension Service. 2000. *Measuring Water Well Levels*. Available online at: http://extension.oregonstate.edu/catalog/pdf/ec/ec1368.pdf

US EPA. 1989. *Accuracy of Depth to Water Measurements*. Available online at: http://www.epa.gov/superfund/remedytech/tsp/download/accur.pdf

11.4.2 Field-based Monitoring Procedures

There are several useful monitoring procedures that can be used to conduct secondary screening to support bacteria source evaluation activities. The following section summarizes a menu of options that can be applied when evaluating potential sources of bacteria from an outfall or storm drain exhibiting dry weather flow.

11.4.2.1 Sample collection

Underground storm sewer sampling may be accomplished without entering the manhole by utilizing an intermediate sampling device, such as an extension pole with a sampling bottle/bag (Figure 11-1). Procedures adapted from Washington State Department of Ecology (2010).

(1) Manhole Sampling Method

(a) Remove manhole as described in Section 11.4.1.1.

(b) Prepare steel measuring tape with lead weight at the end or telescoping survey rod for use by running carpenter chalk along the last few feet of the tape or survey rod.

(c) Place the steel tape or survey rod into the manhole and ensure that they are completely submerged, reaching the bottom of the manhole. Care should be taken to ensure the steel tap or rod stay perpendicular to the bottom of the manhole and that the steel tape does not bend.

(d) Pull the tape or rod back up to ground surface and observe the point at which a color change between dry and wet chalk occurs. This line denotes the length of tape/road that was immersed in water.

(e) Record the depth measurement on field sheet or log book.

(2) Alternate Manhole Sampling

(a) Attach pre-cleaned tubing to peristaltic pump, exercising caution to avoid allowing tubing ends to touch any surface.

(b) Place one end of the tubing below the surface of the water. Avoid placing tubing near bottom of the channel where solids have settled.

(c) Hold the other end of the tubing over the opening of the sample container, exercising care not to touch the sampling container.

(d) Pump the necessary sample volume into the sample container and secure the lid.

Collect remaining samples including quality control samples.11.4.2.2 Ammonia Test Strips
Nitrogen is a fundamental nutrient in the aquatic ecosystem and is required for survival by all plants and animals. In aquatic ecosystems, nitrogen is present in different forms: nitrate, nitrite, ammonia, and organic nitrogen. Of particular interest to storm drain systems is ammonia-nitrogen, which could indicate illegal wastewater connections to the sanitary sewer system, poorly functioning septic systems, or wildlife.

Implementation of the following procedures will require that the field personnel be equipped with ammonia test strips by Hach or similar manufacturer.

(1) To use the ammonia test strips, gloves should first be donned. Appropriate gloves (latex or rubber) are worn ***at all times*** when handling samples or conducting test kit analyses. Other appropriate PPE should be worn, as required.

(2) A sample should then be collected from an outfall or storm sewer line using a sample dipper or other sample collection tool as described in Section 11.4.2.1.

(3) Samples for ammonia will be poured directly from the sample collection tool into a sample cup which will be rinsed three times with the sample.

(4) Analysis will proceed as directed on the ammonia test strip box but will generally proceed in the following manner:

(a) Remove one test strip from the box. Replace top of box tightly immediately.

(b) Dip the test strip into the water sample for the suggest time (5 to 30 seconds). The time the strip is submerged will depend on the brand of test strip. Vigorously move the strip up and down in the water, making sure the test strip pad is always submerged.

(c) Remove the test strip from the water and shake off any excess water. Wait the suggested amount of time for the test strip to change color.

(d) To read result, turn test strip over so that the testing pad is facing away from you.

(e) Compare the color of the test strip pad to the color chart above. Estimate results if the color on the test strip falls between two color blocks.

(5) The results of the analysis will be recorded on a field sheet or log book.

(6) The sample in the cup can be discarded and the sample cup should be rinsed twice with deionized water.

11.4.2.3 Chlorine Test Strips

Chlorine is used in water treatment and wastewater treatment processes to disinfect water. Presence of chlorine in storm drain discharges could indicate an illicit connection with the water supply system, wastewater effluent or another human source.

There are different types of chlorine analyses available for use in the field. Test strips are available from Hach for chlorine residual (i.e., free chlorine); test kits are also available using the N,N-Diethylparaphenylenediamine (DPD) method which will cause a color change which can then be evaluated using color discs or field spectrophotometers.

Procedures are provided in the following section for chlorine residual test strips. Other analyses should proceed as directed in test equipment SOPs.

(1) To use the chlorine test strips, gloves should first be donned. Appropriate gloves (latex or rubber) are worn at ***all times*** when handling samples or conducting test kit analyses. Other appropriate PPE should be worn, as required.

(2) A sample should be collected from an outfall or storm sewer line using a sample dipper or other sample collection tool as described in Section 11.4.2.1.

(3) Samples for chlorine will be poured directly from the sample collection tool into a sample cup which will be rinsed three times with the sample.

(4) Analysis will proceed as directed on the chlorine test strip box but will generally proceed in the following manner:

(a) Remove one test strip from the box. Replace top of box tightly immediately.

(b) Dip the test strip into the water sample for the suggest time (5 to 30 seconds). The time the strip is submerged will depend on the brand of test strip. Vigorously move the strip up and down in the water, making sure the test strip pad is always submerged.

(c) Remove the test strip from the water and shake off any excess water. Wait the suggested amount of time for the test strip to change color.

(d) To read result, turn test strip over so that the testing pad is facing away from you.

(e) Compare the color of the test strip pad to the color chart above. Estimate results if the color on the test strip falls between two color blocks.

(5) The results of the analysis will be recorded on a field sheet or log book.

(6) The sample in the cup can be discarded and the sample cup should be rinsed twice with deionized water.

11.4.2.4 Copper Test Strips

Copper is a metallic element essential to human growth and is literally found all over the world. Detection of copper during secondary screening may indicate an illicit discharge into the storm drain system from human sources, such as algicides, copper pipes, or electrical components.

There are different types of copper field analyses available for use. Test strips are available from Hach for copper providing readings between 0 and 3 mg/L while colorimetric test kits are also available and provide more precise readings between 0.2 and 5 mg/L.

Procedures are provided in the following section for copper test strips. Other analyses should proceed as directed in test equipment SOPs.

(1) To use the copper test strips, gloves should first be donned. Appropriate gloves (latex or rubber) are worn ***at all times*** when handling samples or conducting test kit analyses. Other appropriate PPE should be worn, as required.

(2) A sample should be collected from an outfall or storm sewer line using a sample dipper or other sample collection tool as described in Section 11.4.2.1.

(3) Samples for copper will be poured directly from the sample collection tool into a plastic sample cup which will be rinsed three times with the sample.

(4) Analysis will proceed as directed on the copper test strip box but will generally proceed in the following manner:

   (a) Remove one test strip from the box. Replace top of box tightly immediately.

   (b) Dip the test strip into the water sample for the suggest time (5 to 30 seconds). The time the strip is submerged will depend on the brand of test strip. Vigorously move the strip up and down in the water, making sure the test strip pad is always submerged.

   (c) Remove the test strip from the water and shake off any excess water. Wait the suggested amount of time for the test strip to change color.

   (d) To read result, turn test strip over so that the testing pad is facing away from you.

   (e) Compare the color of the test strip pad to the color chart above. Estimate results if the color on the test strip falls between two color blocks.

(5) The results of the analysis will be recorded on a field sheet or log book.

(6) The sample in the cup can be discarded and the sample cup should be rinsed twice with deionized water.

11.4.2.5 Surfactant/Detergent Colorimetric Screening

Many illicit discharges into storm drains will have elevated concentrations of surfactants and detergents. Industrial cleaning, commercial wash water and car washes may also be sources of surfactants and detergents in storm drains. Leaking sanitary sewers could also contribute detergents used in household cleaning.

Procedures are provided in the following section for the Hach Detergents Test Kit (Model DE-2). Other analyses should proceed as directed in test equipment SOPs.

(1) To use the detergent test kit, gloves should first be donned. Appropriate gloves (latex or rubber) are worn ***at all times*** when handling samples or conducting test kit analyses. Other appropriate PPE should be worn, as required.

(2) Prepare a sample from the outfall/storm drain dry weather discharge

(a) A sample should be collected from an outfall or storm sewer line using a sample dipper or other sample collection tool as described in Section 11.4.2.1.

(b) Rinse the test tube three times with sample water.

(c) Pour 20 mL directly from the sample collection tool directly into the provided test tube (20 mL will be the upper mark on the test tube).

(d) Add 12 drops of the Detergent Test Solution. Place stopper on test tube and shake to mix.

(e) Add chloroform to the lowest mark (5 mL) on the test tube. Chloroform is heavier than water and will sink. Place stopper on test tube and vigorously shake for 30 seconds. All test tube to stand for 1 minute to allow chloroform to separate.

(f) Using the draw off pipet provided in the test kit, remove water from the test tube and discard.

(g) Refill the test tube to the upper 20 mL mark with the Wash Water buffer. Then immediately use the draw off pipet to remove the Wash Water buffer and discard. This step washes away the remaining water sample.

(h) Should the sample be turbid, it may be necessary to filter the chloroform solution. If this is the case, the following steps should be followed:

(i) Place a small ball (about the size of a large pea) of glass wool in the filter thimble.

(ii) Using the draw off pipet, remove the chloroform and filter through the glass wool back into the test tube

(i) Refill the test tube to the upper mark with the Wash Water buffer, place stopper on the test tube and shake vigorously for 30 seconds. Allow to stand one minute to allow chloroform to separate.

(3) While waiting for the chloroform to separate, fill another test tube with demineralized water and place it in the left opening of the color comparator.

(4) Insert the test tube containing the prepared sample into the right opening of the color comparator.

(5) Hold the comparator up to a light and view through the two openings in the front. Rotate the Detergents Color Disc until a color match is obtained. Read the ppm Detergents from the scale window.

(6) The results of the analysis will be recorded on a field sheet or log book.

(7) The sample in the cup can be discarded into a container. The sample cup should be rinsed twice with deionized water and also poured into container for disposal at a later time.

If the color is darker than the highest reading on the color disc, a sample dilution can be performed. To prepare a 20:1 dilution, add 1 mL sample and filling test tube with demineralized water to the 20 mL mark. Follow sample preparation process outlined in Step 2 of this procedure and re-analyze the sample.

It should also be noted that this test may generate waste that is considered hazardous. This waste cannot be dumped into the sanitary sewer system but must be collected and disposed of properly

References

Center for Watershed Protection. 2004. *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*. Available online at: http://cfpub.epa.gov/npdes/docs.cfm?program_id=6&view=allprog&sort=name#iddemanual

11.4.2.6 Canine Scent tracking

The use of canines to track human sources of storm drain illicit discharges have been reported as an accurate method that results in very few false positives (Murray et al., 2011). Canine scent tracking should be used to assist in locating specific sources of human-specific bacteria within a storm drain system as follows.

(1) A provider of canine scent tracking should be contacted to secure a dog-handler pair to conduct the monitoring. One provider of canine scent tracking is Environmental Canine Services, LLC.

(2) If operating canine scent tracking in the field, proceed to storm drain of interest with dog-handler pair. If operating canine scent tracking in the laboratory or office, skip to next section.

(3) At a storm drain of interest, remove the manhole cover as described in Section 11.4.1.1

(4) Once the cover is removed, the handler will give the canine its individual search command and walk to the open structure.

(5) If the canine alerts at the storm drain, the handler will provide interpretation to confirm the presence or absence of human sewage in the storm drain.

(6) The results of the canine scent tracking should be recorded on a field data sheet or logbook.

Canine scent tracking may also be used in a laboratory or office setting as follows. Methods are adapted from the Ottawa County Health Department (2011).

(1) Contact a provider of canine scent tracking to secure a dog-handler pair. Prior to sampling, coordinate a time when sampling will be complete to meet dog-handler pair in a scent-neutral area.

(2) Proceed to storm drain of interest with sampling team only.

(3) At a storm drain of interest, remove the manhole cover as described in Section 11.4.1.1

(4) Once the cover is removed, proceed to take a sample according to procedures outlined in Section 11.4.2.1. Collect at least one 60 mL sample.

(5) Preserve sample on ice at 4 °C. Store for no longer than 8 hours.

(6) Proceed to scent-neutral area to conduct canine scent sampling. Canine scent sampling must be completed within 8 hours of sample collection.

(7) If canine alerts at the sample, the handler will provide interpretation to confirm the presence or absence of human sewage in the sample.

(8) The results of the canine scent tracking should be recorded on a field sheet or logbook.

References

Murray, Jill, Scott Reynolds, Patricia Holden, Laurie Van De Werfhorst. 2011. *Canine Scent and Microbial Source Tracking in Santa Barbara, California*. Water Environment Research Foundation Report U2R09.

Ottawa County Health Department. 2011. *Ottawa County Health Department's Beach Monitoring Project Quality Assurance Project Plan (QAPP)*.

12. Sample Handling and Custody

12.1 Pre-Sampling Procedures

Prior to the collection of field data, the sample team will complete the following activities:

(1) Prepare and calibrate a multi-parameter instrument for use in collecting field measurements prior to sampling (See the equipment operation manual for specific calibration instructions). Calibrations will be conducted by the Responsible Agency's Project QA Officer or Monitoring Manager or their designee. Sampling activities will not be conducted until calibrations can be completed per equipment operations manual.

(2) Gather equipment for measurement of field parameters, including multi-parameter instrument, applicable test strips and test kits, and, if sampling underground storm drains, sampling pole.

(3) Prepare and calibrate a portable Turbidity Meter (e.g., Hach or equivalent), as necessary.

(4) Prepare ice coolers with ice packs or crushed ice to transport samples to the laboratory.

(5) Obtain sample containers from laboratories, including bottles for field blanks and water collection bottles. For sampling underground storm drains, also obtain sterile whirl-pak® bags or equivalent, if necessary.

(6) Prepare pre-label sampling containers as appropriate, e.g., Site ID, Sample ID, and Project ID, and leave blank fields for date and time.

(7) Prepare a solution of 70 percent ethanol for field sterilization of sampling equipment.

(8) Pack a flat head screw driver – used to loosen the band that holds the sampling bottle to the sampling pole.

(9) Check safety gear, including rubber boots and waders, protective gloves, and safety vests.

(10) Pack a waterproof pen and field log book and/or field data sheets.

(11) Pack peristaltic pump and sterile tubing.

(12) Pack box cutter and razor blades.

(13) Pack duct tape.

(14) Prepare vehicle, including fueling.

(15) Pack supplies for shipping samples, if applicable.

(16) Pack chain of custody forms, field data sheets, camera with flash, and zip lock bags.

(17) Ensure keys to monitoring sites with locked access are available.

12.2 Field Documentation

Field crews are required to keep a field log or complete appropriate data forms. Field documentation will be completed using indelible ink, with any corrections made by drawing a single line through the error and entering the correct value. Electronic mobile databases may be used in place of a field log or data forms to directly input data from the field. Taking into account the type of sampling being conducted, e.g., Regional Monitoring Program vs. TMDL Program monitoring, the following items should be recorded in the field log or on data forms for each sample collected at each monitoring site (An example Field Data Sheet Form is included as Attachment 1):

- Date and time of sample collection.
- Site Name and Site ID.
- Unique identification numbers for any replicate or blank samples collected from the site.
- Site IDs of the proximate upstream and downstream sampling locations (for Tier 2 urban source evaluation screening investigations only).
- The results of any field measurements (conductivity, dissolved oxygen, flow, pH, temperature, turbidity, ammonia, chlorine, copper, and detergents) and the time that measurements were made. For underground storm drain sampling, depth measurements may be reported in place of flow.
- Qualitative descriptions of relevant water conditions (e.g., color, flow level, clarity, or odor) or weather (e.g., wind, rain) at the time of sample collection.
- For collection of samples to evaluate bacteria sources, a qualitative description of the surrounding drainage area including evidence of flow in street gutters, presence of road sediments and debris, and indications of excess irrigation. Also note the approximate surface area draining to the inlet.
- For bacteria source evaluation sites, when such characterizations are required, a characterization of the hydrologic connectivity of the surface flow at the site to the downstream impaired water to which it is tributary. If no connectivity is observed, then the characterization shall, at a minimum, describe the general distance between the point where surface flow ceases and the channel confluences with the downstream impaired water. If connectivity is observed, then the characterization shall, at a minimum, describe the typical width and depth of the surface flow reaching the downstream impaired water, any observations that suggest that flows have recently been higher than what is currently observed.
- A description of any unusual occurrences associated with the sampling of that site, particularly those that may affect sample or data quality.

Field crews are required to take digital photographs when sampling each site and maintain a photo log of all photographs taken. At a minimum, the following digital photographs should be taken at each site, regardless of the purpose for sampling:

- A photograph which shows a view of the waterbody upstream of the sample site;
- A photograph which shows a view of the waterbody downstream of the sample site; and

- Photographs which characterize the width and depth of flow and aesthetic characteristics such as water clarity and algal growth.

For Tier 2 urban source evaluations, the following photographs should be taken:

- A photograph which shows the drain inlet;
- A photograph which shows the sampling point inside the storm sewer (it may be necessary to utilize a camera with flash enabled);
- A photograph which shows the drainage area upstream of the sample site; and
- A photograph which shows the drainage area downstream of the sample site

To the extent possible, the photographs that provide an upstream and downstream view of the waterbody should be taken from the same point during each site visit. A photo log of all photographs taken at each sample site shall be maintained that documents the purpose of each photograph (for example, upstream or downstream view) and the date and time of the photograph.

12.3 Sampling Handling, Delivery to Laboratory and Chain of Custody

Proper gloves must be worn to prevent contamination of the sample and to protect the sampler from environmental hazards (disposable polyethylene, nitrile, or non-talc latex gloves are recommended). Wear at least one layer of gloves, but two layers help protect against leaks.. Safety precautions are needed when collecting samples, especially samples that are suspected to contain hazardous substances, bacteria, or viruses.

Properly store and preserve samples as soon as possible. Usually this is done immediately after returning from the collection by placing the containers on top of bagged, crushed or cube ice in an ice chest. Sufficient ice will be needed to lower the sample temperature to at least 4 °C within 45 minutes after time of collection. Sample temperature will be maintained at 4 °C until delivered to the appropriate laboratory. Care should be taken at all times during sample collection, handling, and transport to prevent exposure of the sample to direct sunlight.

Samples that are to be analyzed for bacterial indicators must be kept on ice or in a refrigerator and delivered to a qualified laboratory included in the appendices of this QAPP within 6 hours of sample collection.

Samples analyzed for *Bacteroides* must be kept on ice or in a refrigerator and delivered to a qualified laboratory included in the appendices of this QAPP within 24 hours of collection.

A detailed sample delivery schedule is presented in Tables 10-1 and 10-2 of this QAPP for collection of water samples from RMP Priority 1, 2, and 3 sites. Other monitoring programs have flexible schedules.

Samples will be delivered to analytical laboratories by the Responsible Agency's sampling personnel either directly or via courier.

Every shipment must contain a complete COC Form (see Attachment 2) that lists all samples taken and the analyses to be performed on these samples. COCs must be completed every time samples are transported to a laboratory. Include any special instructions to the laboratory. The original COC sheet (not the copies) is included with the shipment (insert into zip lock bag); one copy goes to the sampling coordinator; and the sampling crew keeps one copy. Samples collected should have the depth of collection and date/time collected on every COC.

Due to increased shipping restrictions, samples being sent via a freight carrier require additional packing. Although care is taken in sealing the ice chest, leaks can and do occur. Samples and ice should be placed inside a large plastic bag inside the ice chest for shipping. The bag can be sealed by simply twisting the bag closed (while removing excess air) and taping the tail down. Prior to shipping the drain plug of the ice chests have to be taped shut. Leaking ice chests can cause samples to be returned or arrive at the laboratory beyond the required holding time. Although glass containers are acceptable for sample collection, bubble wrap must be used when shipping glass.

13. Analytical Methods

Samples collected for the Regional and TMDL Monitoring Programs will be analyzed for various chemical and biological constituents. Field parameters will be monitored at the sampling sites using a multi-parameter water quality probe (or equivalent) and includes conductivity, dissolved oxygen, pH, temperature, and turbidity. Additional constituents (ammonia, chlorine, copper, and surfactants) will be quantified in the field using Hach Company water chemistry kits. Samples for biological constituents, *E.coli*, Enterococci and *Bacteroides*, and other chemical constituents will be quantified at a qualified laboratory.

Multiple EPA approved methods may be used to analyze *E.coli* or Enterococci concentrations in water samples including (a) EPA Method 1603, Standard Methods (SM) 9223B, and IDEXX (18 hour) for *E coli*; and (b) EPA Method 1600 and IDEXX Enterolert for Enterococci. Sediment samples will be sonicated to release all *E.coli* from sediment and biofilms and then analyzed using method EPA 1603.

Analytical methods used to quantify constituent levels are summarized in Tables 13-1 and 13-2.

Table 13-1. Analytical methods for field parameters

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Target Reporting Limit (units, wet or dry weight)	Field Method	
				Analytical Method/ SOP[2]	Modified for Method (Yes/No)
Conductivity[1]	Field monitoring	1.09 µS/cm	0 - 100 µS/cm	SM 2510B	No
Dissolved Oxygen	Field monitoring	5 mg/L	0 - 19.9 mg/L	SM 4500OG	No
pH	Field monitoring	6.5 to 8.5	0 – 14 pH Units	SM 4500-H+B	No
Temperature (water)[3]	Field monitoring	June to Oct: not > 90 °F (32°C); Rest of Year: not > 78°F (25°C) as a result of controllable water quality factors	0 – 50 °C	SM 2550B	No
Turbidity	Field monitoring	5 to 10 Nephalometric Units (NTU)	0 – 800 NTU	SM 2130B	No
Flow	Field monitoring	NA	-0.5 to 19.99 ft/sec	Cross-section velocity profile or Visual flow estimate (see text)	No
Ammonia[4]	Field monitoring	1 mg/L	0 – 6 mg/L[5]	NA	No
Chlorine[4]	Field monitoring	NA	0 – 10 mg/L[5]	NA	No
Copper[4]	Field monitoring	0.1 mg/L	0 – 3 mg/L[5]	NA	No
Surfactants[4]	Field monitoring	0.01 mg/L	0 – 3 mg/L[6]	NA	No
Canine Scent Tracking[4]	Field monitoring	Positive detection indicated by vocalization or active response	No positive response -- Positive response	NA	No

Notes:

[1] Project Action Limits: Applied Basin Plan Water Quality Objectives for conductivity by converting a total dissolved solids value of 700 ppm to a conductivity value.

[2] SM: *Standard Methods for the Examination of Water and Wastewater*, 20th edition.

[3] Urban Source Evaluation Monitoring Program will only measure water temperature

[4] Optional Tier 2 secondary screening methodologies; Project Action Limits based on potential ranges for chemical tracers indicating sewage, as indicated in monitoring plan.

[5] Target Reporting Limit based on test kits sold and distributed by Hach; other manufacturers may specify alternative reporting limits.

[6] Target Reporting Limit based on test kit sold and distributed by Chemets; other manufacturers may specify alternative reporting limits.

Table 13-2. Laboratory analytical methods

Analyte	Laboratory/ Organization	Project Action Limit (units, wet or dry weight)	Target Reporting Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method (Yes/No)	Method Detection Limits	Method
E. coli	Varies	See notes below[1]	Varies	EPA 1603[2]	No	Not applicable	Varies[3]
E. coli	Varies	See notes below[1]	Varies	SM 9223B IDEXX 18HR	No	Not applicable	Varies[3]
Enterococci	Varies	See notes below[1]	Varies	EPA 1600	No	Not applicable	Varies[3]
Enterococci	Varies	See notes below[1]	Varies	IDEXX Enterolert	No	Not applicable	Varies[3]
Genetic markers for human, canine, pig, horse, bird, and rumen	TBD	qPCR and ddPCR	10 gene copies / 1000 mL	qPCR assays	No	Not applicable	10 gene copies/ 1000 mL
Total Suspended Solids	Varies	See notes below[4]	1.0 mg/L	SM 2540D	No	Not applicable	1.0 mg/L
Ammonia	Varies	1.0 mg/L; Ammonia/ Potassium Ratio > 0.6 mg/L	0.1 mg/L	SM 4500	No	Not applicable	0.1 mg/L
Ammonia	Varies	1.0 mg/L; Ammonia/ Potassium Ratio > 0.6 mg/L	0.1 mg/L	EPA 350.1	No	Not applicable	0.01 mg/L
Potassium	Varies	Ammonia/ Potassium Ratio > 0.6 mg/L	NA	EPA 200.7	No	Not applicable	1.0 mg/L
Surfactants (MBAS)	Varies	0.01 mg/L	NA	SM 5540C	No	Not applicable	0.01 mg/L

Notes:

[1] Project Action Limits for *E. coli* and TSS are as follows: (based on the TMDL): *E. coli*: 5-sample/30-day Logarithmic Mean less than 113 organisms/100 mL, and not more than 10% of the samples exceed 212 organisms/100 mL for any 30-day period.

[2] Sediment samples will be sonicated to release all *E. coli* from sediment and biofilms and then analyzed using method EPA 1603.

[3] The achievable laboratory limits are dependent on analytical methods and sample dilutions conducted by laboratories.

[4] TSS: in inland surface waters shall not contain suspended or settleable solids in amounts which cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors.

[5] The target reporting limits are dependent on analytical methods and volumes analyzed by laboratories.

14. Quality Control

All contract laboratories used to implement the SAR Bacteria Monitoring Plan will follow QA/QC programs in accordance with guidelines established by the State of California and the U.S. EPA. Laboratories are required to submit a copy of their SOPs for laboratory quality control to the Responsible Agency's Project QA Officer for review and approval (see Appendices to this QAPP for the SOPs of laboratories being used by this project).

All field and laboratory data will be entered by the Responsible Agency's Data Manager into a database/spreadsheet template provided by the Project Director. Annually, after the end of a sample year, each Responsible Agency's Project Manager will submit the previous sample year's completed database/spreadsheet to the Project Director to support preparation of the Annual Report. The Project Director will upload all previous sample year data collected by the RBMP to CEDEN. Special studies will need to be submitted to CEDEN separately by the Responsible Agency. Any electronic or paper files will be filed in the project archives maintained by the Project Director along with related materials such as field forms, chain of custody forms, photographs, correspondence, etc.

The Responsible Agency's Monitoring Manager or Project QA Officer will review all laboratory data and will request additional re-analysis of samples as warranted. Tables 14-1 through 14-3 describe Sampling (Field) QC activities. Tables 14-4, 14-5 and 14-6 describe Analytical QC activities.

Table 14-1. Field Sampling QC (Field Parameters)

Sample Matrix: Water		
• Sampling SOP: per Monitoring Plan and QAPP Sections 11 and 12 • Analytical Parameter(s): Field Parameters • Analytical Method/SOP Reference: NA		
Field QC	**Frequency**	**Acceptance Limits**
Other: Field Measurements	When taking readings, at least 1 minute or longer (if needed) shall be allowed for until stabilization of readings.	See Section 7, Table 7-1

Table 14-2. Field Sampling QC (TSS, Ammonia, Potassium, Surfactants)

Sample Matrix: Water		
• Sampling SOP: per Monitoring Plan and QAPP Sections 11 and 12 • Analytical Parameter(s): TSS, Ammonia, Potassium, Surfactants • Analytical Method/SOP Reference: TSS (SM 2540D); Ammonia (SM 4500); Ammonia (EPA 350.1); Potassium (EPA 200.7); Surfactants (SM 5540C)		
Field QC	**Frequency**	**Acceptance Limits**
Equipment Blanks	5 percent of samples collected	< Target reporting limit
Cooler Temperature	4 °C	4 °C
Field Replicate Pairs[1]	5 percent of total number of samples collected	< 25 percent

[1] Urban Source Evaluation Monitoring Program will not collect field replicates

Table 14-3. Field Sampling QC (*E. coli*, Enterococci, *Bacteroides*)

Sample Matrix: Water		
• Sampling SOP: per Monitoring Plan and QAPP Sections 11 and 12 • Analytical Parameter(s): *E. coli,* Enterococci*, Bacteroides* • Analytical Method/SOP Reference: *E. coli* (EPA 1603, SM 9223B, IDEXX 18HR); *Bacteroides* (presence/absence *Bacteroides thetaiotaomicron*)		
Field QC	**Frequency**	**Acceptance Limits**
Equipment Blanks	5 percent of samples collected	No detectable amounts or < 1/5 of sample concentration
Cooler Temperature	4 ºC	4 ºC
Field Replicate Pairs[1]	5 percent of total number of samples collected per sample event	< 25 percent

[1] Urban Source Evaluation Monitoring Program will not collect field replicates

Table 14-4. Laboratory analytical QC (TSS, Ammonia, Potassium, Surfactants)

Sample Matrix: Water		
• Sampling SOP: per Monitoring Plan and QAPP Sections 11 and 12 • Analytical Parameter(s): TSS, Ammonia, Potassium, Surfactants • Analytical Method/SOP Reference: TSS (SM 2540D); Ammonia (SM 4500); Ammonia (EPA 350.1); Potassium (EPA 200.7); Surfactants (SM 5540C)		
Laboratory QC	**Frequency/Number**	**Acceptance Limits**
Method Blank	1/20 samples or 1/ sample week	< Target Reporting Limit
Laboratory Duplicate	1/20 samples or 1/ sample week	< 25 percent
Laboratory Matrix Spike	1/20 samples or 1/ sample week	80 - 120
Matrix Spike Duplicate	1/20 samples or 1/ sample week	80 – 120; RPD < 25 percent

Table 14-5. Laboratory analytical QC (*E. coli,* Enterococci, *Bacteroides* - water)

Sample Matrix: Water		
• Sampling SOP: per Monitoring Plan and QAPP Sections 11 and 12 • Analytical Parameter(s): *E. coli,* Enterococci*, Bacteroides* • Analytical Method/SOP Reference: *E.coli* (EPA 1603); *E.coli* (SM 9223B); *E. coli* (IDEXX 18 hour); Enterococci (EPA 1600); Enterococci (IDEXX Enterolert); Genetic markers for human and canine *(Bacteroides thetaiotaomicron)*, horse *(Bacteroides spp.),* pig *(Bacteroodales spp.*), bird (*Heliobacter*), and rumen (*Prevotella*).		
Laboratory QC	**Frequency/Number**	**Acceptance Limits**
Method Blank	1/lot minimum	No detectable amounts
Laboratory Duplicate	10 percent of samples or one sample per test run	< 3.27*R*
Laboratory Control sample (Accuracy)	For each lot of medium received from manufacturer or prepared in laboratory	Verify appropriate response by testing with known positive and negative control cultures for the organism(s) under test

Table 14-6. Laboratory analytical QC (*E. coli, Bacteroides* - sediment/biofilm)

Sample Matrix: Sediment/Biofilm		
• Sampling SOP: per Monitoring Plan and QAPP Sections 11 and 12 • Analytical Parameter(s): *E. coli* • Analytical Method/SOP Reference: *E.coli* (EPA 1603); Genetic markers for human and canine *(Bacteroides thetaiotaomicron)*, horse *(Bacteroides spp.),* pig *(Bacteroodales spp.*), bird (*Heliobacter*), and rumen (*Prevotella*).		
Laboratory QC	**Frequency/Number**	**Acceptance Limits**
Method Blank	1/lot minimum	No detectable amounts
Laboratory Duplicate	10 percent of samples or one sample per test run	< 3.27*R*
Laboratory Control sample (Accuracy)	For each lot of medium received from manufacturer or prepared in laboratory	Verify appropriate response by testing with known positive and negative control cultures for the organism(s) under test

15. Instrument/Equipment Testing, Inspection, and Maintenance

All laboratories used to implement the SAR Bacteria Monitoring Plan will operate using QA/QC programs to maintain their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the analytical method. Laboratories are required to submit a copy of their SOPs for laboratory equipment maintenance to the QA Officer for review and approval (see Appendices to this QAPP for the SOPs of laboratories being used by this project).

Instruments used to gather field measurements (temperature, conductivity, dissolved oxygen, pH and turbidity) will be properly maintained and calibrated per the manufacturers' requirements (Table 15-1). Instruments will be tested prior to the start of field sampling day to verify that each instrument is operating appropriately. If the instrument fails to operate within appropriate parameters, the Responsible Agency's Project Manager in collaboration with the Monitoring Manager will take the appropriate steps to ensure that the equipment is repaired or replaced in a timely manner.

Table 15-1. Testing, inspection, maintenance of sampling equipment and analytical instruments

Equipment / Instrument	Maintenance Activity, Testing Activity or Inspection Activity	Responsible Person	Frequency	SOP Reference
Multi-parameter Probe	Maintenance and Calibrations	Responsible Agency Monitoring Manager	▪ Maintenance – conducted per manufacturer (mfg) specifications; ▪ Calibrations - prior to each sampling activity	Per manufacturer specifications
Marsh McBirney Model 2000 flow meter	Maintenance and Calibrations	Responsible Agency Monitoring Manager	▪ Maintenance – conducted per mfg specifications; ▪ Calibrations - prior to each sampling activity	Per manufacturer specifications
Laboratory analytical instruments for Conventional Constituents	Maintenance and Calibrations	Contract Laboratory Personnel	▪ Maintenance – conducted per mfg specifications; External calibration with 3 – 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the MDL. Linear regression $r^2 < 0.995$ ▪ Calibrations - verification every 20 samples after initial calibration. Standard source different than that used for initial calibration. Recovery 80% - 120%.	Per individual laboratory SOP manual and per equipment maintenance specifications

16. Instrument/Equipment Calibration and Frequency

All contract laboratories will implement QA/QC programs to calibrate their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the method. Contract laboratories are required to submit a copy of their SOPs for laboratory equipment calibration to each Responsible Agency's Project QA Officer for review and approval (see Appendices to this QAPP for the SOPs of laboratories being used by this project).

A Horiba or similar multi-parameter probe will be used to make field measurements for conductivity, dissolved oxygen, pH, temperature, and turbidity (a Hach turbidimeter may be used to measure turbidity). The instruments will be properly calibrated according to manufacturer specifications prior to each use (see Table 15-1).

A Marsh-McBirney Model 2000 flow meter will be used to make flow measurements. It will be properly calibrated according to manufacturer specifications prior to each use (see Table 15-1).

17. Inspection/Acceptance of Supplies and Consumables

Contract laboratories will supply all the sample containers necessary for the monitoring program. Other consumable supplies such as latex gloves, plastic storage bags, and waterproof pens will be provided by the Responsible Agency's Monitoring Manager or an appropriate designee (Table 17-1).

All laboratories will implement QA/QC programs to calibrate their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the method. Contract laboratories are required to submit a copy of their SOPs for laboratory equipment calibration to each Responsible Agency's Project QA Officer or its designee for review and approval (see Appendices to this QAPP for the SOPs of laboratories being used by this project).

Table 17-1. Inspection/acceptance testing requirements for consumables and supplies

Project-Related Supplies / Consumables	Inspection / Testing Specifications	Acceptance Criteria	Frequency	Responsible Individual
Sample bottles	Check integrity of bottles; check for preservatives (*E. coli*, Enterococci)	Ensure no cracks, intact bottle caps; preservative present	Prior to sample collection	Sampling Personnel
Sample bags	Look for tears/holes	Intact, no tears	Prior to sample collection	Sampling Personnel
Test strips	Check test strips for dampness, evidence of color change	Test strips are dry; no color change noted	Prior to use	Sampling Personnel
Colorimetric test kits	Presence/absence of all chemicals and test solutions	Ensure all necessary chemicals are in the kit	Prior to going to field	Sampling Personnel
Latex gloves	Look for tears/holes	Intact, no tears	Prior to use	Sampling Personnel
Storage bags, pens	Presence/absence of supplies	Ensure supplies are in field bin	Prior to going to field	Sampling Personnel

18. Non-Direct Measurements (Existing Data)

18.1 Data Sources and Uses

During the course of the implementation of the Regional and TMDL Monitoring Programs previously existing relevant water quality and flow data from the monitoring sites will be gathered and stored by the Project Director.

As required to meet program reporting requirements, water quality analyses will be periodically conducted by the Project Director to evaluate water quality data collected from monitoring sites. At a minimum, water quality data collected under the SAR Bacteria Monitoring Plan will be evaluated to determine the following:

- Compliance with applicable water quality objectives for REC1;
- Compliance with applicable antidegradation targets for waters classified as REC2 only;
- Progress towards achieving attainment of MSAR Bacteria TMDL WLAs/Las for *E. coli*; and
- Impairment status of waterbodies listed as impaired in the watershed but a TMDL has not been adopted.

As part of the effort to evaluate the above, water quality analyses will include descriptive statistics such as geometric mean and percentile calculations. In addition where appropriate, water quality results may be compared to historical data to assess temporal trends at monitoring sites. Descriptive data for each of the monitoring sites has been established in the SAR Bacteria Monitoring Plan (see Attachments A and B in the Monitoring Plan). These data are used by field sampling personnel to determine exact sample collection locations and provide information regarding how to best access the site.

18.2 Data Acceptability

Existing data are considered acceptable for inclusion in data analyses to support the purposes of this the monitoring program only if it meets the following criteria:

- Data was collected with an approved QAPP;
- The sampling methodology and timing are functionally equivalent, including the method for collecting the water samples and the timing of sample collection (e.g., collection during dry versus wet weather or collection from baseflows vs. storm flows); and
- The laboratory analysis methods are functionally equivalent.

Other existing data may be reviewed and discussed to provide additional waterbody or watershed information (e.g., data collected by entities other than those approved in this QAPP), but the use of the data is for qualitative purposes only and will not be incorporated into quantitative data analyses. If these data are used, the constraints associated with the use and interpretation of the data will be described.

19. Data Management

Data will be maintained as described in Section 9 (Documents and Records). During each sample year, each Responsible Agency's Project Manager will maintain an inventory of data and its forms, and will periodically check the inventory against the records in their possession. Data checks (which may be completed by the Monitoring Manager or the Project QA Officer) include:

- Samples are collected according to the procedures outlined in Section 10 (Sampling Process Design).
- Field measurements are recorded on standard Field Log forms included as Attachment 1. Analytical samples are transferred to a contract laboratory under required COC procedures using a standard COC form included as Attachment 2.
- For any site where a velocity cross section profile flow measurement is taken, standard forms are being used to record necessary measurements (Attachment 3).

All laboratory and field data submitted to the Project Director for upload into CEDEN will follow the guidelines and formats established by SWAMP http://www.waterboards.ca.gov/water_issues/programs/swamp/tools.shtml.

All contract laboratories will maintain a record of transferred records and will periodically assess their record of transferred records against those actually held by a Responsible Agency or the Project Director. Prior to submittal of data by a Responsible Agency to the Project Director, a QA/QC review of the data will be conducted by the Responsible Agency's Data Manager. When all data within a batch set (sample year) have passed QA/QC requirements, the Responsible Agency will submit the data to the Project Director for use in completing the Annual Report. A unique batch number, date loaded, originating laboratory, and the person who loaded the data will be recorded by the Project Director, so that data can be identified and removed in the future if necessary.

The Project Director will compile all data received from Responsible Agencies into a single project spreadsheet/database (annual master dataset). Prior to uploading the annual master dataset into CEDEN as a batch set, the Project Director will conduct an additional final QA/QC review of the data received from each Responsible Agency. The QA/QC review is conducted to:

- Ensure the completeness of the data for the prior sample year;
- Verify the validity of analytical methods, monitoring sites, and sample dates; and
- Ensure that monitoring site information is correctly referenced and that identifiers and descriptions match those provided in the SAR Bacteria Monitoring Plan and this QAPP.

The QA/QC review process implemented by a Responsible Agency or Project Director may involve using automated data checking tools, which assess that new data to be uploaded for consistency with specified rules, including rules that check alpha-numeric formatting, units of measurement, missing information, and others. Data not passing this QA/QC review will be returned to the originating contract laboratory or generator (e.g., a Responsible Agency) for clarification and or correction. Any changes made by the Project Director of data provided by a Responsible Agency will be noted in the annual master dataset.

Responsible Agencies are responsible for ensuring their annual sample year field and laboratory data electronic files are backed-up on a regular basis per the procedures/processes established by their respective agencies. While the Project Director will annually upload the previous sample year's field and laboratory data to CEDEN, the Project Director will maintain a local backup of all electronic files uploaded to CEDEN.

Data submittals from Responsible Agencies to the Project Director will occur by January 15 (dry weather samples) and April 15 (wet weather event samples) of each year and include all data collected in the previous sample year. The Project Director will upload data into CEDEN one time each year within 30 days of submittal of the Final Annual Report.

Group C: Assessment and Oversight

20. Assessments & Response Actions

Data reviews will occur prior to the preparation of the Annual Report (see Section 21). These reviews will be conducted by each Responsible Agency's Project QA Officer and Project Manager. Periodic reviews will always include review of the data to be entered into the SWAMP compatible database to evaluate data accuracy and completeness. Where appropriate, e.g., situations where the laboratory results frequently suggest data quality concerns, audits of laboratory or field sampling teams will be scheduled and conducted. The Santa Ana River Watershed Bacteria Monitoring Program Annual Report will include a data quality assessment section, which will provide documentation of any identified data quality concerns.

Failures in laboratory measurement systems should be documented by the laboratory analyst and corrective actions should be taken and documented in the laboratory record. If the failure is not resolved, it must be conveyed to the Responsible Agency's Project QA Officer who will determine if the analytical failure comprised associated results. The nature and disposition of the problem must be documented in the data report that is sent to the Project QA Officer.

If an audit discovers any discrepancy, the Responsible Agency's Project Manager and Project QA Officer will discuss the observed discrepancy with the Monitoring Manager. The discussion will begin with whether the information collected is accurate, what were the cause(s) leading to the data discrepancy, how the deviation might impact data quality, and what corrective actions might be considered.

The Responsible Agency's Project Manager and/or Project QA Officer have the power to halt all sampling and analytical work by field sample teams or contract laboratories if the data discrepancies noted are considered detrimental to data quality. Alternatively, a Project QA Officer can require that certain corrective actions be made within a defined time schedule. This approach may be used as a means to meet the monitoring schedule presented in Section 10.

If sampling work is halted for any reason, the Responsible Agency's Project Manager shall notify the Project Director and the Santa Ana Water Board Project Manager of the issue(s) and expected resolution – both approach and schedule.

21. Reports to Management

21.1. Periodic Reporting

Responsible Agency Project Managers may periodically share data and results from preliminary analyses from Priority site sampling efforts conducted under the SAR Bacteria Monitoring Plan. Other data collected under the SAR Bacteria Monitoring Plan, e.g., specialized studies, may be shared as well. RBMP data will be uploaded quarterly to a digital dashboard[35] maintained by SAWPA and CDM Smith. Additional data from other RBMP related studies may be added for analysis as well.

21.2 Annual Report

The Project Director will be responsible for the development of the Draft and Final Annual Reports and submittal of the Final Annual Report to the Santa Ana Water Board. After the completion of dry weather sampling each sample year (generally May 1 through November 30, see Section 10), the Project Director will send out a reminder to each Responsible Agency and Contract Laboratory to submit all program-related information described above to the Project Director by January 15th. After the completion of wet weather event sampling that will occur each sample year sometime between November 1 and March 31, the Project Director will send out a reminder to each Responsible Agency and Contract Laboratory to submit all program-related information described above to the Project Director by April 15th.

Under the SAR Bacteria Monitoring Program, the Project Director will prepare a Draft Annual Report by April 30th of each year to reflect findings from sampling conducted during the previous sample year (May 1 through April 30). Findings will include a presentation of the data results and any data analyses completed, e.g., descriptive statistics or trend analyses (see Section 7.3). Each Annual Report will include (a) findings from all RMP sites (See Section 3.3); and (b) findings from any additional required monitoring conducted to support implementation of a bacteria TMDL (e.g., see Section 4.1.1.2).

At a minimum, the Draft Annual Report will be submitted to each Responsible Agency and the Santa Ana Water Board for review. A Final Annual Report will be prepared based on the comments received on the Draft Annual Report. The Final Annual Report will be submitted electronically to each Responsible Agency and the Santa Ana Water Board by June 30th of each year. The Final Annual Report will be made available to the public on either the Santa Ana Water Board or Project Director's website.

[35] Current version of the SAWPA RBMP dashboard can be found at:<< https://sawpa.cdmsmith.com/>>

Group D: Data Validation and Usability

22. Data Review, Verification, and Validation Requirements

Data generated by project activities will be reviewed by each Responsible Agency's Project QA Officer against the data quality objectives cited in Section 7 and the QA/QC practices cited in Sections 14, 15, 16 and 17. Data validation will be performed for each indicator regardless of waterbody. Data validation protocols are presented in Section 23 of this QAPP.

Data will be separated into three categories: (1) Data meeting all data quality objectives; (2) data failing precision or recovery criteria; and (3) data failing to meet accuracy criteria. Data meeting all data quality objectives, but with failures of QA/QC practices will be set aside until the impact of the failure on data quality is determined. Once determined, the data will be moved into either the first or last category.

Data falling in the first category are considered usable by the project. Data falling in the last category are considered not usable. Data falling in the second category will have all aspects assessed. If sufficient evidence is found supporting data quality for use in this project, the data will be moved to the first category, but will be flagged with a "J" as per EPA specifications.

23. Verification and Validation Methods

All data recorded in the field including field measurements, observations, and COC will be checked visually by each Responsible Agency's Project QA Officer and recorded as checked by initials and dates. Field data will be checked to ensure that all necessary data and activities were completed; including collection of all water samples, field blanks, and field replicates, correct units of measurement are reported and values fall within expected ranges. The validation will also check to ensure that samples were delivered to laboratories within required holding times and that all sample handling and custody protocols were followed.

In addition to field data validation, there will be a validation of water quality analysis results. This will involve a review of 10 percent of all laboratory water quality analysis reports. The review will involve verifying that all required parameters were measured, reported in the correct units, and that results fall within expected ranges.

Each Responsible Agency's Project Manager will be responsible for all field data validation reviews. Each of the Laboratory QA Officers will perform checks of all of its records and each of the contract Laboratory Directors will recheck 10 percent. All checks by the laboratories will be reviewed by each Responsible Agency's Project QA Officer and Project Manager.

Issues, including missing data, incomplete site visits, reporting errors (such as incorrect units of measure or incorrect date/time information, etc.), or data management errors will be communicated to the responsible party immediately and documented in the Annual Report for either field sampling, laboratory activities, or database management. If reconciliation and correction of the data are necessary, this will be done through coordination with the Project Director. Any corrections require a unanimous agreement that the correction is appropriate.

24. Reconciliation with User Requirements

The purposes of the Regional and TMDL Monitoring Programs addressed by this QAPP are described in the following sections.

24.1 Regional Monitoring Program

The primary basis for the establishment of a RMP is to evaluate compliance with bacterial indicator water quality objectives established in the Basin Plan for inland freshwaters. The BPA (see Section 5 of this QAPP and SAR Bacteria Monitoring Plan) that established these objectives also established minimum monitoring requirements for the RMP. The RMP is structured to direct water quality monitoring resources to the highest priority waterbodies. As such, the RMP is designed to:

- Provide the data needed to determine if water quality is safe when and where people are most likely to engage in water contact recreation.
- Facilitate the TMDL implementation process and track progress toward attainment of applicable water quality standards, where water quality is impaired due to excessive bacterial indicator levels.
- Apply a risk-based implementation strategy to allocate public resources in a manner that is expected to produce the greatest public health benefit.

With these considerations in mind, priority waterbodies for monitoring under this RMP are described as follows:

- *Priority 1*: The first priority is to establish a monitoring program that can determine whether bacteria levels are "safe" at those locations and seasons where people are most likely to engage in water contact recreation
- *Priority 2*: The second priority is to focus monitoring resources on those waterbodies that have been identified as "impaired" due to excessive bacterial indicator concentrations and a TMDL has already been adopted. Monitoring efforts to evaluate progress toward attainment with the water quality standard in these impaired waters fall with priority two. This will ensure that the RMP is closely coordinated with TMDL-related sampling efforts.
- *Priority 3*: The third priority is 303(d)-listed or impaired waterbodies where a TMDL has not yet been developed. For these Priority 3 sites the RMP includes periodic sample collection on an annual basis.
- *Priority 4*: The fourth priority is to collect the bacteria indicator data needed to implement the antidegradation targets that have been established for waterbodies designated as REC2 only (i.e., the REC1 beneficial use has been de-designated through an approved UAA). Data collection from these Priority 4 waterbodies provides the Santa Ana Water Board with the ability to assess the status and trend of bacterial indicator water quality as part of the normal Triennial Review process.

24.2 TMDL Monitoring Programs

24.2.1 Watershed-wide Compliance Monitoring

The MSAR Bacteria TMDL required the establishment of a watershed-wide compliance monitoring program to measure compliance with WLAs/LAs established by the TMDL, which were derived from Basin Plan objectives established to protect the REC1 beneficial use. Dry weather monitoring to assess compliance with the MSAR Bacteria TMDL during dry weather has been incorporated into the RMP as Priority 1 or 2 sites.

Wet weather monitoring for bacterial indicators is a requirement of the MSAR Bacteria TMDL. The same concentration based wasteload and load allocations for *E. coli* in the TMDL apply to wet weather as well as dry weather conditions. The Monitoring Plan targets sampling one storm event per wet season to meet this TMDL monitoring requirement.

24.2.2 Urban Source Evaluation Monitoring Program

The purpose of the Urban Source Evaluation Monitoring Program is to identify specific activities, operations, and processes in urban areas that contribute bacterial indicators to waterbodies under the MSAR Bacteria TMDL. This monitoring program also seeks to identify which waters are of greatest concern with regards to the source of the bacteria. Sites where human sources of bacteria are most commonly observed have the highest priority for the implementation of source controls and/or additional monitoring efforts to further refine the identification of sources.

Source evaluation activities in major MS4 drainage areas (Tier 1 sites) and at outfalls within prioritized MS4 drainage areas (Tier 2) have been conducted in 2012-19 and have successfully identified and where possible mitigated controllable sources of bacterial indicator derived from discharges covered by MS4 permits. Continued implementation of source evaluation activities, as needed, is a component of the TMDL Monitoring Program and integral to achieving compliance with the TMDL.

24.2.3 Agricultural Source Evaluation Monitoring Program

The purpose of the AgSEMP is to identify specific activities, operations and processes in agricultural areas that contribute bacterial indicators to MSAR watershed waterbodies. Monitoring data is then intended to be used by the Santa Ana Water Board and agricultural stakeholders to support development of the BASMP. Per the TMDL, the BASMP should include, plans and schedules for the following:

- Implementation of bacteria indicator controls, BMPs and reduction strategies designed to meet load allocations;
- Evaluation of effectiveness of BMPs; and
- Development and implementation of compliance monitoring program(s).

Monitoring downstream of agricultural lands was conducted during wet weather in the 2008-2009 wet season from four monitoring sites and included collection of field parameters, bacterial indicator data, and microbial source identification analyses.

A BASMP is currently under development by agricultural dischargers in the MSAR watershed. Because this document is still under development, this section may be updated once the BASMP is finalized.

Moreover, the final BASMP may include monitoring requirements designed to support implementation of the BASMP. If included in the final program, then these monitoring requirements may be incorporated into the Santa Ana River Watershed Bacteria Monitoring Plan and QAPP.

ATTACHMENT 1

SANTA ANA RIVER WATERSHED BACTERIA MONITORING PROGRAM
FIELD DATA SHEET FORMS

Santa Ana River Watershed Bacteria Monitoring Program - Field Data Sheet

General Information:

Site Name: _____
Site ID: _____
Date: _____/_____/_____
Time (24-hr clock): _____
Sampling Team: _____/_____

Field Measurements: *(average of three readings)*

	Reading #1	Reading #2	Reading #3	Average
Conductivity: mS/cm ☐ µS/cm ☐				
Dissolved Oxygen: (mg/L)				
pH:				
Turbidity: (NTU)				
Temp (water): (°C)				
Other: _____				

Flow Connectivity: Y/N (Describe) _____

Flow measurements *(check boxes for units of measure)*:

Total Section Width (*W*): _____ feet ☐ meters ☐

Cross-section:	Depth (*D*)	Velocity (*V*)	Comments
10% across	_____ in ☐ cm ☐	_____ ft/sec ☐ m/sec ☐	_____
50% across	_____ in ☐ cm ☐	_____ ft/sec ☐ m/sec ☐	_____
90% across	_____ in ☐ cm ☐	_____ ft/sec ☐ m/sec ☐	_____

Estimated Flow _____ ft^3/sec ☐ m^3/sec ☐ $Q\ (ft^3/sec) = (0.2*W*D_{10}/12*V_{10}) + (0.6*W*D_{50}/12*V_{50}) + (0.2*W*D_{90}/12*V_{90})$

Grab Sampling: Filled and labeled *(check if applicable)*

1 – 100 mL or 125 mL polyethylene bottle (w/ $NaSO_4$ preservative) for ***E. coli*** *or* **Enterococci**: ..... _____
1 – 1,000 mL polyethylene bottle for **TSS**: ..... _____
1 – 1,000 mL polyethylene bottle for ***Bacteroides:*** ..... _____
1 – 100 mL polyethylene bottle for **Ammonia:** ..... _____
1 – 500 mL polyethylene bottle for **Potassium:** ..... _____
1 – 500 mL polyethylene bottle for **Surfactants:** ..... _____
Additional bottle sets are included for field duplicates and trip blanks ..... _____

Site Observations:

Weather: _____
Visual Evidence of REC-1 Activity: _____
_____
Other: _____
_____
_____

ATTACHMENT 2

SANTA ANA RIVER WATERSHED BACTERIA MONITORING PROGRAM
EXAMPLE CHAIN OF CUSTODY FORMS

County of Orange, Health Care Agency
Water Quality Laboratory (ELAP # 2545)
600 Shellmaker Rd. Bldg. A
Newport Beach, CA 92660
Phone:(949)219-0423 FAX:(949)219-0426

Client:	**OCPW**
Study/Billing Code:	Santa Ana Regional Monitoring Program
Contact Info:	
Date Collected:	mm/dd/yyyy
Sampler Name:	County of Orange

Bottle #	Time Collected	MRN/Station ID, Location	Sampler Comments	Submitter Accession #	Lab Accession #	Test Requested
1		*1000-34-2417* Site1Name	Matrix: FW W: Ht: Q: FTO: Temp:	WRzzzzzz Notes:		Total Coliform Fecal Coliform Enterococci x E. coli Can Bacrio Hum Bacrio Coliphage
Water Type:	Domestic	Surface Marine Ground Reclaimed Other		**Preservative:**	$Na_2S_2O_3$ None Other	
2		*1000-34-2418* Site2Name	Matrix: FW W: Ht: Q: FTO: Temp:	WRzzzzzz Notes:		Total Coliform Fecal Coliform Enterococci X E. coli Can Bacrio Hum Bacrio Coliphage
Water Type:	Domestic	Surface Marine Ground Reclaimed Other		**Preservative:**	$Na_2S_2O_3$ None Other	
3		*1000-34-2418* Site3Name	Matrix: SW W: Ht: Q: FTO: Temp:	WRzzzzzz Notes:		Total Coliform Fecal Coliform Enterococci X E. coli Can Bacrio Hum Bacrio Coliphage
Water Type:	Domestic	Surface Marine Ground Reclaimed Other		**Preservative:**	$Na_2S_2O_3$ None Other	
4		*1000-21-6890* Site4Name	Matrix: FW W: Ht: Q: FTO: Temp:	WRzzzzzz Notes:		Total Coliform Fecal Coliform Enterococci X E. coli Can Bacrio Hum Bacrio Coliphage
Water Type:	Domestic	Surface Marine Ground Reclaimed Other		**Preservative:**	$Na_2S_2O_3$ None Other	

Name / Date / Time	Comments:
Relinquished by:	
Received by:	
Analyzed by:	
Reviewed by:	
Reported to:	Transport Conditions:

ORANGE COUNTY WATER DISTRICT

10500 Ellis Avenue, Fountain Valley, CA 92708

Telephone: (714) 378-3200 Fax: (714) 378-3373

CHAIN OF CUSTODY RECORD

NO.	SAMPLING AGENCY	WRMS STATION NAME	Sample Date	Sample Time	Sampled BY	COMMENTS		NO. OF Bottles	ANALYSIS
1						EC=	Ph=		
						TEMP=	DO=		
2						EC=	Ph=		
						TEMP=	DO=		
3						EC=	Ph=		
						TEMP=	DO=		
4						EC=	Ph=		
						TEMP=	DO=		
5						EC=	Ph=		
						TEMP=	DO=		
6						EC=	Ph=		
						TEMP=	DO=		
7						EC=	Ph=		
						TEMP=	DO=		
8						EC=	Ph=		
						TEMP=	DO=		
9						EC=	Ph=		
						TEMP=	DO=		
10						EC=	Ph=		
						TEMP=	DO=		

RELINQUISHED BY: DATE/TIME	ED BY:
RELINQUISHED BY: DATE/TIME	ED BY: DATE/TIME
SPECIAL INSTRUCTIONS:	BILL ACCOUNT NO.:

Babcock Laboratories, Inc.
(951) 653-3351 FAX (951) 653-1662
www.babcocklabs.com

Chain of Custody Sample Information Record

Client:	**Contact:**	**Phone No.**	213-457-2141
FAX No.	**Email:**		
Project Name:	**Turn Around Time:** Routine / *3-5 Day Rush / *48 Hour Rush / *24 Hour Rush		
Project Location:	***Lab TAT Approval:** By: *Additional Charges May Apply		

Additional Reporting Requests
Include QC Data Package: ☐ Yes ☐ No
FAX Results: ☐ Yes ☐ No
Email Results: ☐ Yes ☐ No
State EDT: ☐ Yes ☐ No
(Include Source Number in Notes)

Sampler Information
Name: _____
Employer: _____
Signature: _____

Sample ID	Date	Time	# of Containers & Preservatives: Unpreserved	H2SO4	HCl	HNO3	Na2S2O3	NaOH	NaOH/ZnAcetate	NH4Cl	MCAA			Total # of Containers	Sample Type: Routine	Resample	Special	Analysis Requested: QT 18hr T.Coliform/E.Coli								Matrix	Notes

Matrix
DW = Drinking Water
GW = Groundwater
WW = Wastewater
S = Source
SG = Sludge
L = Liquid
M = Miscellaneous

Relinquished By (sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company

(For Lab Use Only) **Sample Integrity Upon Receipt/Acceptance Criteria**

Sample(s) Submitted on Ice?	Yes	No	**Sample Meets Laboratory Acceptance Criteria?**	Yes	No
Custody Seal(s) Intact?	Yes	No N/A	**Permission to continue:**	Yes	No
Sample(s) Intact?	Yes	No	**Deviation/Notes:**		
Temperature: _____ °C	☐ Cooler Blank		**Signature/Date:**		

Logged in By/Date: _____

Page _____ **of** _____

ATTACHMENT 3

SANTA ANA RIVER WATERSHED BACTERIA MONITORING PROGRAM
FLOW MEASUREMENT FORM

SANTA ANA RIVER WATERSHED BACTERIA MONITORING PROGRAM

FLOW MEASUREMENTS

Location _____
Portable Flowmeter Used _____ Recorder _____
Date _____
Time _____
Left Bank _____ Right Bank _____ Page _____ of

	Distance from IP	Width	Total Depth	Flow Velocity				Average V*	Area A**	Discharge (avg VXA)
				VO.6	VO.2	VO.8	VO.9			
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
								Total Discharge		

Stream Flow Conditions (I.e., muddy, clear, debris, etc…): _____

_____

* Average Velocity =VO.6 for stream depths between 0.3 and 2.5 feet (six-tenths method).
=(VO.2 + VO.8)/2 for stream depths greater than 2.5 feet (two-point method).
=VO.9 if flow is less than 0.3 feet deep (maximum velocity X 0.9).
** Area =total depth x width
IP =Initial Point

Attachment A

ORANGE COUNTY PUBLIC HEALTH LABORATORY

Title:	Colilert-18
Version:	2.0
Index:	WQL - 109
Organizational Unit:	Water Quality Lab
Category:	WQL Analysis Methods
Document Type:	SOP
Document Status:	Authorised

Authorized By:	Megan Crumpler, PhD, HCLD
Date Authorized:	21-Oct-2020

I. PRINCIPLE

IDEXX Colilert-18 with Quanti-Tray 2000 is a rapid quantitative method for identification of coliform bacteria and *Escherichia coli*. The test is based on "Defined Substrate Technology," which utilizes nutrient indicators that produce color or fluorescence when metabolized by total coliforms and *E. coli*. These specific nutrients are ONPG (O-Nitrophenyl-ß-d-galactopyranoside), producing yellow color and MUG (Methylumbelliferyl-ß-d-glucuronide) producing fluorescence.

II. DEFINITIONS

A. Most Probable Number (MPN) - a number which represents the bacterial density which is most likely present.

B. Coliforms - gram negative, rod-shaped, facultative bacteria which are used to indicate human fecal contamination in water

C. Personal protective equipment (PPE) – specialized clothing or equipment worn by employees for protection against health and safety hazards.

D. Domestic water - water designated as safe for human consumption

E. Marine water - sea water including coastal and bay waters

III. SPECIMENS/SAMPLES

A. 100±2.5mL of Domestic or Marine water.

B. Samples must arrive at the lab within 6hrs after collection.

C. Acceptable transport temperature is greater than 0˚C to less than 10˚C.

D. Sample coloration (green, blue, brown, black, yellow) or turbidity may interfere with interpretation. Consult with Microbiologist II and document in comments field on Chain of Custody (COC).

E. Refer to Sample: Collection, Acceptance and Disposal SOP and for overfilled samples and transport conditions.

F. Refer to the LIS User Guide to add the WQL-Colilert Panel, orderable W2.

IV. SAFETY

A. Wear proper personal protective equipment (PPE) such as a lab coat.

B. Wear gloves for sewage samples.

C. Avoid inhalation of enzyme substrate powder puff when opening the capsule.

D. Avoid long direct exposure to UV light when reading trays.

E. Refer to PHL Basic Safety Rules.

F. Sharps safety

1. Take extra precaution while handling syringe
2. Discard syringe in sharps container

3. Never recap syringe

V. MATERIALS

A. INITIAL PROCESSING MATERIALS, IF DIFFERENT

N/A

B. EQUIPMENT

1. Quanti-tray sealer w/rubber insert
2. Long wavelength ultraviolet lamp (365nm)
3. Electronic pipette
4. Incubator set at 35±0.5°C
5. Water bath set at 44.5°C
6. Vacuum sealing system

C. REAGENTS

1. Colilert-18 powder
2. API 20E reagents
   a. Kovac's Reagent
   b. 10% Ferric Chloride
   c. Voges Proskaur Reagent I (VP I)
   d. Voges Proskaur Reagent II (VP II)

D. SUPPLIES

1. 90mL sterile DI water dilution blank
2. 10mL disposable pipettes
3. Quanti-tray 2000
4. Vacuum sealing pouches
5. m-Endo LES agar plates
6. m-TEC agar plates
7. Sheep Blood agar plates (BAP)
8. Sterile blue loops
9. Alcohol wipes
10. Insulin syringe, 1 cc
11. Biomerieux API 20E test kit
12. API Saline
13. Mineral oil
14. Oxisticks oxidase swabs
15. Cotton swabs (sterile)
16. 1 ml sterile transfer pipet
17. Sharps container

18. Pipette discard

VI. QUALITY CONTROL

A. Quality control is performed on each new lot of enzyme substrate powder before use.

1. Two positive organism, one negative organism, and sterility is set up.
2. Refer to Colilert-18 powder QC chart for detail procedure and documentation.

B. Sterility is performed on each new lot of Quanti-Tray 2000 before use. Refer to Quanti-Tray 2000 QC chart for detailed procedure and documentation.

C. QC is performed on all media, kits, and reagents upon receipt of new lot numbers.

D. Because the lab rarely encounters positive results for E. coli on a domestic water sample, spiking of a domestic sample with E. coli culture will occur on a quarterly basis.

1. Spiking procedure can be found in *WQL – 137: Quality Control Procedures.*
2. Results are documented on the Quarterly Domestic Colilert QA sheet.

E. Refer to QC binder for specific QC procedures and organisms.

VII. INITIAL PROCESSING

A. Due to the 18 hour incubation, Colilert-18 set-up is performed between 3-5 pm.

B. Volume Check

1. 100±2.5mL of Domestic or Marine water is required.
2. If sample is greater than 102.5mL, shake the sample 25 times in 7 seconds, covering a one-foot arc, and then pipette off the excess sample.
3. If sample is less than 97.5mL, consult with Microbiologist II.

C. For Presence/Absence Testing

1. Sample needs to be 33-38˚C.
2. If sample is not in the required temperature range, warm the sample in 35˚C waterbath for 20 minutes or in 44.5˚C waterbath for 7-10 minutes.

VIII. PROCEDURE

A. Qualitative Domestic Water - Presence/Absence

1. Shake the sample 25 times in 7 seconds, covering a one-foot arc.
2. Separate one Colilert-18 snap pack. Substrate is light sensitive, store powder in the dark until ready to for use.
3. Tap the cap of the snap pack to dislodge powder from the cap.
4. Open the snap pack by snapping back the top. Avoid inhaling the powder puff.
5. Add the powder to the sample and gently swirl to mix.
6. Once the powder completely dissolves, incubate the sample at 35±0.5˚C for 18 hours.

7. Record the time/date sample was tested and initial the Colilert/Enterolert/MTF worksheet.

B. Quantitative Domestic Water

1. Turn on Quanti-tray sealer. Allow sealer to warm up, approximately 10 minutes. Green light indicates sealer is ready.
2. Label Quanti-tray 2000 trays with accession number, **undiluted,** date, and time tested.
3. Shake the water sample 25 times in 7 seconds, covering a one-foot arc.
4. Separate one snap pack of Colilert-18 powder.
5. Tap the cap of the snap pack to dislodge powder from the cap.
6. Open the snap pack by snapping back the top. Avoid inhaling the powder puff.
7. Add the Colilert-18 powder to the water sample and gently swirl to mix to avoid bubble formation. Allow the powder to dissolve before pouring into Quanti-tray 2000.
8. Open the Quanti-tray 2000 by squeezing the upper corners of the tray with one hand and gently pull open the foil tab with the other hand to separate the foil from the wells.
9. Slowly pour the sample mixture into the Quanti-tray 2000. Tap the wells on the tray to release bubbles especially the small wells.
10. Place the sample-filled tray onto the rubber insert with the wells facing down.
11. Feed the rubber insert with the sample tray (small well end first) into the sealer until the sealer grabs the tray.
12. Check the tray for leaks and make sure there is sample in all the wells including the large well at the top of the Quanti-tray 2000. No sample in this large well indicates that the sample tested was less than 97.5ml. Consult with Microbiologist II if there is an empty well.
13. Incubate for 18 hours at 35±0.5°C.
14. Record the time/date sample was tested and initial the Colilert/Enterolert/MTF worksheet.

C. Quantitative Marine Water

1. Turn on Quanti-tray sealer. Allow sealer to warm up, approximately 10 minutes. Green light indicates sealer is ready.
2. Label 90 mL sterile DI water dilution blank with accession number.
3. Label Quanti-tray 2000 with accession number, dilution, date, and time tested.
4. Shake the sample 25 times in 7 seconds, covering a one-foot arc.
5. Make a 1:10 dilution of the sample by pipetting 10 mL of the sample into 90 mL sterile DI water dilution blank. **Do not use buffered PBS for diluting the sample.**
6. If increased dilutions are requested, make serial dilutions from the 1:10 dilution. Add 10mL of the 1:10 dilution to another 90 mL sterile DI water

dilution blank until the desired dilution is reached. Make sure to shake the dilutions 25 times in 7 seconds, covering a one-foot arc before making each dilution.

7. Shake the sample 25 times in 7 seconds, covering a one-foot arc.
8. Separate one snap pack of Colilert-18 powder.
9. Tap the cap of the snap pack to dislodge powder from the cap.
10. Open the snap pack by snapping back the top. Avoid inhaling the powder puff.
11. Add the Colilert-18 powder to the 1:10 dilution of the sample or to the final increased dilution that will be tested and gently swirl to mix to avoid bubble formation. Allow the powder to dissolve before pouring into Quanti-tray 2000.
12. Open the Quanti-tray 2000 by squeezing the upper corners of the tray with one hand and gently pull open the foil tab with the other hand to separate the foil from the wells.
13. Slowly pour the sample mixture into the Quanti-tray 2000. Tap the wells on the tray to release bubbles especially the small wells.
14. Place the sample-filled tray onto the rubber insert with the wells facing down.
15. Feed the rubber insert with the sample tray into the sealer (small well end first) until the sealer grabs the tray.
16. Check the tray for leaks and make sure there is sample in all the wells including the large well at the top of the tray. If there is an empty well repeat the procedure.
17. Incubate for 18 hours at 35±0.5°C.
18. Record the time/date sample was tested and initial the Colilert/Enterolert/MTF worksheet.

D. Completed Test Procedure

1. Choose two positive wells (yellow color with or without fluorescence) from the Colilert-18 Quanti-tray for subculture and mark the outline of the wells on the back of the tray with a Sharpie. Assign isolate numbers to the positive wells (-1, -2, etc.).
   a. Positive *E. coli* wells (yellow color and fluorescence) should be picked if present.
   b. A second well is chosen as a precaution to increase recovery.
2. Label appropriate subculture media (mEndo LES for total coliforms; mTEC for *E. coli*) and BAP for each well with lab number, isolate number, dilution, and date subcultured.
3. Clean the back of the chosen well with an alcohol swab and let it dry.
4. Pierce the back of the well with a sterile insulin syringe and draw up a small amount of inoculum.
5. Inoculate labelled media with 1-2 drops of inoculum and safely discard syringe in a sharps container. Streak media for isolation with a loop.

6. Place two small pieces of tape over the back of the pierced well to prevent leakage.
7. Repeat steps D3 through D6 for each numbered well.
8. Incubate BAPs and mEndo plates at 35°C for 24 hours.
9. Incubate mTEC plates at 35°C for 2 hours, followed by 44.5°C water bath in vacuum sealed plastic bags for 22 hours (A total incubation time of 24 hours).
10. Save the Quanti-tray with the wells down in a basket in the refrigerator until the verification is complete.
11. Document the sample information, date tested, initials, the Colilert -18 powder lot number and expiration, and the IDEXX Quanti-tray results on the Completed Test Worksheet located in the Completed Test binder.
12. After 24 hours incubation, examine the subculture media (mEndo LES or mTEC) for typical colonies and BAP for purity. Select the media set from the well that best represents the sample.
    a. mEndo LES typical = red with metallic green sheen colony
    b. mTEC typical = magenta colony
13. If the BAP is pure, skip steps 14-16.
14. If the BAP has more than one colony type, set it aside and use the mEndo LES or mTEC media to obtain a pure isolate for further characterization.
15. With a needle, pick a well-isolated typical colony from the mEndo LES or mTEC plate and sub to a BAP. Streak for isolation.
16. Incubate blood agar plates at 35°C for 18-24 hours.
17. After incubation, examine the BAP for purity and sufficient growth. If growth on the BAP is mixed, consult a Microbiologist II.
18. If culture is pure, set up an API 20E for identification. Refer to the QC Procedures, API 20E document.

IX. RESULT INTERPRETATION

A. For Qualitative/Quantitative testing

1. Total Coliform
    a. Positive (Present) = Yellow Color equal to or greater than the color comparator
    b. Negative (Absent) = No yellow Color observed
2. *E. coli*
    a. Positive (Present) = Yellow Color equal to or greater than the color comparator and Fluorescence under 365nm UV light
    b. Negative (Absent) = No fluorescence observed under 365nm UV light
    c. False positive = Fluorescence under 365nm UV light but No Yellow Color

3. If Yellow Color or Fluorescence is questionable, re-incubate the sample for an additional 4 hours but do not exceed 22 hours.
4. If the sample is inadvertently incubated over 22 hours:
    a. Positives (yellow color) are invalid, repeat testing.
    b. Negatives (no yellow) are valid
5. Invalidation of Results
    a. Negative results invalidation
        i. Sample color (green, blue, brown, black, yellow) or turbidity that may interfere with yellow color development or interpretation.
        ii. Client must be notified immediately by phone. Phone calls should be documented on the Colilert/Enterolert/MTF worksheet.
        iii. Invalid samples due to interference must be re-sampled and analyzed within 24 hours of notification.
    b. Positive results invalidation
        i. This situation occurs if the positive result was due to a laboratory error or the client challenges the positive result.
        ii. Notify client immediately to initiate re-sampling as well as initiate an investigation into the discrepancy.
        iii. This type of invalidation occurs only after a positive result has been reported to the client.

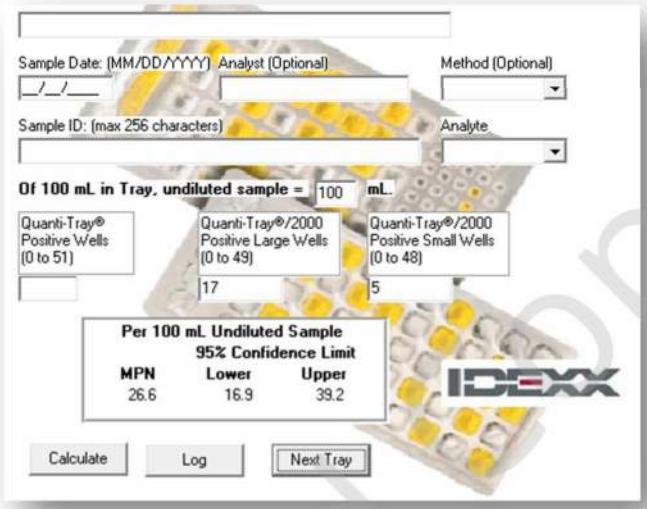
B. Qualitative - Presence / Absence

1. Record the date/time the sample was read and initial the worksheet. Samples should be read 18 hours after set-up time.
2. Total Coliform
    a. Yellow Color observed, record “Present” in the Total Coliform box on the Colilert/Enterolert/MTF worksheet.
    b. No Yellow Color observed, record “Absent” in the Total Coliform box on the Colilert/Enterolert/MTF worksheet.
3. *E. coli*
    a. Yellow Color and Fluorescence observed under 365nm UV light, record “Present” in the *E.coli* box on the Colilert/Enterolert/MTF worksheet.
    b. No Fluorescence observed under 365nm UV light, record “Absent” in the *E.coli* box on the Colilert/Enterolert/MTF worksheet.
4. Notify Environmental Health of any positive Domestics by phone. Any phone calls to Environmental Health should be documented on the Colilert/Enterolert/MTF worksheet.

C. Quantitative

1. Record the date and time the sample was read and initial the worksheet. Samples should be read 18 hours after set-up time.

2. Total Coliform
   a. Count the large and small yellow wells that are greater than or equal to the color comparator (Total Coliform positives).
   b. Record the number of positive large and small wells under the appropriate "Yellow Color at 18hrs" box on the Colilert/Enterolert/MTF worksheet.
3. *E. coli*
   a. Place positive trays under 365nm UV light
   b. Mark the fluorescing (*E.coli* positive) large and small wells with a sharpie.
   c. Count and record the number of positive fluorescent large and small wells under the appropriate "Fluoresce at 18hrs" box on the Colilert/Enterolert/MTF worksheet.
4. Two Methods for Most Probable Number (MPN) Determination
   a. IDEXX MPN Generator – Primary method
      i. Make sure the Generator is in Dilution Mode.
         - Click "Options" at the top of the IDEXX MPN Generator toolbar.
         - Select 'Use Dilution Mode"
         - Save Changes
      ii. Enter the sample volume tested.
      iii. Enter the number of positive large and small wells for Quanti-Tray 2000.
      iv. Click Calculate
      v. Result is displayed under MPN with the upper and lower confidence level.
      vi. The Quanti-Tray 2000 yields a counting range of 1-2419 with a 95% confidence limit.



b. MPN Table – Secondary method

i. Locate the number of positive large wells on the vertical axis.

ii. Locate the number of positive small wells on the horizontal axis.

iii. Where the number of positive large and small wells intersect is the MPN for the sample.

iv. Example: Undiluted sample

Large wells	Small wells	MPN
17	5	26.6

v. MPN table is based on undiluted 100mL sample. Dilutions need to be taken into account when reporting MPN.

vi. Example: Sample diluted 1:10

Large wells	Small wells	MPN
17	5	266

c. Calculate the MPN for both Total Coliforms and E.coli and record on the worksheet.

D. Completed Test

1. Refer to the QC Procedures, API20E document for API 20E result interpretation.

2. Record the API 20E code and identification on the Completed Test Worksheet.

X. REPORTING

A. LIS Entry

1. Bring up Accession Result Entry (ARE) from the Cerner taskbar and scan or manually enter the accession number.

2. Qualitative – Presence/Absence
   a. Free text "Present" or "Absent" in the TCIDEXXnum field for total coliform.
   b. Free text "Present" or "Absent" in the ECIDEXXnum field for *E.coli*.
3. Quantitative
   a. Total Coliform
      i. If applicable, select a qualifier from the drop down box in the TCIDEXXalp field.
      ii. Enter the MPN result in the TCIDEXXnum field
   b. *E.coli*
      i. If applicable, select a qualifier from the drop down box in the ECIDEXXalp field.
      ii. Enter the MPN result in the ECIDEXXnum field.
4. Verify after confirming the site and entry
5. Refer to the Reporting section of the LIS User Guide to generate the spreadsheet and send a report to the client.

B. Completed test
1. Consult with Micro II or Supervising Microbiologist to determine if completed test is for Internal QA/QC of if reporting is required per client request.
2. Internal QA/QC
   a. Record API 20E results on the Completed test worksheet.
   b. File the worksheet in the Completed test binder.
3. If reporting is required per client request, follow the steps below:
   a. Open ARE from the Cerner taskbar.
   b. Scan or type the accession number. There is no additional orderable required for the Completed Test. If the existing orderable has already been verified, select the Mode menu at the top of the screen, and select Correction mode.
   c. Click on the Comment Viewer icon and select Result Comment → Edit Comment.
   d. Enter identification results:
      i. Colilert-18 Completed Test: "[Genus species] by API 20E"
      ii. To refer to the results from another sample (for example, if there were multiple isolates but only one was worked up): "Refer to accession WL-XX-XXXX for identification."
   e. Click the Correct button at the bottom of the screen.
   f. Repeat Steps ***a*** through ***e*** for each accession with a Completed Test workup.

g. Open the most recent spreadsheet containing the data for the accession(s) worked up (see LIS User Guide) and perform a Save As, placing your initials at the end of the file name.

h. Add a line to the spreadsheet for each accession with a Completed Test identification. Copy sample information from the previous line, and add the organism identification and ID method:

   i. Parameter code field: "Coliform Identification"

   ii. Numeric result and Units fields: Genus and species

   iii. Analysis Method field: "API 20E"

i. Save the spreadsheet.

j. Repeat Steps ***g*** through ***i*** for all accession numbers worked up.

k. Refer to the Reporting section of the LIS User Guide to send updated spreadsheets to clients.

XI. MAINTENANCE

A. Equipment preventive maintenance and calibration is performed bi-annually by a County approved contractor.

B. Quanti-Tray Sealer maintenance and performance check is done monthly by Water Lab staff. Refer to Quanti-Tray Sealer Monthly Performance Check QC chart and Quanti-Tray Sealer Maintenance document.

C. Water baths are cleaned and disinfected monthly by Water Lab staff.

D. Long wavelength ultraviolet lamp (365nm) is cleaned monthly by Water Lab staff.

XII. REFERENCES

A. Standard Methods. (2017). *9223B Enzyme Substrate Test* (23rd ed., pp. 9-99-9-101). American Public Health Association, American Water Works Association, Water Environment Federation.

B. IDEXX Colilert-18 product insert

C. Quanti-tray 2000 product insert

D. API 20E product insert

XIII. RELATED DOCUMENTS

A. Change log

B. LIS User Guide

C. Sample: Collection, Acceptance and Disposal SOP

D. PHL Basic Safety Rules

E. Quanti-Tray 2000 Trays QC

F. Colilert 18 Powder QC

G. Quarterly Domestic Colilert QA

H. Quanti-Tray Sealer Performance Log
I. Colilert/Enterolert/MTF Worksheet
J. MPN Table
K. Completed Test Worksheet
L. Membrane Filtration Media and Daily Quality Control
M. QC Procedures Document

Change Log

Date	Description	Approved By
10/02/20	Quarterly domestic QC instated in section VI.	JG

ORANGE COUNTY PUBLIC HEALTH LABORATORY

Title:	Enterolert
Version:	1.0
Index:	WQL - 110
Organizational Unit:	Water Quality Lab
Category:	WQL Analysis Methods
Document Type:	SOP
Document Status:	Authorised

Authorized By:	Megan Crumpler, PhD, HCLD
Date Authorized:	05-Mar-2018

I. PRINCIPLE

IDEXX Enterolert with Quanti-Tray 2000 is a rapid quantitative method for detection of Enterococci in water samples. The test is based on a "Defined Substrate Technology" system, which utilizes a nutrient indicator that produces fluorescence when metabolized by Enterococci. The specific nutrient indicator is a modified MUG (4-methylumbelliferyl-ß-d-glucoside), which, when metabolized by Enterococci, releases 4-methylumbelliferone and glucose. 4-methylumbelliferone exhibits blue fluorescence when viewed under a long-wavelength ultraviolet lamp.

II. DEFINITIONS

A. Most Probable Number (MPN) - a number which represents the bacterial density which is most likely present

B. Personal protective equipment (PPE) – specialized clothing or equipment worn by employees for protection against health and safety hazards.

C. Domestic water - water used for indoor and outdoor household purposes

D. Marine water – sea water including coastal and bay waters

III. SPECIMENS/SAMPLES

A. 100±2.5mL of Domestic or Marine water

B. Samples must arrive at the lab within 6hrs after collection

C. Acceptable transport temperature is greater than 0˚C to less than 10˚C

D. Sample coloration (green, blue, brown, black, yellow) or turbidity may interfere with interpretation. Consult with Microbiologist II

E. Refer to Sample: Collection, Acceptance and Disposal SOP for overfilled samples and transport conditions

F. Refer to the LIS User Guide to add the Enterococcus, IDEXX orderable, W6.

IV. SAFETY

A. Wear the appropriate personal protective equipment (PPE) for the procedure.

B. Wear gloves for sewage samples

C. Avoid inhalation of enzyme substrate powder puff when opening the capsule

D. Avoid long direct exposure to UV light when reading trays

E. Sharps safety

1. Take extra precaution while handling syringe
2. Discard syringe in sharps container
3. Never recap syringe

F. Refer to Laboratory Safety document

V. MATERIALS

A. INITIAL PROCESSING MATERIALS, IF DIFFERENT

N/A

B. EQUIPMENT

1. Quanti-tray sealer w/rubber insert
2. Long wavelength ultraviolet lamp (365nm)
3. Electronic pipette
4. Incubator set at 41±0.5°C

C. REAGENTS

1. Enterolert powder (stored at 2-30°C away from light)
2. Remel RapID STR reagents
3. 3% Catalase
4. Gram Stain Reagents

D. SUPPLIES

1. 90mL sterile DI water dilution blank
2. 10mL disposable pipettes
3. Quanti-tray 2000
4. m-EI agar plates
5. Sheep Blood agar plates (BAP)
6. Blue loops
7. Yellow needles
8. Sharps container
9. Insulin syringe, 1cc
10. Alcohol wipes
11. Pipette discard
12. Bile esculin slant agar
13. Brain Heart Infusion (BHI) broth
14. 6.5% Salt Tolerance broth (NaCl)
15. Frosted microscope slides
16. Remel RapID STR test kit

VI. QUALITY CONTROL

A. Quality control is performed on each new lot of enzyme substrate powder before use.

1. One positive organism, two negative organisms, and sterility is set up
2. Refer to Enterolert powder QC chart for detail procedure and documentation

B. QC is performed on all media, kits, and reagents upon receipt of new lot numbers.

C. Refer to QC Logbook for specific QC procedures and organisms.

D. Sterility is performed on each new lot of Quanti-Tray 2000 before use. Refer to Quanti-Tray 2000 QC chart for detail procedure and documentation

VII. INITIAL PROCESSING

A. Volume Check

1. 100±2.5mL of Domestic or Marine water is required
2. If sample is greater than 102.5mL, shake the sample 25 times in 7 seconds, covering a one-foot arc, and then pipette off the excess sample
3. If sample is less than 97.5mL, consult with Microbiologist II

VIII. PROCEDURE

A. Qualitative Domestic Water - Presence/Absence

1. Shake the sample 25 times in 7 seconds, covering a one-foot arc
2. Separate one Enterolert snap pack. Substrate is light sensitive, store powder in the dark until ready to for use
3. Tap the cap of the snap pack to dislodge powder from the cap
4. Open the snap pack by snapping back the top. Avoid inhaling the powder puff
5. Add the powder to the sample and gently swirl to mix
6. Once the powder completely dissolves, incubate the sample at 41±0.5˚C for 24 hours
7. Record the time/date sample was tested and initial the Colilert Enterolert MTF worksheet

B. Quantitative Domestic Water

1. Turn on Quanti-tray sealer. Allow sealer to warm up, approximately 10 minutes. Green light indicates sealer is ready
2. Label Quanti-tray 2000 trays with accession number, "**undiluted**", date, and time tested
3. Shake the water sample 25 times in 7 seconds, covering a one-foot arc
4. Separate one snap pack of Enterolert powder
5. Tap the cap of the snap pack to dislodge powder from the cap
6. Open the snap pack by snapping back the top. Avoid inhaling the powder puff.
7. Add the Enterolert powder to the water sample and gently swirl to mix. Avoid bubble formation. Allow the powder to dissolve before pouring into Quanti-tray 2000.
8. Open the Quanti-tray 2000 by squeezing the upper corners of the tray with one hand and gently pull open the foil tab with the other hand to separate the foil from the wells
9. Slowly pour the sample mixture into the Quanti-tray 2000. Tap the wells on the tray to release bubbles, especially the small wells
10. Place the sample-filled tray onto the rubber insert with the wells facing down

11. Feed the rubber insert with the sample tray (small well end first) into the sealer until the sealer grabs the tray
12. Check the tray for leaks and make sure there is sample in all the wells including the large well at the top of the tray. No sample in the large well indicates that the sample tested was less than 97.5ml. Consult with Microbiologist II if there is an empty well.
13. Incubate for 24hours at 41±0.5˚C
14. Record the time/date sample was tested and initial the Colilert Enterolert MTF worksheet

C. Quantitative Marine Water

1. Turn on Quanti-tray sealer. Allow sealer to warm up, approximately 10 minutes. Green light indicates sealer is ready.
2. Label 90 mL sterile DI water dilution blank with accession number
3. Label Quanti-tray 2000 with accession number, **dilution**, date, and time tested
4. Shake the sample 25 times in 7 seconds, covering a one-foot arc.
5. Make a 1:10 dilution of the sample by pipetting 10 mL of the sample into 90 mL sterile DI water dilution blank. **Do not use buffered PBS for diluting the sample**
6. If increased dilutions are requested, make serial dilutions from the 1:10 dilution. Add 10mL of the 1:10 dilution to another 90 mL sterile DI water dilution blank until the desired dilution is reached. Make sure to shake the dilutions 25 times in 7 seconds, covering a one-foot arc before making each dilution
7. Shake the sample 25 times in 7 seconds, covering a one-foot arc
8. Separate one snap pack of Enterolert powder
9. Tap the cap of the snap pack to dislodge powder from the cap
10. Open the snap pack by snapping back the top. Avoid inhaling the powder puff
11. Add the Enterolert powder to the 1:10 dilution of the sample or to the final increased dilution that will be tested and gently swirl to mix. Avoid bubble formation. Allow the powder to dissolve before pouring into Quanti-tray 2000
12. Open the Quanti-tray 2000 by squeezing the upper corners of the tray with one hand and gently pull open the foil tab with the other hand to separate the foil from the wells
13. Slowly pour the sample mixture into the Quanti-tray 2000. Tap the wells on the tray to release bubbles especially the small wells;
14. Place the sample-filled tray onto the rubber insert with the wells facing down
15. Feed the rubber insert with the sample tray into the sealer (small well end first) until the sealer grabs the tray
16. Check the tray for leaks and make sure there is sample in all the wells including the large well at the top of the tray. If there is an empty well repeat the procedure.

17. Incubate for 24 hours at 41±0.5˚C
18. Record the time/date sample was tested and initial the Colilert Enterolert MTF worksheet

D. Completed Test Procedure

1. Performed on positive Enterolert Quanti-trays (fluorescence) to verify the method is performing as expected and is providing accurate results
2. Choose two positive (strong fluorescent) wells from the Enterolert Quanti-tray for subculture. The second well is chosen as a precaution to increase recovery.
3. Bracket the outline of the well on the back of the tray with a Sharpie. If more than one well is selected, assign isolate numbers for ease of labelling (e.g., -1, -2).
4. Label one mEI plate and one BAP for each well with lab number, isolate number, dilution, and date subcultured.
5. Clean the back of the chosen well with an alcohol swab and let it dry.
6. Pierce the back of the well with a sterile insulin syringe and draw up a small amount of inoculum.
7. Inoculate the labelled media with 1-2 drops of inoculum and safely discard syringe in a sharps container. Streak media for isolation with a loop or needle.
8. Place two small pieces of tape over the back of the pierced well to prevent leakage.
9. Repeat steps D3 through D7 for each isolate.
10. Incubate mEI plates at 41±0.5˚C and BAP at 35°C for 24 hours.
11. Refrigerate Enterolert Quanti-tray until the Completed Test is finished.
12. Document the sample information, date tested, initials, the Enterolert powder lot number and expiration, and the IDEXX Quanti-tray results on a Completed Test worksheet. Located in the Completed Test binder.
13. After 24 hours incubation, examine the mEI plate for typical colonies (blue halo surrounding the colony) and BAP for purity. Select the media set (mEI and BAP) from the well that best represents the sample
14. If the BAP is pure, skip steps 15-17.
15. If the BAP has more than one colony type, set it aside and use the mEI media to obtain a pure isolate for further characterization.
16. With a needle, pick a well-isolated typical colony from the mEI plate and sub to a BAP. Streak for isolation;
17. Incubate blood agar plates at 35°C for 18-24 hours.
18. After incubation, examine the BAP for purity and sufficient growth. If the growth on the BAP is mixed consult a Microbiologist II. If the growth is pure, set up the biochemicals for Enterococcus
    a. Perform gram stain. Refer to QC Procedures, Gram Stain document.
    b. Perform catalase test.

c. Inoculate a Bile Esculin slant, Brain Heart Infusion (BHI) broth and 6.5% Salt Tolerance broth (NaCl).

d. Incubate Bile Esculin slant and 6.5 % Salt Tolerance Broth at 35°C for up to 48 hours.

e. Incubate BHI broth at 44.5°C for up to 48 hours.

f. For specific biochemical procedures, QC organisms and documentation refer to the appropriate QC charts in the Media Quality Control Binder.

19. Full identification may be required per client's request. Perform RapID STR test. Refer to QC procedures document

IX. RESULT INTERPRETATION

A. For Qualitative/Quantitative testing

1. Enterococci Positive (Present) = Blue Fluorescence under 365nm UV light
2. Enterococci Negative (Absent) = No Fluorescence under 365nm UV light
3. Enterolert are definitive at 24-28hrs.
   a. Positives observed before 24hrs and negatives observed after 28hrs are also valid
4. Some water samples containing soil material may have some background color. In this case, compare the Enterolert sample to a control blank of the same sample if available. If there is not enough sample for a control blank consult a Microbiologist II.

B. Qualitative - Presence / Absence

1. Record the date/time the sample was read and initial the worksheet.
2. Blue Fluorescence observed under 365nm UV light, record "Present" in the "Enterococci" box on the Colilert Enterolert MTF worksheet
3. No Fluorescence observed under 365nm UV light, record "Absent" in the "Enterococci" box on the Colilert Enterolert MTF worksheet
4. Notify Environmental Health of any positive Domestics by phone. Any phone calls to Environmental Health should be documented on the Colilert Enterolert MTF worksheet

C. Quantitative

1. Record the date and time the sample was read and initial the worksheet.
2. Place the tray under 365nm UV light
3. Mark the fluorescing large and small wells with a sharpie
4. Count and record the number of positive fluorescent large and small wells under the appropriate "Blue Fluores. at 24hrs." box on the Colilert Enterolert MTF worksheet
5. Two methods for Most Probable Number (MPN) determination
   a. MPN Table
      i. Locate the number of positive large wells on the vertical axis

ii. Locate the number of positive small wells on the horizontal axis

iii. Where the number of positive large and small wells intersect is the MPN for the sample

iv. Example: Undiluted sample

Large wells	Small wells	MPN
17	5	26.6

v. MPN table is based on undiluted 100mL sample. Dilutions need to be taken into account when reporting MPN

vi. Example: Sample diluted 1:10

Large wells	Small wells	MPN
17	5	266

b. IDEXX MPN Generator

i. Make sure the Generator is in Dilution Mode

- Click "Options" at the top of the IDEXX MPN Generator toolbar
- Select "Use Dilution Mode"
- Save Changes

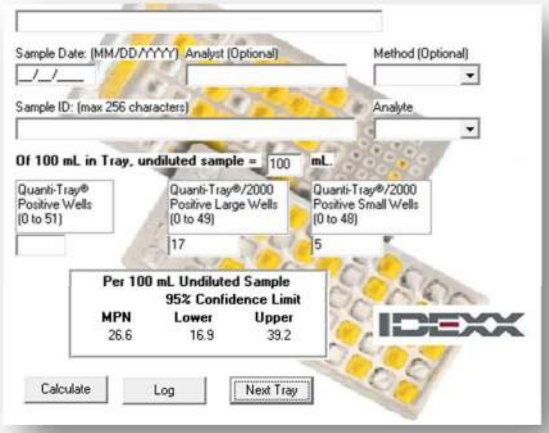
ii. Enter the sample volume tested

iii. Enter the number of positive large and small wells for Quanti-Tray 2000

iv. Click Calculate

v. Result is displayed under MPN with the upper and lower confidence level

c. Record MPN on the worksheet under the "Enterococci MPN/100ml" box



D. For Completed Test

1. Gram stain - *Enterococci* are Gram positive cocci
2. Catalase - The presence of bubbles is a positive reaction. Questionable catalase reaction can be repeated using inoculum from Bile Esculin.
3. Bile Esculin - Blackening of 50% or more of the media is a positive reaction
4. Brain Heart Infusion – Growth or turbidity in the broth at 45ºC is a positive reaction for *Enterococci*
5. 6.5% Salt Tolerance broth - Growth and yellow color of the broth is a positive reaction.
6. Gram-positive cocci that are catalase negative, bile esculin positive, grow in 6.5% NaCl and grow at 45ºC in BHIB, are verified as *Enterococci.*

X. REPORTING

A. LIS Entry

1. Bring up Accession Result Entry (ARE) from the Cerner taskbar and scan or manually enter accession number.
2. Qualitative - Presence / Absence
   a. Free text “Presence” or “Absence” in the ENTIDEXXnum field
3. Quantitative
   a. If applicable, select a qualifier from the drop down box in the ENTIDEXXalp field
   b. Enter the MPN result in the ENTIDEXXnum field
4. Verify after confirming the site and entry
5. Refer to the Reporting section of the LIS User Guide to generate the spreadsheet and send a report to the client.

B. Completed Test

1. Consult with Micro II or Supervising Microbiologist to determine if completed test is for Internal QA/QC of if reporting is required per client request.
2. Internal QA/AC
   a. Record *Enterococcus* biochemical results on the Completed test worksheet and file in the Completed test binder.
3. If reporting is required per client request, follow the steps below:
   a. Open ARE from the Cerner taskbar.
   b. Scan or type the accession number. There is no additional orderable required for the Completed Test.
      i. If the existing orderable has already been verified, select the Mode menu at the top of the screen, and select Correction mode.
   c. Click on the Comment Viewer icon and select Result Comment → Edit Comment.
   d. Enter identification results:

i. Enterolert Completed Test: "[Genus species] by Rapid STR"

ii. To refer to the results from another sample (for example, if there were multiple isolates but only one was worked up): "Refer to accession WL-XX-XXXX for identification"

e. Click the Correct button at the bottom of the screen.

f. Repeat steps **a.** through **e.** for each accession with a Completed Test workup.

g. Open the most recent spreadsheet containing the data for the accession(s) worked up (see LIS User Guide) and perform a Save As, placing your initials at the end of the file name.

h. Add a line to the spreadsheet for each accession with a Completed Test identification. Copy sample information from the previous line, and add the organism identification and ID method:

i. Parameter code field: "Enterococci Identification"

ii. Numeric result and Units fields: Genus and species

iii. Analysis Method field: "Rapid STR"

i. Save the spreadsheet.

j. Repeat steps **g.** through **i.** for all accession numbers worked up.

k. Refer to the Reporting section of the LIS User Guide to send updated spreadsheets to clients.

XI. MAINTENANCE

A. Preventive maintenance of incubators is performed bi-annually by a County approved contractor

B. Quanti-Tray Sealer maintenance and performance check is done monthly by Water lab staff. Refer to Quanti-Tray Sealer Monthly Performance Check QC chart and Quanti-Tray Sealer Maintenance document

C. Long wavelength ultraviolet lamp (365nm) is cleaned monthly by water lab staff.

XII. REFERENCES

A. Standard Methods. (2017). *9230D. Fluorogenic Substrate Enterococcus Test* (23rd ed., pp. 9-122-9-123). American Public Health Association, American Water Works Association, Water Environment Federation.

B. IDEXX Enterolert product insert

C. Quanti-tray 2000 product insert

D. Remel RapID STR System product insert

XIII. RELATED DOCUMENTS

A. Change log

B. LIS User Guide

C. Sample: Collection, Acceptance and Disposal SOP

D. Laboratory Safety Document

E. Quanti-Tray 2000 Trays QC Chart

F. Enterolert Powder QC
G. Quanti-Tray Sealer Performance Check QC Chart
H. Quanti-Tray Sealer Maintenance document
I. Colilert Enterolert MTF worksheet
J. MPN Table
K. Completed Test Worksheet
L. QC Procedures document
M. Gram Stain QC chart
N. 3% Catalase QC chart
O. Bile Esculin Agar Slant QC chart
P. Brain Heart Infusion Broth QC chart
Q. Salt Broth (6.5% NaCl) QC chart

Change Log

Date	Description	Approved By

Attachment B

QUALITY ASSURANCE MANUAL

Babcock Laboratories, Inc.

Located at:

6100 & 6110 Quail Valley Court
Riverside, CA 92507

And

1550 Pepper Drive
El Centro, CA 92243

Mailing address:
PO Box 432, Riverside, CA 92502

Phone:
(951)653-3351

Website:
www.babcocklabs.com

Revision Number:	5.0	Effective Date:	2/28/2021

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Concurrences

Name	Function (Unit)	Signature and Date
Tiffany Gomez*	CEO/President	Tiffany Gomez Digitally signed by Tiffany Gomez DN: C=US, OU=President, O="Babcock Laboratories, Inc.", CN=Tiffany Gomez, E=tgomez@babcocklabs.com Reason: I have reviewed this document Location: your signing location here Date: 2021.02.26 09:36:44-08'00' Foxit PhantomPDF Version: 10.1.1
Bradley Meadows*	Technical Director/Vice President	Brad Meadows Digitally signed by: Brad Meadows DN: CN = Brad Meadows email = bmeadows@babcocklabs.com C = AD O = Babcock Laboratories, Inc. OU = Vice President, Laboratory Director Date: 2021.02.24 17:02:03 -08'00'
Allison Mackenzie*	Executive Vice President of Development, Public Affairs & Advocacy	Allison Mackenzie Digitally signed by: Allison Mackenzie DN: CN = Allison Mackenzie email = amackenzie@babcocklabs.com C = US O = Babcoc Laboratories, Inc. Date: 2021.02.26 12:16:36 -08'00'
Caroline Sangari*	Laboratory Director	Caroline Sangari Digitally signed by: Caroline Sangari DN: CN = Caroline Sangari email = csangari@babcocklabs.com C = US O = Babcock Laboratories, Inc. OU = Laboratory Director Date: 2021.02.23 12:04:31 -08'00'
Stacey Fry*	Quality Assurance Manager	Stacey Fry Digitally signed by: Stacey Fry DN: CN = Stacey Fry email = sfry@babcocklabs.com C = US O = Babcock Labs OU = QA Department Date: 2021.02.23 00:10:25 -08'00'
Julia Sudds	Inorganics Manager	Julia Sudds Julia Sudds 2021-02-25 20:49:37
Marian Fahim*	Client Services Manager	
Valerie Sierzchula	Organics Manager	Carol Kase Valerie Sierzchula
Carol Kase	Microbiology Laboratory Manager	Digitally signed by: Carol Kase DN: CN = Carol Kase C = US O = Babcock Lab OU = Lab Date: 2021.02.24 10:10:53 -07'00'
Melissa Cardenaz	Controller	
Andrea Williams	Human Resource Manager	Andrea Williams Digitally signed by: Andrea Williams DN: CN = Andrea Williams email = awilliams@babcocklabs.com C = AD O = Babcock Laboratories, Inc. OU = Human Resources Date: 2021.02.26 10:48:27 -08'00'

*Approved signatories in addition to authorized members of project management (see personnel files)

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Section 3

INTRODUCTION AND SCOPE
(TNI V1:M2 – Sections 1,2,3)

The purpose of this *Quality Manual* is to outline the management system for Babcock Laboratories, Inc. The *Quality Manual* defines the policies, procedures and documentation that assure analytical services continually meet a defined standard of quality that is designed to provide clients with data of known and documented quality and, where applicable, demonstrate regulatory compliance.

The *Quality Manual* sets the standard under which all laboratory operations are performed, including the laboratory's organization, objectives, and operating philosophy. The *Quality Manual* has been prepared to assure compliance with ISO/IEC 17025:2017 and the 2009/2016 TNI Environmental Laboratory Sector Standard – Volume 1 **–** Management and Technical Requirements for Laboratories Performing Environmental Analysis (EL-V1-M1, M2, M4, M5-ISO-2009/2016).

In addition, the Quality Manual has been prepared to be consistent with the following requirements: AOAC Guidelines for Laboratories, EPA QA/R-2 and the various accreditation and certification programs listed in Appendix E.

3.1 Scope of Testing

The laboratory's scope of analytical testing services includes the analysis of drinking water, wastewater, soils and other matrices including bottled beverages. A detailed list of certified methods can be found in Appendix E of this *Quality Manual*.

3.2 Table of Contents, References and Appendices

The Table of Contents is in Section 2 and Appendices are in Section 29.

This *Quality Manual* uses the references included in Modules 1-7 in the 2009/2016 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis.

Additional references include:

The AOAC International Guidelines for Laboratories Performing Microbiological and Chemical Analyses of Food, Dietary Supplements and Pharmaceuticals April 2015, SW-846, DW Standard Methods, and ASTM.

R105 – Requirements When Making Reference to A2LA Accredited Status, current revision.

3.3 Glossary and Acronyms Used

Quality control terms are generally defined within the section that describes the activity.

For advertising purposes, the use of the terms "A2LA" or "ANAB/ANSI" and the "A2LA Accredited" or "ANAB Accredited" symbols require prior approval from QA and will be done in strict accordance with the most recent version of the accrediting bodies 'advertising policy documents.

3.3.1 Glossary

The *Terms and Definitions* Section of Modules 1, 2, 4 & 5 in the 2009/2016 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis.

Additional definitions can be found in Appendix D of this *Quality Manual*

3.3.1.1 **The TNI Standard:** Modules 1-7 in the 2009 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis (EL-V1, M1 through M7, ISO-2009/2016).

3.3.2 Acronyms

A list of acronyms used in this document and their definitions are:

AB	–	Accrediting Body
ANSI	–	American National Standards Institute
ASQC	–	American Society for Quality Control
ASTM	–	American Society for Testing and Materials
Blk	–	Blank
°C	–	degrees Celsius
cal	–	calibration
CAS	–	Chemical Abstract Service
CCV	–	Continuing calibration verification
CDOC	-	Continuing Demonstration of Capability
COC	–	Chain of custody
DO	–	Dissolved oxygen
DOC	–	Demonstration of Capability
DoD	-	Department of Defense
EPA	–	Environmental Protection Agency
ELAP	-	Environmental Laboratory Accreditation Program
g/L	–	grams per liter
GC/MS	–	gas chromatography/mass spectrometry
IDOC	-	Initial Demonstration of Capability
ICP-MS	–	Inductively coupled plasma-mass spectrometry
ICV	–	Initial calibration verification
ISO/IEC	–	International Organization for Standardization/International Electrochemical Commission
lb/in2	–	pound per square inch

LCS	–	Laboratory control sample
LFB	–	Laboratory fortified blank
LOD	-	Limit of Detection
LOQ	-	Limit of Quantitation
MDL	–	Method detection limit
mg/Kg	–	milligrams per kilogram
mg/L	–	milligrams per liter
MRL	-	Method Reporting Limit/Level
MS	–	Matrix spike
MSD	–	Matrix spike duplicate
NELAC	–	National Environmental Laboratory Accreditation Conference
NELAP	–	National Environmental Laboratory Accreditation Program
NIST	–	National Institute of Standards and Technology
PT	–	Proficiency Test(ing)
PTP	-	Proficiency Testing Provider
PTPA	–	Proficiency Testing Provider Accreditor
QA	–	Quality Assurance
QC	–	Quality Control
QM	–	*Quality Manual* (also may be noted as QAM)
RL	–	Reporting level (limit)
RPD	–	Relative percent difference
RSD	–	Relative standard deviation
SOPs	–	Standard operating procedures
spk	–	Spike
std	–	Standard
TNI	-	The NELAC Institute
ug/L	–	micrograms per liter
UV	–	Ultraviolet
VOC	–	Volatile organic compound
WET	–	Whole effluent toxicity

3.4 Management of the *Quality Manual*

The Quality Manager is responsible for maintaining the currency of the *Quality Manual*.

The *Quality Manual* is reviewed annually by the Quality Assurance Department and laboratory personnel to ensure it still reflects current practices and meets the requirements of any applicable regulations or client specifications. Sections of the manual are updated by making a change to the Section and then increasing the revision number by one. Minor changes made throughout the year will result in the revision number increasing by .1. The cover sheet of the *Quality Manual* (Section 1) must be re-signed and the Table of Contents (Section 2) is updated whenever a Section is updated.

The *Quality Manual* is considered confidential within Babcock Laboratories, Inc. and may not be altered in any way except by approval of the Laboratory Director and Quality Manager. If it is distributed to external users, it is for the purpose of reviewing The Laboratory's management system and may not be used for any other purpose without written permission.

Section 4

ORGANIZATION
(TNI V1:M2 – Section 4.1)

The laboratory is a legally identifiable organization. The laboratory is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, CA ELAP Rules and Regulations, DOD QSM and that meet the needs of the client, regulators or recognition bodies. Through application of the policies and procedures outlined in this Section and throughout the *Quality Manual*:

- The laboratory assures that it is impartial and that personnel are free from undue commercial, financial, or other undue pressures that might influence their technical judgment.

- Management and technical personnel have the authority and resources to carry out their duties and have procedures to identify and correct departures from the laboratory's management system.

- Personnel understand the relevance and importance of their duties as related to the maintenance of the laboratory's management system.

- Ethics and data integrity procedures (see Appendix A, Section 5 – "Management" and Section 19 – "Data Integrity Investigations") ensure personnel do not engage in activities that diminish confidence in the laboratory's capabilities.

- Confidentiality is maintained. Refer to Section 10.1 "Client Confidentiality".

4.1 Organization

The laboratory is a commercial laboratory. The Tax ID and CA corporation numbers are available upon request, if applicable.

The laboratory has locations in Riverside and El Centro CA.

The laboratory's organization chart can be found in Appendix B. Additional information regarding responsibilities, authority and interrelationships of personnel who manage, perform or verify testing is included in Section 5 – "Management" and Section 20 – "Personnel". These Sections also include information on supervision, training, technical management, job descriptions, quality personnel, and appointment of deputies for key managerial personnel.

The laboratory has the resources and authority to operate a management system that is capable of identifying departures from that system and from procedures during testing, and initiates actions to minimize or prevent departures.

4.2 Conflict of Interest and Undue Pressure

The organizational structure indicated above minimizes the potential for conflicting or undue interests that might influence the technical judgment of analytical personnel. In addition, procedures are in place to prevent outside pressures or involvement in activities that may affect competence, impartiality, judgment, operational integrity, or the quality of the work performed at the laboratory.

Arrangements, such as policies and procedures to prevent commercial, financial or other influences that may negatively affect the quality of the work or negatively reflect on the competence, impartiality, judgment or operational integrity are described in the Ethics and Data Integrity manual (Appendix A).

A conflict of interest policy is included in the Ethics and Data Integrity manual (Appendix A). This includes procedures for staff who seek outside employment while employed at Babcock. Please see Section 7 of the Ethics and Data Integrity manual for more information and procedure.

Section 5

MANAGEMENT
(TNI V1:M2 – Section 4.1, 4.2)

The laboratory maintains a management system that is appropriate to the scope of its activities.

5.1 Management Requirements

Management includes the CEO/President, Technical Director/Vice President, Executive Vice President of Development, Public Affairs & Advocacy, Laboratory Director, Department Managers, Controller and QA Manager.

In addition to management, the following staff is considered key managerial personnel: Assistant Managers, Project Managers and IT System Administrator.

Management's commitment to good professional practice and to the quality of its products is defined in the Quality Policy statement, Section 5.3

Management has overall responsibility for the technical operations and the authority needed to generate the required quality of laboratory operations. Management ensures communication within the organization to maintain an effective management system and to communicate the importance of meeting customer, statutory, and regulatory requirements. Management assures that the system documentation is known and available so that appropriate personnel can implement their part. When changes to the management system occur or are planned, management ensures that the integrity of the system is maintained.

Management is responsible for carrying out testing activities that meet the requirements of the TNI Standard, CA ELAP Regulations, the ISO/IEC 17025 Standard, and that meet the needs of the client.

Management activities implement, maintain, and improve the management system, and identify noncompliance with the management system of procedures. Management initiates actions to prevent or minimize noncompliance.

Management ensures technical competence of personnel operating equipment, performing tests, evaluating results, or signing reports, and limits authority to perform laboratory functions to those appropriately trained and/or supervised (Refer to Section 20 – "Personnel" of the *Quality Manual*).

Management is responsible for defining the minimal level of education, qualifications, experience, and skills necessary for all positions in the laboratory and assuring that technical staff have demonstrated capabilities in their tasks.

Training is kept up to date as described in Section 20 – "Personnel" by periodic review of training records and through employee performance review.

Management bears specific responsibility for maintenance of the management system. This includes defining roles and responsibilities to personnel, approving documents, providing required training, providing a procedure for confidential reporting of data integrity issues, and periodically reviewing data, procedures, and documentation. The assignment of responsibilities, authorities, and interrelationships of the personnel who manage, perform, or verify work affecting the quality of environmental tests is documented in Job Descriptions.

Management ensures that audit findings and corrective actions are completed within required time frames.

Designated deputies are appointed by management during the absence of key managerial personnel such as the Technical Director or the Quality Manager, and always if the absence is more than 15 consecutive calendar days.

5.2 Management Roles and Responsibilities

5.2.1 Chief Executive Officer/President

5.2.1.1 Responsibilities

The Chief Executive Officer/President (CEO) is responsible for:

- Develops a strategy for the Corporation to identify the risks and opportunities for the business, including asset and business acquisitions, and for securing the necessary credit and working capital to implement such strategy.
- In consultation with the Board of Directors, and management staff, sets policy objectives and strategy for the operation and expansion of the business, including oversight of the development of operating budgets, sales and profitability targets, product development, quality assurance and the development and retention of customer relationships.
- Provides supervision for all corporate officers and other management personnel and is responsible for monitoring the job performance of such personnel, providing performance feedback and evaluations, and making recommendations to the Board of Directors regarding the hiring, termination and compensation of executive personnel.
- Oversees policies for the supervision, evaluation, retention and compensation of all employees of the Corporation.
- Ensures that the Corporation is in compliance with its regulatory and legal obligations.

5.2.2 Executive Vice President of Development, Public Affairs & Advocacy

5.2.2.1 Responsibilities

The Executive Vice President of Development, Public Affairs & Advocacy (EVPDPA or EVP) is responsible for:

- Oversees the business development team and its operations.
- Develops and implements comprehensive sales plans that meet the objectives of the overall Company strategy.
- Monitors customer, market, and competitor activity and provides feedback to Company leadership team and other business functions.
- Manages key customer relationship and participates in closing strategic opportunities.
- Represents the Company to governmental and third-party regulators, and advocates for policies and issues that support the Company values and are in the best interest of the Company.

5.2.3 Controller

5.2.3.1 Responsibilities

- Develops performance measures, budgets, and financial strategies.
- Monitors cash balances and cash forecasts, arrange for debt and equity financing, and invest funds as applicable.
- Provides supervision of the accounting and finance department.
- Oversees and reviews the preparation of all financial and tax reporting.
- Reviews and audits financial data and internal controls.
- Ensures that the company complies with all legal and regulatory requirements.
- Reports financial results to the board of directors.
- Oversees office equipment management/operations.
- Manages company's legal affairs in areas of bankruptcies, small claims, insurance claims, etc.

5.2.4 QA Manager

The QA Manager (or designee) is independent from laboratory operations, has the responsibility and authority for ensuring that the management system related to quality is implemented, maintained and followed at all times. The QA Manager has direct access to the Technical Director, Laboratory Director and CEO, (refer to Organizational chart in Appendix B). Improvements to the management system are also QA responsibilities. The QA Manager performs these responsibilities using quality tools such as audits, control charts, PT results, data review, corrective actions, preventative actions, process improvements, risk assessment, customer feedback and management reviews. Training and proof of experience in QA/QC procedures and the laboratory's management system are available for the QA Manager upon request. . The Technical Director or Laboratory Directorserve as deputy in the absence of the QA Manager.

5.2.4.1 Responsibilities

The QA Manager is responsible for:

- Ensuring quality system is compliant with appropriate standards such as TNI, ELAP, ISO, DOD.
- Serving as a focal point for QA/QC;

- Have functions independent from laboratory operations in areas of QA oversight
- Evaluating data objectively and performing assessments without outside (e.g., managerial) influence;
- Oversight and review of quality control data;
- Arranging or conducting internal audits annually;
- Notifying management of deficiencies in the quality system;
- Having general knowledge of the analytical methods for which data is reviewed;
- Complete training and/or experience in QA/QC procedures, including the lab's quality system
- Monitoring corrective actions;
- Ensuring that the management system related to quality is implemented and followed at all times;
- Monitoring and maintaining laboratory certifications; and
- Keeping this *Quality Manual* current.

5.2.5 Technical Director/Vice President

The Technical Director (or designee) is a full-time laboratory staff member who overseesin collaboration with the Laboratory Director, the supervision of day-to-day laboratory technical operations and data reporting. The Technical Director, in consultation with the Laboratory Director, is responsible for developing and implementing protocols for all laboratory functions and ensuring that testing performed in the laboratory conforms to recognized standards of accuracy and quality assurance.

If the Laboratory Director is absent for fifteen (15) consecutive calendar days or more, the Laboratory Director, QA Manager or other designee with appropriate qualifications will serve as deputy and perform the Technical Director's duties. Beyond a thirty-five (35) consecutive calendar day absence, management will notify the primary accreditation body in writing of the absence of the Technical Director and the appointment of the deputy.

The Technical Director is not the technical director of more than one accredited environmental laboratory.

5.2.5.1 Responsibilities

The Technical Director/VP is responsible for:

- Meets the Technical Director general and education requirements and qualifications found in Sections 4.1.7.2 and 5.2.6.1 of the TNI Standard - EL-V1M2-2009; 2016.
- Is experienced in the fields of accreditation for which the laboratory seeks or holds accreditation.
- Works with Quality Assurance Manager to ensure the lab's quality system is compliant with appropriate standards such as TNI, ISO, DOD.

- Monitors performance data in QA/QC and the validity of the analyses for the laboratory;
- Participates in and oversees research and methods development for both existing fields of testing and new potential laboratory services.
- Regular methods review, improvements and modifications, in addition to regulatory literature reviews;
- Acts as a technical resource for laboratory staff and assists with method and instrument troubleshooting;
- Reviews methods, testing, quality control and other operational reports to ensure that quality standards, regulatory requirements, efficiencies, and schedules are met.
- Is accountable for the creation and implementation of technology & IT budgets.
- Provides assistance to the Quality Assurance Manager with method and data quality issues, and makes recommendations;
- Serves as a resource for Sales & Marketing, providing technical advice on proposals and client projects.
- Oversees the IT Department and ensures IT objectives are met.

5.2.5.2 Technical Managers

A Technical Manager (TM) is a laboratory staff member who reports directly to the Technical Director and serves as a resource/liaison to the laboratory. A Technical Manager is identified for each section of the laboratory. Each TM is experienced and knowledgeable in the analytical methods, quality control requirements, instrumentation and procedures for the assigned lab section. TMs are responsible for some oversight of day to day operations of their section with a majority of their time devoted to research and method development under the Technical Director's supervision.

5.2.6 Laboratory Director

The Laboratory Director (or designee) is a full-time laboratory staff member who oversees in collaboration with the Technical Director, the supervision of day-to-day laboratory operations and data reporting. The Laboratory Director is responsible for developing and implementing protocols for all laboratory functions and ensuring that testing performed in the laboratory conforms to recognized standards of accuracy and quality assurance. The Laboratory Director is responsible for the Laboratory Managers and all analytical and field staff.

5.2.6.1 Responsibilities

The Laboratory Director is responsible for:

- Oversees daily laboratory operations through direct supervision of Department Managers and lab staff.
- Works with Quality Assurance Manager to ensure the lab's quality system is compliant with appropriate standards such as TNI, ISO, DOD.
- Advises on new potential laboratory services.
- Reviews and monitors on-going laboratory production, service and staffing.
- Works with managers to ensure Turn Around Time and production goals are consistently met.
- Monitors contractual obligations and workload in conjunction with instrumentation and staffing to ensure adequate laboratory capacity.
- Oversees laboratory staff development.
- Develops performance measures for evaluating the profitability of the laboratory operations, including budgeting and capital equipment needs.
- Serves as a resource for Sales & Marketing, providing production, capacity and staffing analytics for proposals and client projects.
- Oversee Facility Maintenance personnel.
- Overseeing the company's safety program through supervision of Babcock Safety Coordinator and Babcock Safety Committee.

5.3 Quality Policy and Core Values

Management's commitment to quality and to the management system is stated in the Quality Policy below. The Quality Policy includes our honor code, purpose and core values and is upheld through the application of related policies and procedures described in the laboratory's *Quality Manual*, SOPs and policies. Along with the Standards of Ethical Conduct (Code of Ethics) outlined in the Ethics and Data Integrity Manual (Appendix A) our Core Values embody the rules of conduct which each employee agrees to follow at Babcock Laboratories.

Quality Policy Statement

The Babcock Labs Quality Policy outlines Babcock's commitment to achieve the highest standards of quality in every area of the company from analytical data to professional services to our clients. This policy is authorized by the CEO and promoted by management. The policy encompasses the lab's standard of service with the following objectives:

- Test methods performed are current and certified to ensure client needs and regulatory requirements are met.
- Requirements of TNI, ELAP and ISO 17025 standards are followed for all certified test methods.
- To ensure improvements in the quality system on an on-going basis and continually assess effectiveness.
- Analytical tests are performed by trained personnel who meet all training requirements and have been trained on this quality system.
- To deal honestly and fairly with staff, clients and the public.
- To consistently fulfill client expectations of service such as TAT and quality of product.
- Ensure only appropriate and properly maintained equipment is used.
- Investigate problems promptly and objectively.

Babcock Honor Code: Endeavor to always do the ***right*** thing.

Babcock Purpose: To safeguard public health and the environment.

Babcock Core Values:

Go the extra mile

Find better ways

Work together

Do the right thing

Own It.

This policy is implemented and enforced through the unequivocal commitment of management, at all levels, to the Quality Assurance (QA) principles and practices outlined in the *Quality Manual*. However, the primary responsibility for quality rests with each individual within the laboratory organization. Every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority. Every laboratory employee is required to familiarize themselves with the quality documentation and to implement the policies and procedures in their work. All employees are trained annually on ethical principles and procedures surrounding the data that is generated. The laboratory ensures that personnel are free from any commercial, financial, and other undue pressures, which might adversely affect the quality of work and maintains a strict policy of client confidentiality.

5.4 Ethics and Data Integrity System

The laboratory has an Ethics and Data Integrity manual that is included in Appendix A. The laboratory's Ethics and Data Integrity program, training and investigations are discussed in Section 19 – "Data Integrity Investigations".

5.5 Documentation of Management/Quality System

The management system is defined through the policies and procedures provided in this *Quality Manual* and written laboratory Standard Operating Procedures (SOPs) and policies. All Quality and Management System documentation is documented and presented in English.

5.5.1 Quality Manual

The *Quality Manual* contains the following required items:

5.5.1.1 document title;

5.5.1.2 laboratory's full name and address(s);

5.5.1.3 name, address (if different from above), and telephone number of individual(s) responsible for the laboratory;

5.5.1.4 identification of all major organizational units which are to be covered by this quality manual and the effective date of the version;

5.5.1.5 identification of the laboratory's approved signatories (Section 28);

5.5.1.6 the signed and dated concurrence (with appropriate names and titles), of all responsible parties including the quality manager(s), technical director, and the agent who is in charge of all laboratory activities, such as the laboratory director;

5.5.1.7 the objectives of the management system and contain or reference the laboratory's policies and procedures;

5.5.1.8 the laboratory's official quality policy statement, which shall include management system objectives and management's commitment to ethical laboratory practices and to upholding the requirements of this Standard; and

5.5.1.9 a table of contents, and applicable lists of references, glossaries and appendices.

In addition, this Quality Manual contains or references:

5.5.1.10 all maintenance, calibration and verification procedures used by the laboratory in conducting tests;

5.5.1.11 major equipment and reference measurement standards used as well as the facilities and services used by the laboratory in conducting tests;

5.5.1.12 verification practices, which may include inter-laboratory comparisons, proficiency testing programs, use of reference materials and internal quality control schemes

5.5.1.13 procedures for reporting analytical results;

5.5.1.14 the organization and management structure of the laboratory, organizational charts;

5.5.1.15 procedures to ensure that all required records are retained, as well as procedures for control and maintenance of documentation through a document control system that ensures that all standard operating procedures (SOPs), manuals, or documents clearly indicate the time period during which the procedure or document was in force;

5.5.1.16 job descriptions of key staff and reference to the job descriptions of other laboratory staff;

5.5.1.17 procedures for achieving traceability of measurements;

5.5.1.18 procedures for ensuring that the laboratory reviews all new work to ensure that it has the appropriate facilities and resources before commencing such work;

5.5.1.19 procedures for handling samples;

5.5.1.20 procedures to be followed for feedback and corrective action whenever testing discrepancies are detected, or departures from documented policies and procedures occur;

5.5.1.21 policy for permitting departures from documented policies and procedures or from standard specifications;

5.5.1.22 procedures for dealing with complaints;

5.5.1.24 procedures for protecting confidentiality (including national security concerns), and proprietary rights;

5.5.1.25 procedures for audits and data review;

5.5.1.26 procedures for establishing that personnel are adequately experienced in the duties they are expected to carry out and are receiving any needed training;

5.5.1.27 policy addressing the use of unique electronic signatures, where applicable.

5.5.2 Standard Operating Procedures (SOPs)

Standard operating procedures (SOPs) represent all phases of current laboratory operations. They include an effective date, revision number, and signature of the approving authorities and are available to all personnel. They contain sufficient detail such that someone with similar qualifications could perform the procedures. There are two types of SOPs used in the laboratory: 1) Technical SOPs (T) including test method SOPs, which have specific requirements as outlined below, and 2) General use SOPs (G) which document general procedures.

Qualifications for approving authorities for SOPs are as follows:

- Must have experience with and comprehension of the technology or process
- Have read or have experience of referenced methods in SOP

Each accredited analyte or method has an SOP. Sometimes an SOP is a copy of a method, and any additions are clearly described. The laboratory's test method SOPs include the following topics, where applicable:

i. identification of the method;
ii. applicable matrix or matrices;
iii. limits of detection and quantitation;
iv. scope and application, including parameters to be analyzed;
v. summary of the method;
vi. definitions;
vii. interferences;
viii. safety;
ix. equipment and supplies;
x. reagents and standards;
xi. sample collection, preservation, shipment and storage;
xii. quality control;
xiii. calibration and standardization;
xiv. procedure;
xv. data analysis and calculations;
xvi. method performance;
xvii. pollution prevention;
xviii. data assessment and acceptance criteria for quality control measures;
xix. corrective actions for out-of-control data;
xx. contingencies for handling out-of-control or unacceptable data;
xxi. waste management;
xxii. references; and
xxiii. any tables, diagrams, flowcharts and validation data.

*For additional DOD SOP requirements see Appendix L Section 5

5.5.3 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows unless otherwise noted:

Quality Manual
SOPs and Policies
Other (Work Instructions (WI), memos, flow charts, etc.)>

Section 6

DOCUMENT CONTROL
(TNI V1:M2 – Section 4.3)

This Section describes how the laboratory establishes and maintains a process for document management. Procedures for document management include controlling, distributing, reviewing, and accepting modifications. Documentation for management system reviews are maintained and available during assessments upon request. The purpose of document management is to preclude the use of invalid and/or obsolete documents.

Documents can be SOPs, policy statements, specifications, calibration tables, charts, textbooks, posters, notices, memoranda, software, drawings, plans, etc. These may be on various media, whether hard copy or electronic, and they may be digital, analog, photographic or written.

The laboratory manages three types of documents: 1) controlled, 2) uncontrolled, and 3) obsolete.

A controlled document is one that is uniquely identified, issued, tracked, and kept current as part of the management system. The controlled document is reviewed, and either signed and dated, or acknowledged in writing or by secure electronic means by the issuing authority(ies). Controlled documents may be internal documents or external documents. Forms used by staff and verified spreadsheets for data acquisition are controlled prior to use. These documents provide instruction or guidance.

Uncontrolled documents are those which have not been reviewed, approved, provided a unique ID or documented in the lab's quality management system or master list. Post-its and handwritten notes are uncontrolled and should not be used for instruction or guidance. Any uncontrolled document must clearly be identified as "Uncontrolled.

Obsolete documents are documents that have been superseded by more recent versions or are no longer needed.

6.1 Controlled Documents

The most current electronic version of the documents is tracked, maintained and controlled by the QA department on the Babcock Server.

Controlled internal documents are uniquely identified with 1) a unique name or number identification 2) effective date, 3) revision identification, 4) page number, 5) the total number of pages (or a mark to indicate the end of the document), and 6) approvers initials. SOPs contain the signatures of the approving and issuing authorities.

Documents are periodically reviewed as needed and during audits, to ensure their contents are suitable and in compliance with the current management systems requirements, and accurately describe current operations.

Internal documents created for guidance and aid are controlled. These internal documents may not be utilized by staff until the document has been approved by a member of management or designee, uniquely identified as described above and added to the lab's Master List of documents. The use of uncontrolled documents by staff is prohibited.

Original electronic versions of controlled documents are limited to personnel with authorized access to alter. Approved unalterable documents are located on the Babcock Server and access is available to staff at all locations where operations are essential to the effective functions of the laboratory.

A master list of controlled internal and external documents is maintained that includes the current revision status and distribution to staff. Where external manuals, reference books, or methods are controlled, they are identified by title, author, copyright date, or date of publication. The controlled document list is maintained by the QA Department and is updated on a continuous basis.

Re-printed electronic documents located in areas that are not indicated as points of distribution on the master list are not controlled. A note must be placed on any of these printed documents labeling them as uncontrolled and containing the date printed. It is the responsibility of the document holder to ensure he/she is following the most current document. The QA department shall ensure electronic copies of controlled documents are available on the Babcock server, hard copies are distributed as stated on the master list and notify the appropriate personnel when revisions are posted.

Controlled documents may not be taken from company property or sent electronically without written permission from management.

6.1.1 Document Changes to Controlled Documents

Amendments to controlled documents made manually by hand are not permitted. Suggested revisions to controlled documents are added and tracked electronically to a draft version and presented for review and approval to the appropriate manager or designee that performed the original review unless specifically designated otherwise. The designated personnel shall have access to pertinent background information upon which to base their review and approval. Once changes are accepted and approved a member of the QA department updates the revision number and effective date and creates a revision log, if applicable. The revision log and updated document are made available for all staff to review before the effective date. In the event that a revision cannot be made immediately, the amendment may be added (with subscripted date and initials) to the current controlled version by member of the QA department. Notification of the amendment to affected staff and any needed training will be documented in a memo as needed. With approval from a member of

management, a draft containing significant changes may be used by staff on a temporary basis until the new controlled document is issued.

All original readings of SOPs are documented by a wet signature or electronically in the lab's QA document software (Qualtrax) for new or revised SOPs. Acknowledgement of subsequent SOP revisions is documented electronically on the Babcock Server in Qualtrax.

More detailed information on SOP modification can be found in the G-100-SOP Review and Modification standard operating procedure located on the server.

6.2 Obsolete Documents

All invalid or obsolete documents are removed from general distribution, or otherwise prevented from unintended use.

Obsolete documents retained for legal use or historical knowledge preservation are appropriately marked and retained on the Babcock Server.

Section 7

REVIEW OF REQUESTS, TENDERS AND CONTRACTS
(TNI V1:M2 – Section 4.4)

The review of all new work assures that oversight is provided so that requirements are clearly defined, the laboratory has adequate resources and capability, and the test method is applicable to the customer's needs. This process assures that all work will be given adequate attention without shortcuts that may compromise data quality.

Contracts for new work may be formal bids, signed documents, verbal, or electronic. The client's requirements, including the methods to be used, must be clearly defined, documented and understood. Requirements might include target analyte lists, project specific reporting limits (if any), project specific quality control requirements (if any), turnaround time, and requirements for data deliverables. All reviews must also cover any work that will be subcontracted by the laboratory. Special method instructions/requests that deviate from established laboratory protocol may be noted on the Chain of Custody or contained in the QAPP or RFP stored in CopierScans.

The review process is repeated when there are amendments to the original contract by the client. The participating personnel are informed of the amendments. The amendments are maintained in Element and the client's files.

A member of Client Services informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. The client must also be contacted if laboratory accreditation is suspended, revoked, or voluntarily withdrawn.

7.1 Procedure for the Review of Routine Work Requests

A member of the project management team reviews the Chain of Custody and confirms that the laboratory has any required certifications, can meet the client's data quality and reporting requirements, and has the capacity to meet the clients turn around needs. This review is documented on the work order and in the form of the change in status from "Received" to "Available" in the Element LIMS. The date and initials indicates that the PM or PMA has reviewed the incoming work order and has resolved all the operational and quality considerations for the laboratory to meet the customer's needs.

That review should encompass but not be limited to the following:

- method capabilities, analyte lists, reporting limits, and quality control limits
- turnaround time feasibility

7.2 Procedure for the Review of New Work Requests with no additional terms and conditions

For new work requests based on Babcock Laboratories' Standard Terms and Conditions, a member of the sales team reviews the request and issues a tender in the form of a bid. This review confirms that the laboratory has any required certifications, can meet the client's data quality and reporting requirements, and has the capacity to meet the client's turn around needs. A member of management may be consulted as needed to complete the review. The review of the request and tender is documented on the bid in Element with the reviewer identified as the Laboratory Contact on the Element bid screen.

That review should encompass but not be limited to the following:

- method capabilities, analyte lists, reporting limits, and quality control limits
- turnaround time feasibility
- QA/QC issues, including certification/accreditation
- final report formatting and electronic deliverable documents
- time required to keep sample in house
- final sample disposal requirements

7.3 Procedure for the Review of New Work Requests with additional terms and conditions

For new, complex or large projects, with non-Babcock Terms and Conditions, the proposed work contract is forwarded to the VP, Executive VP or the CEO to evaluate such items as:

- contractual obligations, bonding issues and payment terms
- general, workman's compensation, automobile and professional liability requirements
- penalties, remedies, and/or liquidated damages
- indemnity and defense requirements
- contract termination conditions

These items are in addition to all those mentioned above although the review of those details may be delegated as needed by the VP, Executive VP or the CEO.

The assigned sales associate submits the bid and formal quote to the client and copies of all signed contracts are maintained on the server. These signatures indicate the review of the request for proposal, the response and the contract.

The client is informed of any deviation from the contract including the test method or sample handling processes. All differences between the request and the final contract are resolved and recorded before any work begins. It is necessary that the contract be acceptable to both the laboratory and the client. This information is stored in the client's files located on the Babcock server.

7.4 Documentation of Customer Communication

Records are maintained for every contract or work request, when appropriate. This includes pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract.

Records of all project-related communication with the client (including e-mails, fax, telephone conversation etc.) are kept in the following locations:

- Documentation of reviews and any significant changes to contracts are kept up-to-date in the client’s file on the server by the Project Managers or Sales Staff.
- As required, Element is also updated to reflect any project changes or special requests.
- All phone conversations with clients are recorded in NetSuite.
- The client is informed of any deviations from the contract via phone or in writing via email or letter.

For additional DOD data review requirements see Appendix L Section 7

Section 8

SUBCONTRACTING OF ENVIRONMENTAL TESTS
(TNI V1:M2 – Section 4.5)

A subcontract laboratory is defined as a laboratory external to this laboratory, or at a different location than the addresses indicated on the front cover of this manual, that performs analyses for this laboratory. Work may subcontracted temporarily due to unforeseen reasons such as workload, capacity, and instrumentation issues, etc. Work for which the laboratory does not hold accreditation, may be subcontracted on a continuous basis to an approved subcontractor who meets certification and regulatory requirements.

When subcontracting analytical services, the laboratory assures work requiring accreditation is placed with an appropriately accredited laboratory or one that meets applicable statutory and regulatory requirements for performing the tests.

When work is performed at more than one laboratory location all documentation, COC and final reports clearly notes which location performed the analytical work.

8.1 Procedure

The Client Services Manager or designee maintains a list of subcontractors.

A copy of the certificate and analyte list from subcontractors is maintained as evidence of compliance. This information is maintained by Client Services and Business Development and is kept on the Babcock server.

The certificate and analyte list are reviewed by Client Services or Business Development to ensure the subcontracting laboratory has the appropriate accreditation to do the work.

Client is notified in original contract of the intent to subcontract work for specific analysis. If subcontracting is not part of the original contract, Project Managers must notify the client of the intent to subcontract future work, and when possible, approval is recorded in the client's file.

Samples will only be subcontracted to certified laboratories which meet the client's regulatory requirements.

The laboratory performing the subcontracted work is identified in the final report. The laboratory assumes responsibility to the client for the subcontractor's work, except in the case where a client or a regulating authority specified which subcontractor is to be used.

*For additional DOD Subcontracting requirements see Appendix L Section 8

Section 9

PURCHASING SERVICES AND SUPPLIES
(TNI V1:M2 – Section 4.6)

The laboratory ensures that purchased supplies and services that affect the quality of environmental tests are of the required or specified quality, by using approved suppliers and products. Supplies and services used by the laboratory that may affect the quality of analytical tests are standards, reagents, solvents, sample containers, calibrations of scales, balances and pipettes, etc.

The laboratory has procedures for purchasing, receiving, and storage of supplies that affect the quality of environmental tests.

9.1 Procedure

The Lab Director reviews and approves the purchase of services and supplies and approves the content of purchasing documents prior to ordering. The Technical Director and Quality Manager may be consulted as needed to determine the suitability of any new supply or service as outlined below. The following criteria will be used to review and approve supplies and services.

- Ensure that supplier meets technical specifications.
- Ensure that supplier holds appropriate accreditation(s)
- Ensure that certified reference materials are purchased and used where required. For example, reference materials used for work under ISO 17025 scope should be obtained from a Guide 34 reference material producer.
- Ensure any required documentation is requested at time of purchase such as Certificates of Analysis, SDS, product instructions, etc
- Review vendor notes for staff feedback.

Evaluation of suppliers and purchased supplies is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. By signing the packing slip or other supply receipt documents the received material is approved for use. The purchasing documents contain the data that adequately describes the services and supplies ordered. The description may include type, class, grade, identification, specifications or other technical information.

The supplies received are inspected for breakage, leaks or any other damage. The supplies and chemicals are checked for date of manufacture, expiration date, concentration, grade, storage conditions, etc. (where applicable). The supplies received are stored according to manufacturer's recommendations, laboratory SOPs or test method specifications.

Any documents received with the supplies and services including specifications, certificates of analyses, warranties, maintenance records, calibration records etc are kept with Element maintenance logs or on the Babcock server.

The purchased supplies and reagents that affect the quality of the tests are not used until they are inspected or otherwise verified as complying with requirements defined in the test method. Items are stored in designated areas and maintained by an internal inventory system.

9.2 Approval of Suppliers

The Purchasing Department maintains a list of approved suppliers.

Suppliers are approved through the procedure outlined above. For the purchase of capital equipment and use of new vendors or supplies for analytical testing the Technical Director, Quality Manager or approved Technical Manager may be consulted to ensure supplier meets laboratory, quality and accreditation requirements for a particular department or methodology.

A list of approved suppliers is maintained in the company's NetSuite inventory program. Staff feedback will be used to assess continued suitability. If a supplier is determined as not meeting the quality or technical requirements needed, supplier will no longer be used. Notes identifying a supplier who is not approved for use will be kept in the vendor notes in NetSuite and reviewed before approval of purchases.

Section 10

SERVICE TO THE CLIENT
(TNI V1:M2 – Section 4.7)

The laboratory collaborates with clients and/or their representatives in clarifying their requests and in monitoring laboratory performance related to their work. Each request is reviewed to determine the nature of the request and the laboratory's ability to comply with the request within the confines of prevailing statutes and/or regulations without risk to the confidentiality of other clients.

10.1 Client Confidentiality

The laboratory maintains a strict client confidentiality policy (see Figure 10-1 below) which is reviewed with and agreed upon with each employee at their time of hire.

All Electronic communication between staff and clients or their representatives includes the following statement:

Note: The information in this message may be privileged and confidential and protected from disclosure. If the reader of this message is not the intended recipient, or an employee or agent responsible for delivering this message to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you received this communication in error, please notify us immediately by replying to the message and deleting it from your computer. Thank you.

10.2 Client Support

Communication with the client, or their representative, is maintained to provide proper instruction and modification for testing. Project managers are assigned to each client. Technical staff is available to discuss any technical questions or concerns the client may have.

The client, or their representative, may be provided reasonable access to laboratory areas for witnessing testing.

Delays or major deviations to the testing are communicated to the client immediately by Project Management using our Non-Conformance process (see Section 12 "Control of Non-Conforming Environmental Testing Work").

The laboratory will provide the client with all requested information pertaining to the analysis of their samples. An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

*For additional DOD client support see Appendix L Section 10

10.3 Client Feedback

The laboratory seeks both negative and positive feedback from its clients. Feedback provides acknowledgement, corrective actions where necessary, and opportunities for continuous improvement.

Negative customer feedback is documented as a customer complaint (see Section 11 – "Complaints").

On an on-going basis, clients are asked to complete a Client Satisfaction Survey The survey is sent to clients via email through the company CRM (NetSuite).Clients have the ability to complete the survey at any time and more than once if they wish. As incentive to complete the survey, clients who participate are entered into a drawing for a small gift. Questions asked cover various areas of service, including: Customer Service, Overall Quality of Services, Professional/Technical Resource, Completeness of Services , Field Services and Testing Services. An example of some of the Customer Satisfaction Survey Questions included in the survey:

- Based on your most recent experiences, please rate your satisfaction with your project manager's performance for each of the following, Responsiveness, Knowledge, overall.
- Have you recently utilized Babcock Lab's field services? If yes, please rate your level of satisfaction regarding your interaction with our staff.
- Have you recently interacted with sample receiving staff? If yes, please rate your level of satisfaction regarding your interaction with our staff.

Results from each survey are shared with staff and saved on the Babcock Server.

Survey questions have available an area for comment, and request that if not rating a maximum high rating, then to comment on how to improve the rating.

Tabulated average results are shared in department meetings. Selected client comments are compiled and shared directly with staff (office, lab and field) involved with particular work associated for that client.

When comments are unclear, require clarification, or indicate a potential problem, the assigned project manager and/or Client Services Manager take(s) the appropriate action to investigate and resolve the issue, including communication with the client. The QA department may assist with the investigation and any corrective action. Follow-up activities include consultation with Client Services, Project Management, the Lab Director, the Technical Director or CEO, depending on the situation.

Client communications are recorded in the lab's CRM, NetSuite.

Figure 10-1 Client Confidentiality Agreement

BABCOCK Laboratories, Inc.
The Standard of Excellence for Over 100 Years

Client Confidentiality Agreement

I. **Purpose.** The purpose of this Confidentiality Agreement is to protect the identity, privacy and data information of our clients. Staff may encounter sensitive information that is the proprietary property of our clients. Therefore, to avoid causing material harm or violating client confidentiality agreements between Babcock Laboratories, Inc. and our clients, it is imperative that employees refrain from disclosing any information about our clients to a third party.

II. **Confidential Information.** Under no circumstances may confidential client information, such as sample information or analytical results, be discussed in the presence of third parties, except under the Terms outlined below. No files, documents and/or analytical results containing confidential information are to be shared or released to third parties, except under the Terms outlined below. Confidential information includes, but is not limited to, the following:

1. Analytical statuses, results, lab reports, or any forms of data.
2. Sample Information.

III. **Terms.** By signing this Confidentiality Agreement, you agree to adhere to the highest ethical standards and to abide by the following provisions:

1. Client Calls: Babcock Laboratories staff must verify that a client calling to request test results or other proprietary information is listed as an authorized contact in the Babcock CRM or LIMS databases for the specific client for which the caller is requesting information. Once the caller has been verified as an authorized contact, test results may be given.
2. Authorized Contact: Authorized contacts are listed by the client on the New Client Information and/or Client Information Update forms. These individuals are permitted to receive test results and reports.
    i. Contacts are added to the CRM and/or LIMS databases by a member of the Babcock customer service department. Additional authorized contacts may be added when requested by a current authorized contact. Documentation of this authorization must be retained in the CRM database.
3. Electronic Transmission of Results: If a person requests results and/or a copy of a report and is listed in the CRM or LIMS databases, results will only be emailed or faxed to the email address and fax number listed in the databases. If a sample request contact email/fax is different from the authorized contact listed in the CRM or LIMS databases, the authorized contact is contacted for consent to send results to both contacts. An ongoing consent note may be placed in the CRM and LIMS databases, per the authorized contact's request.
4. Employee Separation/Legal Proceedings: Client confidentiality shall be maintained, and all Babcock Laboratories, Inc. trade secrets, mailing lists, trade agreements and confidential information shall be returned to Babcock Laboratories prior to termination of employment. If any confidential information is sought for legal process, notify Babcock Laboratories directly and cooperate in maintaining confidentiality during proceedings.

My signature below certifies that I understand, and agree to adhere to, the forgoing policies.

Employee Signature Date

Print Name

Section 11

COMPLAINTS
(TNI V1:M2 – Section 4.8)

The purpose of this section is to assure that customer complaints are addressed and corrected. This includes requests to verify results or analytical data. Complaints provide the laboratory an opportunity to improve laboratory operation and client satisfaction.

Complaints by customers or other parties are reviewed by management and an appropriate action is determined. All customer complaints are documented by the person receiving the complaint and addressed to the responsible manager or designee.

Complaints questioning analytical results, reports or execution of project specific requests are documented using a Client Request Form (CRF). See Figure 11-1 for an example of this form. Upon the completion of any investigations or re analysis documented on the form, the client is contacted with the response to the complaint. Where an error is identified, an amended report is issued.

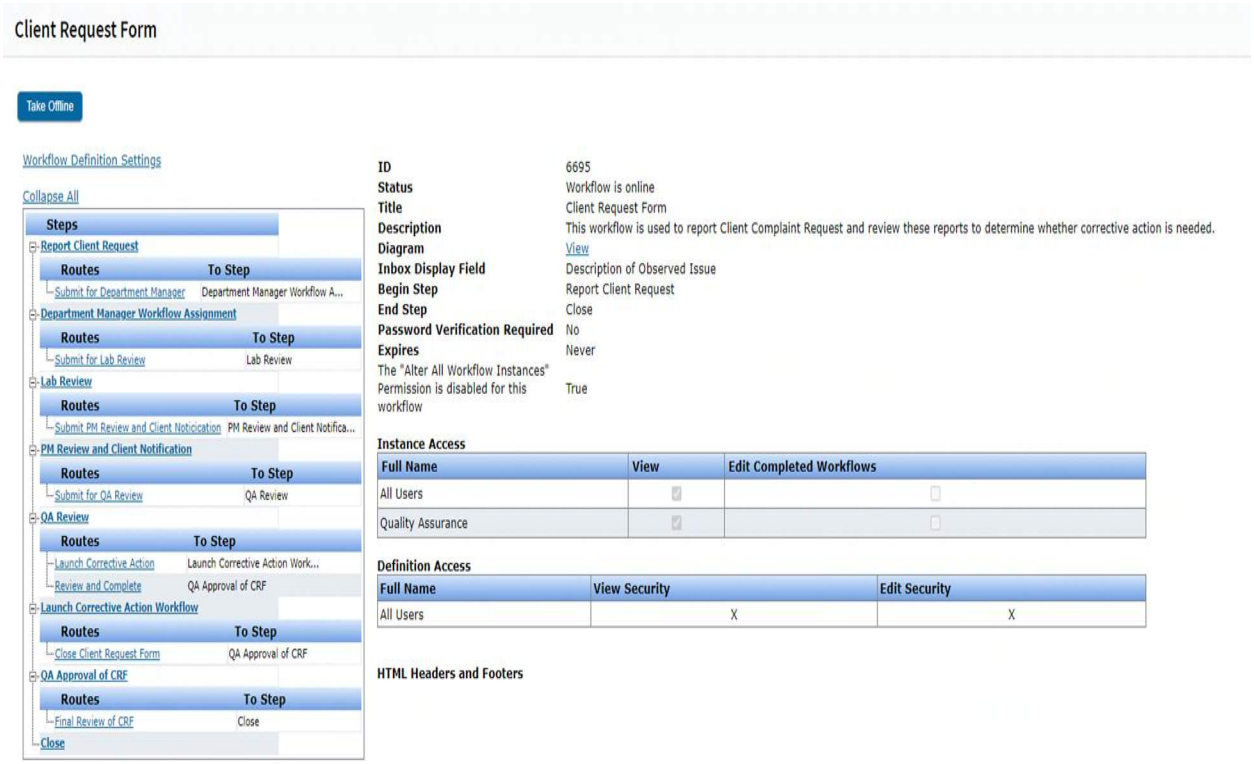
Complaints regarding our standard of service such as ability to meet requested turnaround time are documented in the lab's CRM (NetSuite) by the person receiving the request and may be reviewed for preventive action (see Section 15 – "Preventive Action") or risk assessment to minimize a future occurrence.

All complaints that result in a CRF are addressed inside Qualtrax, as an urgent priority so they can be resolved in a timely manner. Complaints or client requests should be addressed in less than 48 hours, where practical. The responsibilities and authorities for the completion of the CRF are detailed as follows:

- Upon receiving the complaint from the customer, the Project Manager or Project Manager Assistant is responsible for initiation of the CRF and submittal to the involved Department Manager(s). The form must be filled out completely and all pertinent information documented so that any required investigations and verifications can be carried out.
- The Department Manager is responsible for facilitating any follow up, verification, investigation and corrective action needed in order to resolve the complaint. A laboratory result is validated as follows:
    - Raw Data is examined to determine if calculations are correct, any dilutions were noted correctly and the proper volume was used.
    - Supporting QC is examined to determine if batch was in compliance.
    - Sample bottles are examined to determine if properly labeled and preserved and if the sample appearance supports the result.
- The Department Manager or designee is also responsible for completion of the required sections of the CRF, any necessary status updates and submittal of form back to the Project Manager.
- Upon receiving the CRF, the Project Manager is responsible for communication with the client regarding the resolution to the complaint, and issuing any amended reports if needed. Once documentation reflects all actions taken, the Project Manager is responsible for submitting the form to Quality Assurance. The Project Manager Assistant also performs CRF procedures as needed.

- The QA Manager or designee may be consulted at any time and is responsible for review of the completed form to ensure that proper action was taken and initiation of any formal corrective action when needed.

Figure 11-1 Example of Client Request Form (CRF)-Qualtrax



Client Request Form

View Printable Version Delete

ID 6846
Current Step is Close
History

Close

IMPORTANT: Read instructions before proceeding

If this was **reported by a customer**, use the Client Request Form Workflow
If this was **reported internally**, use the Nonconformance Report Workflow

Source
Customer Feedback

Customer/Company Name
Test

Work Order Number
Test

Batch
Test

Sample Names
Test

Analysis/Method or subject in question
Test

If other

Description of Observed Issue
Provide as much detail as you're able about the observed issue- including a detailed description and date(s)
Test

Department Manager(s)
Kitiya R. Veazey(538)

Analyst Involved in Preparation and/or Analysis
Kitiya R. Veazey(538)

Initial Result Reported
test

RE Result
test

Within Range?
Yes

Analyst Response to Client Request
Select all that apply
RE Confirmed

PM
Kitiya R. Veazey(538)

Client Notified?
Yes

Status Updated?
Yes

Price Discounted?
No

Analysis Cancelled?
No

Results Reported?
Yes

Client to Resample?
No

Report Amended?
No

Client Notification Details
Please provide details of client notification here. For supplemental attachments, please use the Supplemental Documentation field above.
test

Reason for Amendment
test

Section Involved
Laboratory

Person Responsible
Kitiya R. Veazey(538)

Summary for Monthly Report
test

QA Comments- Review of Observed Issue
test

Corrective Action Needed?
If "Yes", please complete the Nonconformance Report subform below to launch a Corrective Action workflow
No

Personnel Responsible for Root Cause Analysis

Work Stopped?
No

Date Work Stopped
If work was stopped, include date here

Date Work Resumed

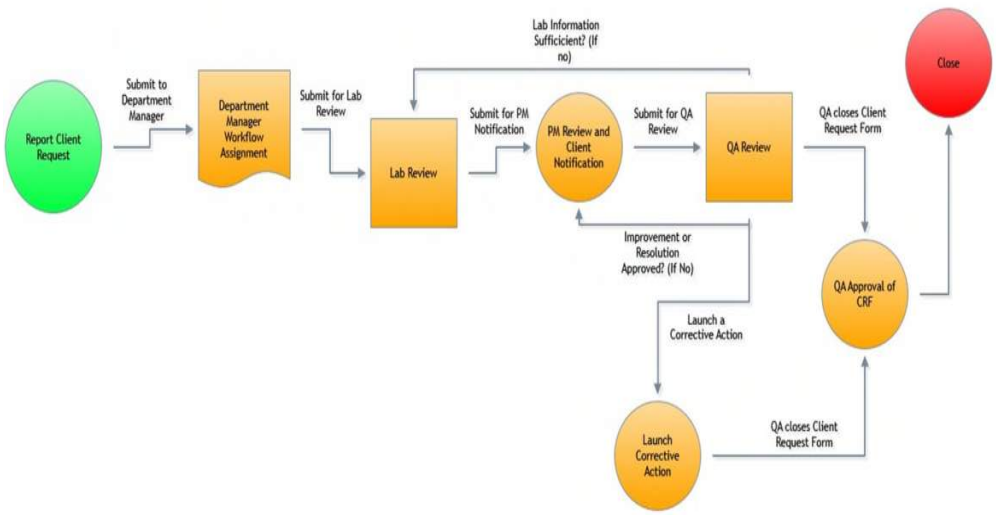
Department(s)
Lab-Metals

Section(s)
Laboratory

Improvement or Resolution Approved?
Yes

Is Lab Information Sufficient?
Yes

Acknowledgement of All Parties Involved
Select every person that this issue was discussed with
Kitiya R. Veazey(538)



Section 12

CONTROL OF NON-CONFORMING ENVIRONMENTAL TESTING WORK
(TNI V1:M2 – Section 4.9)

Non-conforming work is work that does not meet acceptance criteria or requirements. Nonconformances can include departures from standard operating procedures or test methods or unacceptable quality control results (see Section 27 – "Quality Assurance for Environmental Testing"). Identification of non-conforming work can come through customer complaints, quality control, instrument calibrations, evaluating consumable materials, staff observation, final report review, management reviews and internal and external audits.

12.1 Exceptionally Permitting Departures from Documented Policies and Procedures

Requests for departures from laboratory procedures are approved by the Laboratory Director or QA Manager and documented. Planned departures from procedures or policies do not require audits or investigations.

In the event that it is necessary to deviate from a documented policy, procedure or specification, several steps must be taken for approval of the exception. The Laboratory Director and QA Manager, if needed, meet to discuss and research the proposed exception. When circumstances are such that the QA Manager and Lab Director agree that permission to deviate from policy, procedure or specification is warranted, the following steps must be taken.

- Where applicable, the client is contacted for approval of the proposed change in procedure and verbal or written approval is requested and receipt verified.
- The agreed upon change in policy, procedure, or specification is documented and kept in the project file.
- Copies of the change are attached to the analytical records, where applicable.
- Copies of the change are attached to the review reports for any analyses directly related to the change.
- Copies of the change are filed in the client report file.

12.2 Non-Conforming Work

The lab policy for control of non-conforming work is to identify the non-conformance, determine if it will be permitted, and take appropriate action. All employees have the authority to stop work on samples when any aspect of the process does not conform to laboratory requirements.

The procedure for investigating and taking appropriate corrective actions of non-conforming work are described in Section 14 – "Corrective Action". Section 14.3 describes procedures for Technical Corrective Actions. Formal corrective action procedures must be followed for non-conforming work that could reoccur (beyond expected random QC failures) or where there is doubt about the laboratory's compliance to its own policies and procedures.

The investigation and associated corrective actions of non-conforming work involving alleged violations of the company's Ethics and Data Integrity policies must follow the procedures outlined in Section 19 – "Data Integrity Investigations".

The laboratory evaluates the significance of the non-conforming work, and takes corrective action immediately. Samples are reanalyzed if possible in order to prevent the need to report Non-Conforming data to the client. The client is notified if a situation occurs that affects the reporting of data and requires client communication through the use of a Non-Conformance Report (NCR) form. See Figure 12-1 for an example of this form. Even though results are properly qualified, an NCR form must be initiated so client can be contacted regarding the nonconformance and determine whether they want qualified results reported. Clients are notified of nonconforming work through the procedures below.

The procedure, responsibilities and authorities for the management of non-conforming work are detailed as follows. The QA Manager may be consulted at any time:

- All employees are responsible for identifying and reporting situations involving a non-conformance. Upon discovery of the situation, it is imperative that the status of the analysis in question be updated to a status of "pending" in ELEMENT so it is not inadvertently reported, if applicable.
- If reanalysis is not possible, the Department Manager or their designee is responsible for the initiation and submittal of the NCR form to the Project Manager. The NCR form is initiated in Qualtrax under Workflows NCR. The "Report Possible Nonconformance" section of the NCR form is filled out completely.
- The form must be filled out completely and all pertinent information documented prior to client notification to ensure the Project Manager has the information needed to discuss the issue with the client.
- The PM may be notified of the internal issue ASAP by phone, email or in person, but a form should be created and sent to the PM within 48 hours to ensure the nonconformance is documented, addressed and client notification is performed in a timely manner. Clients are notified of the nonconformance at the time it is discovered and the NCR form is initiated, but at a minimum notification must be performed within fifteen days from discovery of the nonconformance.
- Upon receipt of the NCR form, the Project Manager is responsible for clarification of the information provided on the NCR form, verification of data qualifiers or notes from lab and communication with the client regarding the nonconformance.
- Once notified of the nonconformance, the client advises the PM regarding which action they want taken. The client may want the nonconforming data reported with appropriate qualifiers, cancelled, re-sampled, etc. depending on their requirements.
- Upon client notification, the PM updates the "PM Review and Client Notification" section of the NCR form to document the client's decision regarding the nonconforming work. The form is updated to document client's response, whether results were reported, cancelled, re-sampling required; a report amendment was needed, etc.
- Staff involved in the NCR issue is acknowledged on the form.

- Once client notification is completed, the QA department is responsible for review of the completed NCR form to ensure that proper corrective action was taken and initiation of any formal corrective action when needed.
- Completed forms are maintained inside of Qualtax and are accessible to staff.

The following are examples of situations requiring the initiation of a NCR form:

- Sample breakage occurs or not enough sample is available for analysis or re-analysis.
- Results in a batch must be reported with a properly qualified LCS/BS failure.
- A sample result must be reported with an unacceptable number of properly qualified Surrogate failures.
- Missed regulatory holding time.
- QC procedures were not followed correctly and data is inadvertently released to the client. (For example, samples from a run that contains out-of-control QC such as the LCS/LFB, MB, calibration checks, or invalid calibration curve without the proper note accompanying the data.) Client must be contacted and report amended.
- Departures from standard operating procedures or test methods that were not permitted and agreed upon with client.
- Erroneous sample data is inadvertently released to client. Client must be contacted and report amended.

The laboratory allows the release of non-conforming data only with approval by the Technical Director, Lab Director or QA Manager on a case-by-case basis. Non-conforming data is clearly identified in the final report (see Section 28 – "Reporting the Results").

The discovery of a nonconformance for results that have already been reported to the customer must be immediately evaluated for significance of the nonconformance, its acceptability to the customer, and determination of the appropriate corrective action.

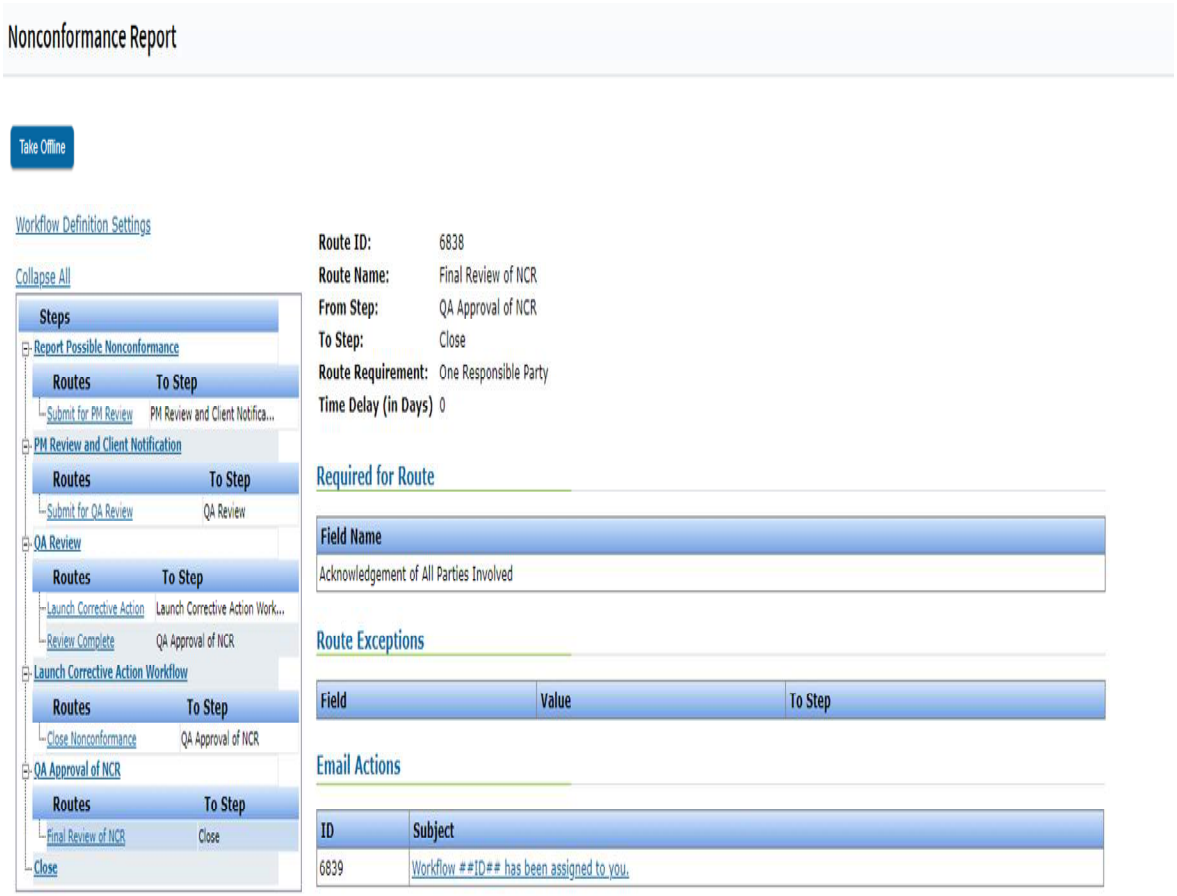
*For additional DOD Nonconformance requirements see Appendix L Section 12

12.3 Stop Work Procedures

Employees have Stop Work Authority for activities in their immediate work area regarding unsafe conditions or situations affecting conformance to the policies and procedures of Babcock Laboratories, Inc. For activities outside their immediate work area, employees are obligated to communicate any unsafe or non-conforming conditions to a member of management. Please refer to Appendix A "Ethics and Data Integrity Manual" for more information on Stop Work Procedures.

Resumption of work after work has been stopped is authorized by a member of management

Figure 12-1 Example of Non-Conformance Reporting Form



Nonconformance Report

View Printable Version Delete

ID 6841
Current Step is Close
History

Close

IMPORTANT: Read instructions before proceeding

If this was **reported by a customer**, use the Client Request Form Workflow
If this was **reported internally**, use the Nonconformance Report Workflow

Source
Internal Issue

Customer/Company Name
test

Work Order Number
test

Batch
test

Sample Names
test

Nonconformance Report
The subform below should be completed when the observed issue is determined to require corrective action

Date of Occurrence	Department(s)	Section(s)	Standard(s)	Description of Observed Issue	Immediate Action Taken	Supporting Documentation
	Lab-Metals	Laboratory				

PM
Kitiya R. Veazey(538)

Analysis/Method or subject in question
test

Reason
QC Failure

If other

Description of Observed Issue
Provide as much detail as you're able about the observed issue- including a detailed description and date(s)
test

Client Notified?
Yes

Status Updated?
Yes

Price Discounted?
No

Analysis Cancelled?
No

Results Reported?
Yes

Client to Resample?
No

Report Amended?
No

Client Notification Details
Please provide details of client notification here. For supplemental attachments, please use the Supplemental Documentation field above.
test

Reason for Amendment
test

Section Involved
Laboratory

Person Responsible
Valerie C. Sierzchula(581)

Summary for Monthly Report
test

QA Comments- Review of Observed Issue
test

Corrective Action Needed?
If "Yes", please complete the Nonconformance Report subform below to launch a Corrective Action workflow
No

Personnel Responsible for Root Cause Analysis

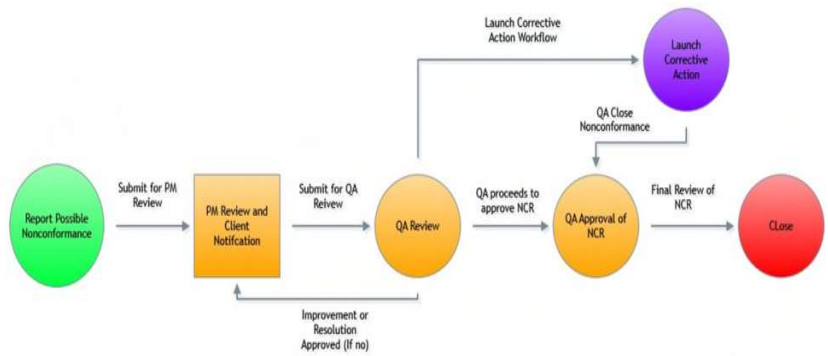
Work Stopped?
No

Date Work Stopped
If work was stopped, include date here

Date Work Resumed

Improvement or Resolution Approved?
Yes

Acknowledgement of All Parties Involved
Select every person that this issue was discussed with
Julia D. Sudds(540)



Section 13

IMPROVEMENT
(TNI V1:M2 – Section 4.10)

Improvement in the overall effectiveness of the laboratory management system is a result of the implementation of the various aspects of the laboratory's management system: quality policy and objectives (Section 5 – "Management"); internal auditing practices (Section 17 – "Internal Audits"); the review and analysis of data (Section 27 – "Quality Assurance for Environmental Testing"); the corrective action (Section 14 – "Corrective Action") and preventive action (Section 15 – "Preventive Action") process; and the annual management review of the quality management system (Section 18 – "Management Reviews") where the various aspects of the management/quality system are summarized, and evaluated and plans for improvement are developed.

RISK AND OPPORTUNITY
(ISO 17025:2017 – Section 8.5)

The laboratory will consider the risks and opportunities associated with day to day operations. Actions taken to address risks and opportunity are essential to:

- Assure the management system achieve intended results;
- Enhance opportunities to achieve laboratory objectives;
- Achieve improvement;
- Prevent or reduce potential failures in the laboratory

Risks and opportunities are discussed, reviewed, implemented and evaluated for effectiveness on an on-going basis during internal audits, management reviews, department meetings, company strategic planning and management meetings. Any actions taken must be proportional to the potential impact on analytical results or operations.

Section 14

CORRECTIVE ACTION
(TNI V1:M2 – Section 4.11)

Corrective action is the action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence.

Corrective action is implemented when nonconforming work or departures from the policies and procedures in the management system or technical operations have been identified.

Deficiencies cited in external assessments, internal quality audits, data reviews, customer feedback/complaints, control of nonconforming work or managerial reviews are documented and require corrective action. Corrective actions taken are appropriate for the magnitude of the problem and the degree of risk.

14.1 General Procedure

All staff is responsible for initiating formal corrective action due to systematic errors, using a corrective action report. Refer to Figure 14-1 for an example of a corrective action form. Formal corrective action is required in the following instances:

- On routine data reviews where a nonconformance is found that could reoccur. (beyond expected random QC failures)
- As a response to internal and external audit findings
- Where there is doubt about the compliance of the laboratory to its own policies and procedures.
- Upon client request
- To document challenges presented to Ethics and Data Integrity program.

A description of the non-conformance, finding or problem is recorded on the report and issued to the appropriate personnel so it can be investigated and root cause determined. A corrective action plan is developed and implemented to prevent reoccurrence. The assigned staff has 30 days to complete the investigation, determine root cause and implement the corrective action. Depending on the correction needed or extent of the action plan, due dates may be adjusted to ensure thorough completion. If the corrective action is not completed in a timely manner further actions may be taken. The implementation of the action plan is monitored for effectiveness.

14.1.1 Cause Analysis

The first step of the process starts with the initial investigation and determination of root cause(s) of the problem. This investigation should be completed within 2 weeks of initiation of corrective action report. Some investigations may require more time, however need to be kept a priority and completed in a timely manner. All sections of the investigation section must be thoroughly addressed with date, initials and comments as needed to determine root cause. Once the investigation

details have been identified and recorded this information to determine the root cause(s).

14.1.2 Selection and Implementation of Corrective Actions

Once root cause is identified an action plan to prevent reoccurrence is determined and recorded with expected date of completion. Where uncertainty arises regarding the best approach for analysis of the cause of exceedances that require corrective action, management and experienced personnel will recommend corrective actions that are appropriate to the magnitude and risk of the problem and that will most likely eliminate the problem and prevent recurrence.

Corrective actions resulting from findings of external assessments from Accrediting Bodies (AB) are implemented once the AB provides approval for the corrective action. If changes to an approved corrective action are required, approval from the AB is obtained prior to implementation.

The appropriate Department Manager ensures that corrective actions are implemented within the agreed upon time frame.

*For additional DOD Corrective Action requirements see Appendix L Section 14

14.1.3 Monitoring of Corrective Action

Department Managers and Quality Assurance will monitor implementation and documentation of the corrective action to assure that the corrective actions were effective. Monitoring may occur during scheduled internal audits or regular data review. When necessary, additional reviews are scheduled to ensure corrective action was implemented and effective. These will be documented on the corrective action form.

14.2 Additional Audits

Where the identification of nonconformances or departures from normal lab procedures cast doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with the TNI Standard, the laboratory ensures that the appropriate areas of activity are audited in accordance with Section 17 – "Internal Audits" as soon as possible.

In many cases, the additional audits are follow-ups after the corrective action has been implemented to ensure it is effective. These are done when a serious issue or risk to the laboratory have been identified.

14.3 Technical Corrective Action

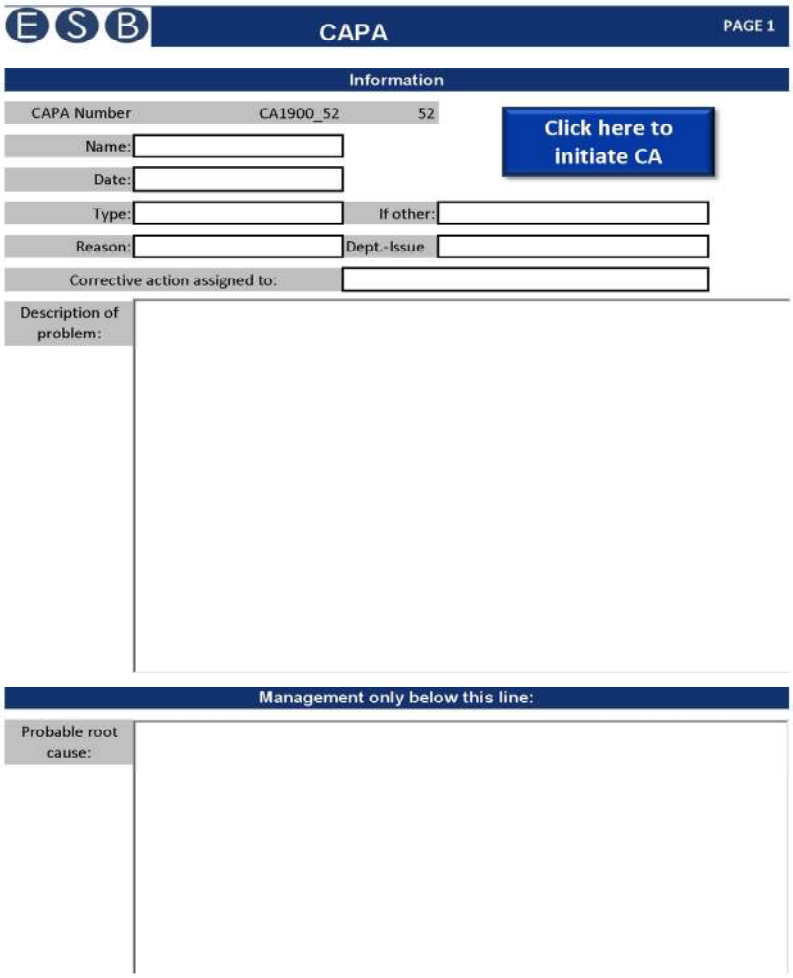
Sample data associated with failed quality control is evaluated for the need to be reanalyzed or qualified. Unacceptable quality control results are documented, and if the evaluation requires cause analysis, the cause and solution are recorded (also see Section 12 – "Control of Nonconforming Environmental Testing Work"*).* Analysts routinely implement corrective actions for data with unacceptable QC measures. First level correction may include re-analysis without further assessment. If the test method SOP addresses the specific actions to take, they are followed. Otherwise, corrective actions start with assessment of the cause of the problem.

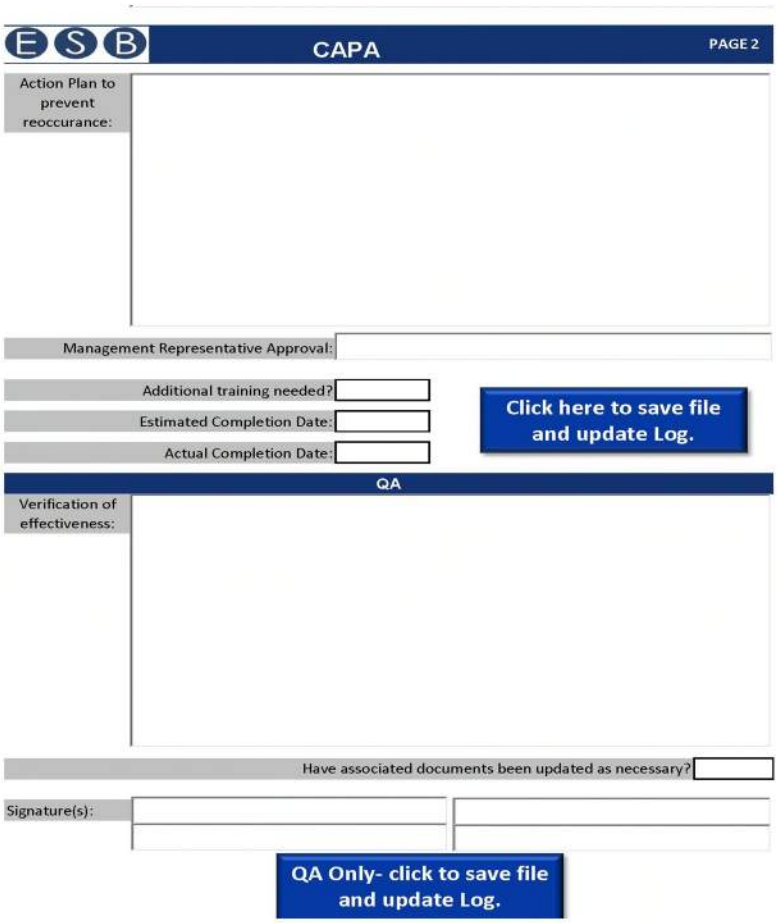
Corrective actions for non-systematic errors or expected random failures are documented in the raw data records and in Element LIMS. Refer to G-255-Technical Corrective Action SOP for procedure. Corrective actions for nonconformances that may reoccur (beyond expected random QC failures) or where there is concern that the laboratory is not in compliance with its own policies and procedures require that a corrective action report be completed (see Section 14.1).

Quality Assurance reviews the corrective action reports and suggests improvements, alternative approaches, and procedures where needed.

If the data reported are affected adversely by the nonconformance, the affected data is clearly identified in the report and the customer is notified.

Figure 14-1 CAPA Form





Section 15

PREVENTIVE ACTION
(TNI V1:M2 – Section 4.12)

Preventive action is a pro-active process to identify opportunities for improvement rather than a reaction to the identification of problems or complaints.

Babcock preventive action procedures include, but is not limited to: review of QC data to identify quality trends; on-going quality meetings and review of policies with staff to ensure employees remain knowledgeable in quality procedures; review of client feedback to look for improvement opportunities; review of proficiency testing data to look for analytes that were nearly missed or those with enhanced recoveries after method/instrumentation improvements; annual managerial reviews; monthly managerial discussions regarding current challenges and pro-active improvements moving forward; scheduled instrument maintenance; and testing an updated LIMS in tandem with the current LIMS to assure at least one working system while test LIMS is evaluated for its improved capabilities and their predicted effect on operations.

When improvement opportunities are identified or if preventive action is required, action plans are developed, implemented and monitored to reduce the likelihood of the occurrence of nonconformities. These may include established goals, responsible personnel and metrics to measure progress towards goals.

Procedures for preventive actions include the initiation of such actions and subsequent monitoring to ensure that they are effective. Ongoing preventive action is measured throughout the year for effectiveness. Documentation for Preventative Actions are maintained in the QA server folder and accessible to all staff for review and discussion as needed.

All personnel have the authority to offer suggestions for improvements and to recommend preventive actions, however management is responsible for implementing preventive action.

15.1 Procedure for New Preventive Action

- Staff member initiates process by suggesting an improvement or recommending a preventive action.
- When an opportunity for preventive action arises, a preventive action form is created by a member of management and saved in the CAPA section of the Babcock Server.
- The following sections are completed
    - Initiated by
    - Action (non-conformance) trying to prevent
    - Action Plan including resources needed and staff responsible
    - Goals including deadlines
    - Set a date to review for effectiveness
- Action plan is carried out
    - Ensure that communication is thorough and clear
    - Ensure that any required training takes place
- Review for effectiveness is completed by a member of management or QA

- If action is determined as ongoing it is measured subsequently for effectiveness.

Section 16

CONTROL OF RECORDS
(TNI V1:M2 – Section 4.13)

Records are a subset of documents, usually data recordings that include annotations, such as daily refrigerator temperatures posted to a laboratory form, lists, spreadsheets, or analyst notes on a chromatogram. Records may be on any form of media, including electronic and hard copy. Records allow for the historical reconstruction of laboratory activities related to sample-handling and analysis.

The laboratory maintains a record system appropriate to its needs, records all laboratory activities, and complies with applicable standards or regulations as required. The maintenance, retention and security of all records is consistent with the customer's requirements. Records of original observations and derived data are retained to establish an audit trail. Records help establish factors affecting the uncertainty of the test and enable test repeatability under conditions as close as possible to the original.

16.1 Records Maintained

Records of all procedures to which a sample is subjected while in the possession of the laboratory are kept. The laboratory retains all original observations, calculations and derived data (with sufficient information to produce an audit trail), calibration records, personnel records and a copy of the test report for a minimum of five years from generation of the last entry in the records. Many client contracts require record retention of 10 years so the laboratory generally maintains records for up to 10 years. QA documentation, is also held a minimum of 10 years. Where possible, instrument software is enabled to record and track any changes or edits made to instrument records. At a minimum, the following records are maintained by the laboratory to provide the information required for historical reconstruction:

i) all raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' worksheets and data output records (chromatograms, strip charts, and other instrument response readout records);

ii) a written description or reference to the specific method(s) used, which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value (a copy of all pertinent Standard Operating Procedures);

iii) laboratory sample ID code;

iv) date of analysis;

v) time of analysis;

vi) instrumentation identification and instrument operating conditions/parameters (or reference to such data);

vii) all manual calculations (including manual integrations);

viii) analyst's or operator's initials/signature or electronic identification;

ix) sample preparation, including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;

x) test results (including a copy of the final report);

xi) standard and reagent origin, receipt, preparation, and use;

xii) calibration criteria, frequency and acceptance criteria;

xiii) data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;

xiv) quality control protocols and assessment;

xv) electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries;

xvi) method performance criteria including expected quality control requirements;

xvii) proficiency test results;

xviii) records of demonstration of capability for each analyst;

xix) a record of names, initials, and signatures for all individuals who are responsible for signing or initialing any laboratory record;

xx) correspondence relating to laboratory activities for a specific project;

xxi) corrective action reports;

xxii) preventive action records; risk assessment

xxiii) copies of internal and external audits including audit responses;

xxiv) copies of all current and historical laboratory SOPs, policies and *Quality Manual*s;

xxv) sample receiving records (including information on any interlaboratory transfers);

xxvi) sample storage records;

xxvii) data review and verification records;

xxviii) personnel qualification, experience and training records;

xxviv) archive records; and

xxviv) management reviews.

16.2 Records Management and Storage

The laboratory maintains a record management system for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage, and reporting. Refer to G-104-Records Management SOP for procedures.

Observations, data and calculations are to be recorded at the time they are made.

Data generated by automated data collections systems is recorded electronically and records indicate the date and who creates and edits any electronic record. Electronic records are protected to prevent unauthorized access or amendment. All records stored electronically are backed up to prevent loss. Refer to G-105-Good Automated Laboratory Practices SOP for procedures on management and storage of electronic data.

All other data is recorded immediately and legibly in permanent ink. It is assumed that all entries and notes on an analytical worksheet are made on the date of initialing by the analyst who has initialed the page. Additional documentation is needed for the following:

- If the analyst adds entries on a different day, he/she must date and initial the additional entries.
- If a second analyst adds an entry, the analyst must date and initial her/his entry.
- If adds or edits are made to more than one page, each page should be dated and initialed or clearly identified on the document.

Corrections are initialed and dated with the reason noted for corrections other than transcription errors. A single line strikeout is used to make corrections so that the original record is not obliterated. If the reason for the correction is not evident or the correction is more than simply miswritten data, an explanation for the correction should be footnoted at the bottom of the page.

Records, including electronic records, are easy to retrieve, legible, and protected from deterioration or damage; held secure and in confidence; and are available to accrediting bodies for a minimum of five years or as required by regulation or contract. Records that are stored only on electronic media are supported by the hardware and software necessary for their retrieval. Access to protected records is limited to prevent unauthorized access or amendment.

Additional information regarding control of data is included in Section 22.5 – "Control of Data".

Procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records are found in G-104-Records Management SOP. Quality records shall include reports from internal audits and management reviews as well as records of corrective and preventive actions and risk assessments.

Archived information and access logs are protected against fire, theft, loss, environmental deterioration, vermin, and in the case of electronic records, electronic or magnetic sources. Archived records have limited access and are checked out through an access log.

In the event that the laboratory transfers ownership or goes out of business, records are maintained or transferred according to client instructions. Appropriate regulatory and state legal requirements concerning laboratory records shall be followed.

16.3 Legal Chain of Custody Records

Evidentiary sample data are used as legal evidence. Procedures for evidentiary samples can be found in G-240-Legal Evidentiary Custody SOP.

16.4 Electronic Signatures

Electronic signatures are utilized to note the review or approval of laboratory documents such as final reports and SOPs. Use of electronic signatures for reporting and SOPs is limited to select staff such as approved signatories (see QAM concurrences), project management, business development and approved SOP signatories. All staff utilize password protected electronic signatures for QA documents accessed through QA's document control program such as Qualtrax.

The IT department is responsible for maintaining electronic signatures. The IT System Administrator creates a password protected and encrypted electronic signature for each individual, as needed.

Section 17

AUDITS
(TNI V1:M2 – Section 4.14)

Audits measure laboratory performance and verify compliance with accreditation/ certification and project requirements. Audits specifically provide management with an on-going assessment of the management system. They are also instrumental in identifying areas where improvement in the management/quality system will increase the reliability of data. Audits are of four main types: internal, external, performance and system. Section 17.6 discusses the handling of audit findings.

17.1 Internal Audits

Annually, the laboratory prepares a schedule of internal audits to be performed during the year. This schedule may be updated as needed to reflect the current needs of the company as long as all areas of the lab are reviewed each year. Internal audits are performed for all sections of the laboratory, both technical and quality systems are reviewed. These audits verify compliance with the requirements of the management/quality system, including analytical methods, SOPs, the *Quality Manual*, ethics policies, data integrity, other laboratory policies, and the NELAP, ELAP and ISO Standards.

It is the responsibility of the QA Manager to plan and organize audits as set by the schedule and requested by management. These audits are carried out by trained and qualified personnel who are, wherever resources permit, independent of the activity to be audited. Audit personnel are trained and qualified in the specific management system element or technical area under review. For technical methods where the QA auditor may have less experience, support may be provided by an experienced staff member such as the technical manager for the department, department leads, department manager or technical director to perform the audit and observe/interview auditees.

In addition to the scheduled internal audits, it may sometimes be necessary to conduct special audits as a follow-up to corrective actions, PT results, complaints, regulatory audits or alleged data integrity issues. These audits address specific issues.

The area audited, the audit findings, and corrective actions are recorded. Audits are reviewed after completion to assure that corrective actions were implemented and effective. This review may occur during the next scheduled audit unless findings are observed that cast doubt on the validity of data. Corrective actions that warrant sooner review cannot wait for the next scheduled audit. In these cases the QA Auditor will set a timely review date for the corrective action to ensure the issue was corrected and changes implemented as needed.

17.2 Internal Audit Procedures

Internal Audits are performed throughout the year as scheduled by the QA department. QA auditors and designees have sufficient authority to carry out the audit, have access to work areas, and have the ability to access and observe all activities affecting quality. Audit results are reported to management. The procedure below is followed.

- Audits are scheduled by quarter.
- Per pre-determined schedule the QA department notifies the department manager of the upcoming audit during the beginning of each quarter.
- QA identifies recently completed work order(s) which include some or all analyses performed under the department being audited.
- Any applicable SOPs are placed in draft per SOP G-100 and released to department manager and staff for review and any needed edits.
- QA prepares for each audit by initiating audit checklists, observation checklists, reviewing previous audits and any findings, method and QC review, SOPs, etc.
- QA performs a cradle to grave paper audit for the work order(s) identified. The following documents are reviewed as part of the paper audit:
    - Sample acceptance and receiving documentation: Chain of Custody, Client project info, Client Bid/contract if available, Element info and final work order including login/PM reviews and splitting notes, if applicable.
        - Items are reviewed for compliance with certification requirements and to internal procedures.
        - Documents are checked for completion, accuracy and traceability.
    - Analytical data packages from lab
        - Data Packages are submitted by lab staff for each batch or test method performed on the work order being reviewed.
        - Raw data, raw electronic data from test reports, calibrations, standard, reagents, COAs, equipment and support equipment at a minimum are reviewed for traceability, calibration and complete documentation.
    - Training documentation
        - For each staff member involved in any portion of the activities performed during the audit, required training documentation is reviewed for completion.
        - Technical staff IDOCs and DOCPs are reviewed
        - Non-Technical staff training authorizations or completed competencies are reviewed
    - Method performance
        - Control charts to identify QC and method trends are reviewed. Historically determined limits are re-evaluated and updated as needed.
        - Method requirements such as MDLs and RLs are reviewed and updated as needed
- In addition to the paper audit, a member of the QA department (or designee) observes and interviews involved staff.

- The QA auditor will either schedule a time to perform the observation with the employee or the observation is not scheduled and performed on the spot. This often depends on current staffing and lab operations.
- Using the audit checklists and current SOP, the employee is asked to demonstrate the task/test being observed while explaining the procedures they follow.
- During the observation the auditor will interview the employee in regards to their knowledge of the task such as analytical interferences, purpose for testing, SOP adherence, SOP accuracy, lab technique, QC required, etc.
- During the observation and interview staff is asked for their input regarding possible improvements or added efficiencies they may have discovered while performing the task or analysis.
- While performing observations the auditor will also inspect work areas for any expired standards or reagents, instrument IDs and maintenance records, support equipment used and calibration dates, safety or housekeeping recommendations, chemical/sample disposal, etc.
- Multiple staff may be audited during the quarter, depending on size of the department and experience levels of staff.
    - Observations are often performed with newer staff to the department. This provides a review of the employee's training effectiveness, techniques learned, knowledge and understanding of the task at hand.
    - Senior staff is also observed.
        - If a particular employee has been audited in previous audits multiple times for the same task, a less experienced employee may be audited for that particular analysis to ensure all staff is audited.

- Upon the completion of the procedures outlined above, all data and information collected and reviewed during the audit is used to compile an Audit Summary Report.
    - The Audit Summary Report includes the following sections that are completed per the information gathered from each department's internal audit:

        - Purpose
            - Documents area(s) audited and objectives of audit

        - Scope
            - Outlines actions performed during the audit such as items reviewed during paper audit, identifies which documents were reviewed, SOPs reviewed, interviews, certification standards used for audit and related documents utilized.

        - Employees Observed/Interviewed
            - Lists staff involved in audit

- Analyses/Methods Observed or Included in Paper Audit Trail
  - Lists methods included in audit
- Summary of Paper Audit Trail
  - Overview of documentation reviewed, feedback on areas reviewed.
- Summary of Observations and Interviews
  - Overview of documentation reviewed
  - Notes specifics and staff of areas observed
- Summary of Findings
  - Lists each Finding as a result of the audit
  - Each Finding notes the QA STD reference for the finding as well as the number of the accompanying Corrective Action (CAR)
- Recommendations for Improvement, Risk Assessment and Opportunities
  - Lists any recommended (but not required for compliance) changes, updates, staffing, training, equipment, etc. that may improve testing, lab efficiencies, staff experience or day to day operations.
  - Areas of risk may be noted if identified
  - Opportunities may be discussed with staff and noted

- For each documented and referenced finding QA creates a Corrective Action/CAPA form which is assigned a unique ID number. (See Fig 14-1)
- An audit closing/meeting is held with the auditor(s), department manager and staff.
  - The Audit Summary Report is reviewed and discussed in detail. All areas of report are reviewed with the department with feedback from the auditors provided on each section.
  - Each finding is reviewed with the department and discussed in detail
    - Assigned CARs and due dates are set. (Typically 30 days from initiation)
    - Possible corrections or changes to assist with the Root Cause Investigation are discussed, if needed.
  - Once completed, all involved staff, manager and auditors sign and date the audit report.
- Corrective Actions are completed by the department per the set due date and reviewed for effectiveness by QA. See Section 14- Corrective Action.
- See Figure 17-1 for a sample Audit Summary Report.

17.3 External Audits

It is the laboratory's policy to cooperate and assist with all external audits, whether performed by clients or an accrediting body. Management ensures that all areas of the laboratory are accessible to auditors as applicable and that appropriate personnel are available to assist in conducting the audit.

17.4 Performance Audits

Performance audits may be Proficiency Test Samples, internal single-blind samples, double-blind samples through a provider or client, or anything that tests the performance of the analyst and method.

Proficiency Test Samples are discussed in Section 27 – "Quality Assurance for Environmental Testing".

17.5 System Audits

The Laboratory's management system is audited though the completion of the TNI Quality Systems checklist, DOD ELAP checklist(s) as applicable and annual management reviews. Refer to Section 18 – "Management Reviews" for further discussion of management reviews.

The Quality Assurance department conducts an audit of the laboratory LIMS and Quality Management System to ensure data integrity and data processes are acceptable. An audit may be performed if a LIMs update requires review, if a new process or workflow is initiated, processes are altered or requests by management. Findings from the audit which result in corrective actions are presented to management and completed per the procedure below Handling Audit Findings.

17.6 Handling Audit Findings

Internal or external audit findings are responded to within the time frame agreed to at the time of the audit. The response may include action plans that could not be completed within the response time frame. A completion date is established by management for each action item and included in the response.

The responsibility for developing and implementing corrective actions to findings is the responsibility of Department Managers. Corrective actions are documented through the corrective action process described in Section 14 – "Corrective Action" of this *Quality Manual*.

Audit findings that cast doubt on the effectiveness of the laboratory operation to produce data of known and documented quality or that question the correctness or validity of sample results must be investigated. Corrective action procedures described in Section 14 – "Corrective Action" must be followed. Clients must be notified in writing if the investigation shows the laboratory results have been

negatively affected and the client's requirements have not been met. The client must be notified within two business days after the laboratory discovers the issue. Laboratory management will ensure that this notification is carried out within the specified time frame.

All investigations that result in findings of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients. See Section 19 (Data Integrity Investigation) for additional procedures for handling inappropriate activity.

Figure 17-1 Sample- Audit Summary Report

Summary of [ABC DEPARTMENT] Audit

Performed By	
Date Initiated	
Date Completed	
Corrective Actions Due	
Corrective Action reviewed for effectiveness on:	

Purpose

- To gather evidence regarding the conformity of procedures and practices related to the "*ABC*" department to the requirements stated in the Babcock Laboratories Quality Manual, Standard Operating Procedures, analytical methods (if appropriate), ISO/IEC 17025:2005:2017 and the 2009/2016 TNI STD.
- Observe staff for analytical technique, knowledge of task at hand, training documentation
- Look for opportunities for improvement to documents and process
- Update information where necessary.

Scope

- Conduct a paper audit of the department by performing a cradle to grave review of all documentation relating to analysis performed by the *"ABC"* department. The following is documented in the Paper Audit summary;
    - Analysts involved
    - Batches reviewed
    - Completeness of training documentation
    - Comments and questions about the data
    - Findings and recommendations for improvement
- Initiate review of department technical SOPs to ensure accuracy and adherence
- Look for and review any applicable SOPs
    - G-200 Training SOP
    - G-201 Support Equipment
    - G-253 Data Review & Validation
    - Department Technical SOPs
- Conduct observations/interviews of analysts in department using observation checklists
- Interview department manager or lead
- Review any related documentation (examples of completed forms, checklists etc.)
    - Maintenance logs
    - Training checklists, if applicable
    - Data pages
    - Analytical methods
- Review TNI Standards (2009/2016)
- Review any applicable ISO/IEC 17025 STD sections

- Review applicable sections of the Babcock QA Manual for compliance to standards and quality system requirements.

Employees Observed/Interviewed

Analyst A	Analyst C
Analyst B	Manager A

Analyses/Methods Observed or Included in Paper Audit Trail

EPA 300.0	EPA 218.7	EPA 300.1	EPA 7199	EPA 314.0	

Summary of Paper Audit Trail

Example Only- "A cradle to grave paper audit was completed on three work orders (1,2 & 3) from three current Babcock clients. These work orders covered various matrices of samples analyzed by test methods performed by the ABC department. Overall the paper audit found few errors or issues requiring attention. No systematic errors were identified. Document review for all three work orders found that all samples were submitted, received, logged in, reviewed and updated for release to the laboratory in a timely manner and following all internal procedures in place. A review of current login procedures indicated that samples were accepted by the lab and logged in per lab protocol. No errors found. Review of all analytical data, batches and training records found no errors or systematic findings. Cross-outs were dated and initialed."

Summary of Observations and Interviews

Example Only- "Observations and interviews were performed in the ABC laboratory with current staff. The ABC group is doing an excellent job. All areas reviewed and observed were found to be in great standing and compliant with current Babcock lab procedures and Quality System. The ABC lab was found to be clean and very organized. Work areas are tidy; data is easily accessible and filed neatly; standards, supplies, and consumables stored appropriately, etc. During interviews and observations the analyst were all very accommodating and took the time needed to participate in the audit. I found ABC team members to be very knowledgeable in their test methods, QC requirements, instrumentation operation and current daily lab operation procedures. During this audit, QA was pleased to find the ABC group running as a well-oiled machine. The analysts all work together as a team, really manage their time well and run daily operations very efficiently. With "analyst" joining the team last year, from his interview and observations it is evident that he was trained very well by his trainers, and that our current training procedures were followed. He was trained using the SOPs available. Continued……..

During the audit, all documentation was found in order. Each batch contained standard/reagent logs with accurate and up to date ID#s and expiration dates. All batches were peer reviewed properly with all pages filled out, peer review pages were accurate and up to date, manual integrations were performed following internal procedures (SOP G-255) and reviewed by peers, data was properly qualified, QC issues or follow-ups handled appropriately and client notification timelines met. Maintenance logs were in order and up to date. The department succeeds on a

consistent basis in meeting their TATs and other internal deadlines. While observations were performed in the lab, a few random containers were identified needing a label or a new label. These items were corrected at that time so no corrective action is needed. Continued…..

Summary of findings

A corrective action form is required for the noted findings below. Please perform a thorough Root Cause Analysis (RCA) for each as needed and determine the appropriate action plan needed to implement the corrective action, if applicable.

Reference	Finding	CAR#	Date CAR reviewed
SOP T-201 Support Equipment Section 3, QAM Section 23, TNI V1M2 Section 5.5.13.1	Auto pipettes are inspected and verified at least once a month and calibrated as needed. • Completed records for ABC's pipette verifications could not be found for April/year.	"CAyear_001"	

Recommendations for Improvement, Risks and Opportunities

Item	Recommendation	Action taken
Efficiency	Would like a filtration system for CAM & TCLPs. Current setup is slow going since it's shared amongst departments.	
Equipment	Chart recorder pen is dim.	

Section 18

MANAGEMENT REVIEWS
(TNI V1:M2 – Section 4.15)

Top management reviews the management system on an annual basis and maintains records of review findings and actions.

18.1 Management Review Topics

The following are reviewed to ensure their suitability and effectiveness:

- the suitability of policies and procedures;
- reports from managerial personnel;
- the outcome of recent internal audits;
- corrective and preventive actions;
- address risk and opportunity
- assessments by external bodies;
- the results of interlaboratory comparisons or proficiency tests;
- changes in the volume and type of the work;
- customer feedback;
- complaints;
- recommendations for improvement;
- other relevant factors, such as quality control activities, resources, and staff training.

18.2 Procedure

Management reviews are a separate activity from laboratory internal audits. Management reviews are conducted as a review of the laboratory's management system.

Management review topics are regularly considered and discussed during strategic planning and during regular management meetings. During manager meetings as well as in on-going communication amongst the management team, review topics are discussed, assessed for changes or review, etc. on a consistent basis. Agendas and notes from manager meetings are available upon request, as applicable.

A formal management review is scheduled and conducted annually. This review may be performed during the same time frame as strategic planning. The entire management team participates in the formal review.

An agenda is prepared which includes the above mentioned review topics and sent out to the participants prior to the scheduled meeting(s).

Information and data relating to the agenda items is collected, compiled and presented to the management team. Topics or activities identified as critical to day

to day operations and meeting company objectives are incorporated into laboratory strategic planning and monitored on a continuous basis.
Management will determine appropriate completion dates for action items and ensure they are completed within the agreed upon time frame.

All goals, objectives and action plans for the review year are documented with timelines for completion and manager responsible for meeting the goal. A company scorecard which outlines all goals and objectives for the year is maintained and reviewed with management on an on-going basis. Staff are also presented the scorecard noting the company goals, objectives and planning determined in management reviews.

A sign in sheet is completed on the day of the review.

Findings and follow-up actions from management reviews are recorded.

Section 19

ETHICS AND DATA INTEGRITY INVESTIGATIONS
(TNI V1:M2 – Section 4.16)

In addition to covering data integrity investigations, this section covers all topics related to ethics and data integrity policies, procedures and training.

Babcock Laboratories, Inc. is committed to ensuring the integrity of its data and providing valid data of known and documented quality to its clients. The elements in Babcock Laboratories' Ethics and Data Integrity program include:

- An Ethics and Data Integrity Manual containing policies and procedures (Appendix A).
- Annual ethics and data integrity training.
- A Statement of Ethics and Data Integrity signed by all management and staff during the annual data integrity training and at the time of employment (see Appendix A).
- Procedures for confidential reporting of alleged data integrity issues.
- An audit program that monitors data integrity (see Section 17 – "Audits") and procedures for handling data integrity investigations and client notifications.

19.1 Ethics and Data Integrity Procedures

The Ethics and Data Integrity statement provides an overview of the program. The Ethics and Data Integrity Manual includes written procedures for the following topics:

- Definitions and examples of Data Integrity and Fraud
- Ethics and data integrity responsibilities of all staff
- Conflict of Interest
- Data Integrity reporting procedures and Investigations
- Response to Ethical and Data Integrity Issues

Additional procedures that are considered part of the Ethics and Data Integrity program include:

- Manual integration procedures (See SOP G-251 "Chromatographic Quantification of Data" Procedure for the Integration of Chromatographic Peaks)
- Corrective action procedures (Section 14 of this *Quality Manual* and SOP G-255 "Technical Corrective Action")
- Data Integrity training procedures (See detail below)

Management reviews data integrity procedures yearly and updates these procedures as needed.

19.2 Training

Ethics and Data Integrity training is provided as a formal part of new employee orientation and a refresher is given annually for all employees. Employees are required to understand that any infractions of the laboratory data integrity procedures shall result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment or civil/criminal prosecution. This is discussed in the Ethics and Data Integrity Policy that every employee is required to sign annually. Attendance for required training is monitored through a signature attendance sheet.

Data integrity training emphasizes the importance of proper written narration on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially deficient. The following topics and activities are covered:

- organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting;
- how and when to report data integrity issues;
- record keeping;
- training, including discussion regarding all data integrity procedures;
- data integrity training documentation;
- in-depth data monitoring and data integrity procedure documentation; and
- specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

When contracted technical or support personnel are used, management is responsible for ensuring that they are trained to the laboratory's management system and data integrity procedures, competent to perform the assigned tasks, and appropriately supervised.

Topics covered are provided in writing and available electronically to all trainees.

19.3 Confidential Reporting of Ethics and Data Integrity Issues

Confidential reporting of data integrity issues is assured through the procedures outlined in section 8 of Appendix A. Whether the reporting was provided by laboratory staff or in some cases by the client, reporting procedures will be followed.

19.4 Investigations

All investigations resulting from data integrity issues are conducted confidentially. They are documented and notifications are made to clients who received any negatively affected data that did not meet the client's data quality requirements. Procedures for investigation are included in section 8 of the manual (appendix A)

Section 20

PERSONNEL
(TNI V1:M2 – Section 5.2)

Babcock Laboratories, Inc. employs competent personnel based on education, training, experience and demonstrated skills as required. The laboratory's organization chart can be found in Appendix B.

20.1 Overview

All personnel are responsible for complying with all quality and data integrity policies and procedures that are relevant to their area of responsibility.

All personnel who are involved in activities related to sample analysis, evaluation of results or who sign test reports, must demonstrate competence in their area of responsibility. Appropriate supervision is given to all personnel. For personnel in training, management supervises the training and ensures the trainer is accountable for the quality of the trainee's work. Personnel are qualified to perform the tasks they are responsible for based on education, training, experience and demonstrated skills as required for their area of responsibility.

The laboratory provides goals with respect to education, training and skills of laboratory staff. These goals are outlined in Employee Job Descriptions. Training needs are identified at the time of employment and when personnel are moved to a new position or new responsibilities are added to their job responsibilities. Ongoing training, as needed, is also provided to personnel in their current jobs. The effectiveness of the training must be evaluated before the training is considered complete.

Contracted personnel, when used, must meet the same competency standards and follow the same policies and procedures that laboratory employees must meet.

20.2 Job Descriptions

Job descriptions are available for all positions that manage, perform, or verify work affecting data quality, and are located on the Babcock Server. Overviews of management's responsibilities are included in Section 5 – "Management".

Job descriptions include the specific tasks, minimum education and qualifications, skills, and experience required for each position.

20.3 Training

All personnel are appropriately trained and competent in their assigned tasks before they contribute to functions that can affect data quality. It is management's responsibility to assure personnel are trained. Training records are used to document approval of personnel competency. The date on which authorization and/or competence is confirmed is included.

Training records are maintained by the QA department and include Demonstration of Capability and authorization statements, on-going training documents such as Ethic's and Data Integrity and Quality statements.

Additional information on training can be found in G-200-EmployeeTraining Procedure SOP.

20.3.1 Training for New Staff

All new staff members are given introductory training and orientation upon arrival. All personnel, including temporary or contracted staff are provided training in general QA and safety procedures during their new hire training. The training is documented on a new employee checklist that outlines what was covered during the training. The new employee also receives Ethics and Data Integrity training and must sign-off on the Ethics and Data Integrity Policy statement. In addition all new staff are trained on IT policies and computer security measures outlined in the Babcock Information Security Policies and Standards Manual.

The initial training for a new task contains the following steps:

- All documentation involved with a new and unfamiliar task is read and understood by the trainee.
- Training is under the direct supervision of an authorized trainer or manager. During the time the analyst is in training, the trainee may sign laboratory notebooks, logbooks, worksheets, etc… but they must be co-signed by the trainer who is responsible for the data generated.
- The trainee demonstrates competency in the new task before they can operate independently. The competency for a test method is accomplished by a demonstration of capability as defined in Section 22 – "Environmental Methods and Method Validation". Approval of competency is noted by the date and initials of the QA Manager or designee on the training documentation.
- Each step of the training process is documented.
- The documentation is maintained in the employee's completed QA file on the server.

20.3.2 Ongoing Training

All staff members are given annual refresher Ethics and Data Integrity training and are required to sign off on the Ethics and Data Integrity Policy statement. The training is documented on a training statement that outlines what was covered during the training.

Ongoing training consists of:

- The employee attests, through signature, that they have read, understood, and agree to perform the latest version of the Quality Manual and any SOPs or policies that the analyst is responsible for following.
- Annually all employees receive refresher training on IT policies and computer security. Training is documented.

- Annually, the analyst shows continued proficiency in each method they perform. Refer to Section 22 and applicable Appendices of this QA Manual for details.
- Attending training related to job function as applicable.
- Maintaining training documentation in the employee's completed QA file on the server.

Section 21

ACCOMODATIONS AND ENVIRONMENTAL CONDITIONS
(TNI V1:M2 – Section 5.3)

21.1 Environmental

The laboratory facility is designed and organized to facilitate testing of environmental samples. Environmental conditions are monitored to ensure that conditions do not invalidate results or adversely affect the required quality of any measurement. Such environmental conditions include temperature and humidity.

If the laboratory environment is required to be controlled by a method or regulation, the adherence is recorded. For example, temperature is monitored and recorded during TCLP extraction.

Environmental tests are stopped when the environmental conditions jeopardize the results.

21.2 Work Areas

Work areas may include access and entryways to the laboratories, sample receipt area, sample storage area, shipping area, instrumental analysis area, chemical and waste storage area and data handling storage area.

Access to, and use of, areas affecting the quality of the analytical tests is controlled by restriction of areas to authorized personnel only. See Building Security below.

The laboratory work spaces are adequate for their use, and appropriately clean to support analytical testing and ensure an unencumbered work area.

Technical requirements for accommodation and/or environmental conditions that can affect the results of environmental tests are ensured as follows:

- Laboratory space is arranged to minimize cross-contamination between incompatible areas of the laboratory.
- Laboratory samples are stored in assigned locations. Samples noted with elevated or hazardous concentration levels are stored separate from general samples.
- Volatile analyses are performed in an area with restricted access to prevent possible cross contamination or solvent vapor contamination.
- Biological and microbiological work areas are monitored for sterility and follow a regular cleaning and sterilization schedule. See Appendix I.

The laboratory procedure for good housekeeping includes such measures as:

- janitorial service either internal or contracted,
- periodic dedicated clean-up days, and,

- each employee is responsible for straightening up their work area at the end of their shift..

21.3 Floor Plan

Floor plans can be found in Appendix C.

21.4 Building Security

The laboratory is kept secure during off hours with an alarm system. The identity of each person arming or disarming the building's alarm systems is recorded by the monitoring company through the use of individual alarm access codes. All doors except the main entrance are only accessible to authorized staff. Staff enter the building by scanning their photo ID badge at the door to unlock the door for entry. The door will lock once closed. Employees must wear their ID badge while on the premises to identify them as approved staff.

Only management and select staff are provided keys to the laboratory. Areas utilized for data storage and inventory are locked at all times. Access to these restricted areas is limited to authorized staff only. During off hours a locked gate that requires a scanned photo ID badge to enter the property is utilized.

Visitors must check in at the front desk upon arrival to receive a guest badge. Visitors will be accompanied by laboratory personnel while on-site and when access to secure areas is requested.

Section 22

TEST METHODS AND METHOD VALIDATION
(TNI V1:M2 – Section 5.4 and Sections 1.4, 1.5 and 1.6 of Technical Modules TNI V1:M 4,5)

Methods and/or procedures are available for all activities associated with the analysis of the sample including preparation and testing. For purposes of this Section, "method" refers to both the sample preparation and determinative methods.

Babcock Laboratories uses appropriate test methods and procedures for all tests and related activities within its responsibility (including sample collection, sample handling, transport and storage, sample preparation, and sample analysis). The methods and procedures are consistent with the accuracy required, and with any standard specifications relevant to the calibrations or tests concerned.

Before being put into use, a test method is confirmed by a demonstration of capability or method validation process.

All methods are published or documented. Deviations from the methods are allowed only if the deviation is documented, technically justified, authorized by management and accepted by the customer and regulating authority such as DOD, as needed.

22.1 Method Selection

A reference method is a method issued by an organization generally recognized as competent to do so. (When ISO refers to a standard method, that term is equivalent to reference method.) When a laboratory is required to analyze a parameter by a specified method due to a regulatory requirement, the parameter/method combination is recognized as a reference method.

The laboratory will use methods that meet the needs of the customer. Such methods will be based on the latest approved edition of the method unless it does not meet the needs of the customer.

The laboratory selects methods that are appropriate to the customer needs. When the regulatory authority mandates or promulgates methods for a specific purpose, only those methods will be used.

If a method proposed by a customer is considered to be inappropriate or out-of-date, the customer is informed and the issue is resolved before proceeding with analysis of any samples (see Section 7 – Review of Requests, Tenders and Contracts).

If a method is not specified by the customer, an appropriate method will be selected using the process outlined below. The customer will be informed of

the selected method. All communications between the laboratory and the customer are documented.
If the data is to be submitted to a regulatory authority, the method(s) specified by the regulatory authority will be used.

- For drinking water compliance a method will be selected from those specified in 40 CFR Part 141, or the applicable state regulations.
- For NPDES permits, the method will be selected from those specified in 40 CFR Part 136.
- If the end use of the data is not regulatory or if the regulatory authority does not specify a method, the laboratory will determine the customer needs in terms of reporting level (e.g., LOD, LOQ), bias (e.g., screening versus quantitative) and the laboratory capabilities and capacity. Based on these criteria, the laboratory will select an appropriate method based on the following hierarchy:
  -Resources from published in regional, national or international standards
  -Methods published by other technical organizations such as ASTM, Standard Methods or AOAC
  -Methods develop by the instrument manufacturer
  -Laboratory –developed methods.

22.2 Laboratory-Developed Methods

If the laboratory develops a method, the process of designing and validating the method is carefully planned and documented. All personnel involved in the method design, development and implementation will be qualified, equipped with adequate resources, and in constant communication during all stages of development.

Laboratory-developed methods are utilized with client approval as required. Client approval may be provided in the official contract with the laboratory or during method development. Methods will not be used unless they have been technically justified, documented, approved for use and accepted by the client.

22.3 Method Validation

Validation is the confirmation, by examination and objective evidence, that the particular requirements for a specific intended use are fulfilled.

Validation of a reference method is required when considerable modifications are made to the method such as stoichiometry, technology, mass tuning acceptance criteria, quantitation ions, compressing digestion or extraction timeframes, reducing reagent or solvent volumes, changing solvents, or compressing instrument runtimes.

At a minimum, reference methods are validated by performing an initial demonstration of capability. Additional requirements are discussed for each technology.

Method Validation and Demonstration of Capability procedures can be found in:

- Appendix I – Microbiology
- Appendix H – Chemistry

All methods that are not reference methods are validated before use. The validation is designed so that the laboratory can demonstrate that the method is appropriate for its intended use. All records (e.g., planning, method procedure, raw data and data analysis) shall be retained while the method is in use.

Non-reference Validation Process: The validation process is defined by the needs of the application or the project. For example, the addition of analytes to EPA/existing methods may include the following validation steps:

Calibration for analyte

Processed RL (LOQ) check

Processed Blank (results below ½ RL)

Second source midlevel verification (if available)

Note: *The inclusion of the parameter in the method shall meet all required calibration requirements and the quality control requirements of the method to which the parameter is being added.*

Alternatively, validation steps for special projects where procedures are developed by the laboratory may include:

Demonstration of ability to replicate results

Known positive control (if available)

Processed Blank (negative control)

The above validation process is documented. Method development trials and discoveries are recorded. Laboratory developed procedures are documented in writing for analysts to follow. Data is documented in such a way that all steps of preparation and quantification are clear and can stand on its own without explanation.

A method that meets the above requirement is identified in such a way so that there is no confusion that the method has been modified.
Indication of the modification may be identified in one of the following ways:

Noted in report units* or analyte’’’ footnote on final report –

**/’’’ NELAP does not offer accreditation for this analyte/method/matrix combination*

Method reference on report stipulates “M” for modified.

*For additional DOD method validation requirements see Appendix L Section 22

22.4 Estimation of Analytical Uncertainty

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

Analytical uncertainty calculations can be derived by the procedures outlined below. Uncertainties include the identified uncertainty components for an analysis, ensuring all critical components are evaluated.

22.4.1 Estimation of uncertainty of measurement is derived from real world samples using both accuracy and precision statistics. The following options may be used as applicable:

- Lab Control (BS) control limits, derived statistically using a min of 20 data points. In this case the MOU is 2s.
- Matrix spike control limits, derived statistically from historical data, in our estimation provide the best approximation of the uncertainty of measurement for an analyte in a matrix by a specific method. Control limits consist of computing an average of at least 20 spike recoveries + three standard deviations.
- For analytical procedures that do not use a matrix spike, duplicate historical data derived from real world samples is used as an estimation of uncertainty of measurement by computing an average of at least 20 RPDs + three standard deviations.
- If the test method in question is an approved method which includes information on guidance and calculations of uncertainty measurements, these procedures may be followed, if applicable.
- Projects which may have specific requests for the reporting of uncertainty will be addressed as needed.

This estimation of uncertainty can be presented to the end user on a QC report or by request. For information regarding any particular measurement, contact the QA Department.

22.4.2 Alternative Procedure for Estimation of Uncertainty of Measurement

Measurement Uncertainty is defined as an Uncertainty (of measurement) parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the quantity of interest, or measurand. Uncertainty of measurement comprises, in general, of many components. Some of these components may be evaluated from the statistical distribution of the results of a series of measurements. Other components, which also can be characterized by standard deviations, are evaluated from assumed probability distributions based on experience or other information. The result of the measurement is the best estimate of the value of the quantity of interest, and that all components of uncertainty, including those arising from systematic effects, such as components associated with corrections and reference standards, contribute to the dispersion.

- Estimation of uncertainty of measurement is derived from real world samples using a variety of factors to create an uncertainty budget. Factors may include:

  a) Human Factors (Human error, repeatability studies)
  b) Test and Method Validation Studies (reproducibility)
  c) Accommodation and Environmental Conditions (Temperature, Temperature Coefficients, other environmental forces)
  d) Equipment/Reference Standards (Traceability, Specifications, Tolerances, Resolution, Manufacturer Specifications, etc.)

- Data is compiled from all items listed above that are relevant to the methodology being assessed and can be measured.
- For each methodology compiled, valid measurement data is entered into a software program provided by the Calibration Laboratory Assessment Program (CLAS). The following compiled data is entered into the software template:

  a) The Component of Uncertainty- Examples are Human Error/Reproducibility study data, Calibration certificate resolutions or tolerances for equipment, manufacturer specifications for equipment or consumables, environmental accommodations or allowances, etc.
  b) An Uncertainty value for each item. This value may be derived from in house studies, calibration certificates or from the manufacturer.
  c) Distribution for each item. Choose a distribution component of uncertainty from the drop down menu that is the most valid component for each Component of Uncertainty. Options include:

     - Normal (1s, 2s or 3s)-used for normal distributions such as uncertainty values provided on calibration certificates or manufacturer provided specifications and tolerances.
     - Rectangular (also Rectangular x2) - used when uncertainty value probability falls within a range. Often the best distribution to use if you are unsure which applies.
     - Triangular- used when uncertainty value falls within a wide range but has a central tendency.
     - U-shaped-used when uncertainty value falls within a range but tends to be an extreme ends of range.

  d) A value for Divisor and Standard Uncertainty is calculated by the CLAS software once values for b and c are entered.
  e) An Uncertainty of Measurement result is obtained.

This estimation of uncertainty can be presented to the end user on a QC report or by request. For information regarding any particular measurement, contact the QA Department.

22.5 Control of Data

To ensure that data are protected from inadvertent changes or unintentional destruction, the laboratory uses procedures to check calculations and data transfers (both manual and automated).

22.5.1 Computer and Electronic Data Requirements

The laboratory assures that computers, user-developed computer software, automated equipment, or microprocessors used for the acquisition, processing, recording, reporting, storage, or retrieval of environmental test data are:

- documented in sufficient detail and validated as being adequate for use;
- protected for integrity and confidentiality of data entry or collection, data storage, data transmission and data processing;
- maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of environmental test data; and
- held secure including the prevention of unauthorized access to, and the unauthorized amendment of, computer records. Data archive security is addressed in Section 16 – "Control of Records" and building security is addressed in Section 21- "Accommodations and Environmental Conditions".
- The laboratory controls access to all programs that are used to acquire, process, record or report data.
- The laboratory uses spreadsheets to perform data acquisition and calculations. Before using these programs or reporting results, the laboratory shall validate the underlying calculations and protect the integrity of each spreadsheet by the following procedure;
    - Once a Draft spreadsheet is created, it is validated by manually calculating results on a blank version of the spreadsheet and comparing the results to the automated spreadsheet. Spreadsheets are verified by staff experienced and knowledgeable in the method/data calculations associated with the spreadsheet.
    - Spreadsheets or data acquisition programs created and utilized through software may be validated through the use of alternate software and comparison of calculated formulas and results.
    - Both spreadsheets are retained and date and initials of the validator are recorded on both spreadsheets.

- After the spreadsheet is validated, the calculations are protected from inadvertent manipulations. This is done by locking the formulated cells in the worksheet and applying password protection. All programs are password-protected. Each employee is granted access only to those programs that he or she uses. The password is unique to the individual, and cannot be shared.

- Upon completion and validation of the spreadsheet the document is submitted to QA where it is assigned a unique identifier (name or ID) and effective date. The controlled spreadsheet is added to the master list and saved on the Babcock Server. Manually calculated spreadsheets used in the validation step are saved with the controlled spreadsheet on the server.

- The verified and controlled spreadsheet is ready for use and released to all appropriate staff.

22.5.2 Data Reduction

The analyst calculates final results from raw data or appropriate computer programs provide the results in a reportable format. The test methods provide required concentration units, calculation formulas and any other information required to obtain final analytical results.

Calculate all results using maximum digits available.

If transferring files, enter results into the LIMS using the maximum digits available. If manually entering data, enter results into the LIMS using the maximum digits available The LIMS rounds results based on the number of significant figures specified for that analysis.

Rounding rules are as follows:

- If the digit 6,7,8, or 9 is dropped increase preceding digit by one unit.
- If the digit 0,1,2,3, or 4 is dropped do not alter preceding digit.
- If the digit 5 is dropped,
  From the end of a result: round off preceding digit to the nearest even number (e.g. 2.25 → 2.2 and 2.35 → 2.4).
  From the middle of a result: increase preceding digit by one unit. (e.g. 2.251 → 2.3 and 2.351 → 2.4).

The laboratory has manual integration procedures that must be followed when integrating peaks during data reduction located in G-251-Chromatographic Quantification of Data SOP.

All raw data must be retained and it is maintained as described in Section 16 – "Control of Records".

22.5.3 Data Review Procedures

Data review procedures are located in Section 27.4 – "Data Review".

Section 23

Equipment
(TNI V1:M2 – Sect 5.5 and Section 1.7 of Technical Modules TNI V1:M 4,5)

23.1 General Equipment Requirements

The laboratory provides all the necessary equipment required for the correct performance of the scope of environmental testing performed by the laboratory.

All equipment and software used for testing and sampling are capable of achieving the accuracy required for complying with the specifications of the environmental test methods as specified in the laboratory SOPs.

Equipment is operated by authorized and trained personnel only (see Section 20 – "Personnel"*)*.

The laboratory has procedures for the use, maintenance, handling and storage of equipment, which are readily available to laboratory personnel. Manuals provided by the manufacturer of the equipment provide information on use, maintenance, handling and storage of the equipment. The laboratory maintains an ongoing equipment list that includes additional information such as which lab location the equipment is located or storage location(s). This list is maintained on the Babcock Server and readily available upon request.

All equipment undergoes verification and if required, calibration prior to use to ensure that it meets laboratory specifications and relevant standard specifications.

Test equipment, including hardware and software, are safeguarded from adjustments that would invalidate the test result measurements by limiting access to the equipment and using password protection where possible (see Section 22.5 – "Control of Data"*)*.

Any item of equipment subjected to overloading or mishandling, gives suspect results, or has shown by verification or otherwise to be defective is taken out of service. It is clearly labeled as "Out of Service" and the date with a prominent sign, and wherever possible, stored separately until it has been repaired. Repair is determined successful when the instrument satisfactorily performs the routine quality control measures for which it is employed. The problem shall be examined to determine if the instrument defect had any effect on previous calibrations or results. If it has shown that previous tests are affected, then procedures for nonconforming work are followed and results are documented (see Section 12 – "Control of Nonconforming Environmental Testing Work" and Section 14 – "Corrective Action").

When equipment needed for a test that is outside of permanent control of the laboratory, the lab ensures the equipment meets the requirements of this manual prior to its use by inspecting or otherwise testing it.

All equipment is properly inspected, maintained, and cleaned. All maintenance procedures are documented.

Each item of equipment is, when appropriate (i.e. thermometers), labeled, marked, or otherwise identified to indicate its calibration status.

23.2 Handling, Storage and Transport of Equipment

Each instrument or piece of equipment has instructions for its start-up, operation and shutdown described in manufacturer's manuals or per laboratory procedure. Only authorized personnel should operate equipment.

The current location of equipment in use is noted on the ongoing equipment list located on the Babcock Server.

If sensitive equipment must be moved, it is moved and transported according to manufacturer's instructions. Transportation or moving equipment may be performed by the manufacturer,another service provider or designated laboratory staff. Equipment is not returned to service until performance checks and verification have been performed and documented. Please see Appendix H.1b for procedure describing verification steps required after equipment has been moved.

23.3 Equipment Records

Records shall be maintained for each major type of equipment and reference materials significant to the tests being performed. These records include documentation on all routine and non-routine maintenance activities and reference material verifications, including:

- The name of the item of equipment;
- The name of software used.
- The manufacturer’s name, type identification, and serial number or other unique identification;
- The date received and date placed in service;
- Current location; laboratory and department; if moved to new location, note location and date;
- If available, the condition when received (e.g. new, used, reconditioned);
- A copy of the manufacturer’s instructions; or reference to their location.
- Dates of calibrations and/or verification if infrequent; or reference to where this information can be found (i.e. raw data).
- Dates, results and copies of reports and certificates of all acceptance criteria.
- Completed Maintenance Plan (linked to Maintenance Logs). Maintenance Plans document routine preventative maintenance required for instrumentation which may include:
    - Routine checks or preventative maintenance required on a daily basis (or with each use)
    - Routine checks or preventative maintenance required weekly or monthly
    - Routine checks or preventative maintenance required annually.

- Any other preventative maintenance performed as needed.
- Details of regular maintenance carried out to date (See section 23.4);
- History of any damage, malfunction, modification, or repair;
  - Changes made to instrument and if applicable, reasons for change;
  - "Out of service" notation when equipment is down;
  - "In service" notation when equipment is repaired, accompanied by the initial batch number performed on the equipment since the repair, if available. Valid QC results within this initial batch verify equipment performance.
  - Trouble-shooting history and tips

23.4 Maintenance Logs

Electronic laboratory maintenance logs are maintained for all analytical instrumentation and support equipment. Hard copy maintenance logs are maintained by the Field department for their support equipment. Logs include Equipment Records described in Section 23.3. Maintenance logs are created by the QA Department for new instrumentation as needed upon requests from staff.

Each piece of equipment has an assigned log and a unique ID number. Logs also include equipment identification information, location, link to Maintenance Plans (Section 23.3) and all documentation of maintenance or repair.

New instrumentation may require a MDL study, retention time study, or new IDoC study. A New Instrument Checklist may be completed for applicable new equipment and documents any needed studies.

For each maintenance log/piece of equipment, the manager assigns a person who is responsible for the log and any corresponding equipment. The assigned person responsible for ensuring the following:

- A maintenance log is available for the piece of equipment/instrumentation.
- The electronic log includes direct links to equipment information and the Maintenance Plan. These items must be current and correct. Linked equipment information is found on the Babcock server in the Equipment Records and Maintenance Plans folder.
- Documentation of both routine maintenance and major repairs.
- Maintenance plans are carried out and any in-house maintenance performed is recorded in the log.
- Any repair or service call summaries arising from visits by manufacturer approved repair personnel are scanned and saved with the maintenance log.
- When equipment taken out of service due to maintenance is returned to service, an entry stating such is put in the maintenance log. Where applicable, please include the ID of the first Batch with acceptable QC or other evidence to demonstrate the proper working of the instrument when it is returned to service.
- Work with manager to address any issues noted during Log Reviews. The QA department reviews maintenance logs on a consistent basis, often during

internal audits to ensure complete and on-going documentation of maintenance.
- Notify QA regarding any logs for instruments taken out of commission permanently so they can be retired from the system.

23.5 Support Equipment

Support Equipment includes, but is not limited to balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices, volumetric dispensing devices, and thermal/pressure sample preparation devices.

All support equipment has a maintenance log and maintained in proper working order. Records are kept for all repair and maintenance activities of support equipment, including service calls, if applicable.

All raw data records are retained to document equipment performance. Records may be scanned and saved electronically. These records include logbooks, data sheets, or equipment computer files.

23.5.1 Support Equipment Maintenance

Regular maintenance of support equipment, such as balances and fume hoods is performed at least annually.

Maintenance on other support equipment, such as ovens, refrigerators, and thermometers is conducted on an as needed basis.

Maintenance Plans are maintained for applicable support equipment.

23.5.2 Support Equipment Calibration

All balances and thermometers are calibrated or verified annually over the range of use using NIST traceable references where available. The calibration results are within required specifications or (1) the equipment is removed from service until repaired, or (2) records are maintained of correction factors to correct all measurements. If correction factors are used this information is clearly marked on or near the equipment.

Support equipment such as balances, ovens, refrigerators, freezers, and water baths are verified with a NIST traceable reference if available, each day prior to use, to ensure operation is within the expected range for the application for which the equipment is to be used.

Volumetric dispensing devices (except Class A glassware and Glass microliter syringes) are checked for accuracy on a monthly basis if used for quantitatively sensitive measurements.

For additional information on support equipment, refer to G-201-Support Equipment SOP.

For microbiology analyses refer to Appendix I.

23.6 Analytical Equipment

23.6.1 Maintenance for Analytical Equipment

All equipment is properly maintained, inspected, and cleaned.

Maintenance of analytical instruments and other equipment may include regularly scheduled preventive maintenance or maintenance on an as-needed basis. Instrument malfunction is documented in Maintenance Logs, which become part of the laboratory's permanent records. A description of what was done to repair the malfunction and proof of return to control are documented in the log.

23.6.2 Instrument Calibration

Initial instrument calibration and continuing instrument calibration verification are an important part of ensuring data of known and documented quality. If more stringent calibration requirements are included in a mandated method or by regulation, those calibration requirements override any requirements outlined here or in laboratory SOPs. When intermediate checks are needed to maintain confidence in the calibration status of the equipment, these checks shall be carried out according to a defined procedure. Generally, procedures and criteria regarding instrument calibrations are provided in Technical Standard Operating Procedures.

Section 24

MEASUREMENT TRACEABILITY
(TNI V1:M2 – Section 5.6)

Measurement quality assurance comes in part from traceability of standards to certified materials.

All equipment used affecting the quality of test results is calibrated prior to being put into service and on a continuing basis (see Section 23 – "Equipment"). These calibrations are traceable to national standards of measurement where available.

If traceability of measurements to SI units is not possible or not relevant, evidence for correlation of results through interlaboratory comparisons, proficiency testing, or independent analysis is provided.

24.1 Reference Standards

Reference standards are standards of the highest quality available at a given location, from which measurements are derived.

Reference Standards, such as ASTM Class 1 weights, are used for calibration verification.

Reference standards, such as ASTM Class 1 weights, are calibrated by an entity that can provide traceability to national or international standards. Documentation of NIST certification is maintained for each reference standard. The following reference standards are sent out to be calibrated to a national standard.

- Class 1 weights.
- NIST traceable reference thermometers.

24.2 Reference Materials

Reference materials are substances that have concentrations that are sufficiently well established to use for calibration or as a frame of reference.

When availability of a CRM is scarce the laboratory uses the reference materials provided in PT studies as a substitute if available.

Purchased reference materials require a Certificate of Analysis where available. If a reference material cannot be purchased with a Certificate of Analysis, it is verified by analysis and comparison to a certified reference material and/or demonstration of capability for characterization.

Internal reference materials, such as working standards or intermediate stock solutions, are checked with each batch of samples.

Additional working standards such as working class weights or internal thermometers are checked annually.

24.3 Transport and Storage of Reference Standards and Materials

The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials.

Reference standards and materials are stored according to manufacturer's recommendations, method SOP requirements and separately from samples.

24.4 Labeling of Reference Standards, Reagents, and Reference Materials

The laboratory has procedures for purchase, receipt and storage of standards, reagents and reference materials. Purchase procedures are described in Section 9 – "Purchasing Services and Supplies".

Expiration dates can be extended if the reference standard or material's integrity is verified and there is no language in the method prohibiting an extension. The extended date may not be beyond the expiration date of the referenced standards used to re-verify. The performance of the expired standard is compared to that of a fresh standard.

Any expired reference standards that are not re-certified for use are removed from use. An expired standard may be kept and used for non-compliant internal qualitative purposes only if it is labeled clearly as to its approved use.

Reagent quality is verified during routine analysis. Each lot is approved following successful performance with a batch of samples. Sample results are not accepted until satisfactory performance has been demonstrated.

24.4.1 Stock Standards, Reagents, Reference Materials and Media

Records for all standards, reagents, reference materials, and media include:

- the manufacturer/vendor name (or traceability to purchased stocks or neat compounds)
- the manufacturer's Certificate of Analysis or purity (if supplied or requested)
- the date of receipt
- lot or serial number (if required)
- recommended storage conditions
- date opened
- expiration date
- unique identification number (generated by LIMS)

If the original container does not have an expiration date provided by the manufacturer or vendor an expiration date of 5 years from the date of receipt is given to dry chemicals and 3 years from the date of receipt given to liquid chemicals. These dates may be extended as long as the chemical is verified and the test quality controls are still meeting method requirements. If the manufacturer

provides an expiration date it will be used until that date and may only be re-certified on a case by case basis. Materials are visually inspected before use in order to avoid the accidental use of expired or defective materials.

In methods where the purity of reagents is not specified, analytical reagent grade is used. If the purity is specified, that is the minimum acceptable grade. Purity is verified and documented according to Section 9 – "Purchasing Services and Supplies".

24.4.2 Prepared Standards, Reagents, Reference Materials and Media

Records for standards, reagents, reference materials, and media preparation include:

- traceability to purchased stock or neat compounds
- reference to the method of preparation
- date of preparation
- an expiration date after which the material shall not be used (unless its reliability is verified by the laboratory).
  Note: The expiration date of the prepared standard cannot exceed the expiration date of the primary standard.
- preparer's initials (if prepared)
- unique identification number (generated by LIMS)

Prepared reagents are verified to meet the requirements of the test method by checking appropriate parameters (See Appendix J).

24.5 Reagent Grade Water:

Reagent Grade water for preparation of Standards and Reagents shall meet or exceed ASTM Type II water requirements with no detectable concentration of the compound or element to be analyzed at the detection limit of the analytical method. This is monitored by the analysis and documentation of the D.I. conductivity on a daily basis and by the analysis of a method blank prepared with each preparation batch. If the conductivity reading is greater than 4µmho/cm, the analyst notifies the manager and the tanks are checked. The water company is called to change the tanks. The lab uses Nanopure water until the D.I. is fixed. No samples are prepared for boron analysis until the D.I. unit is serviced and tanks are exchanged. For Microbiology analyses we are exempt from the annual Bacteriological Water Quality Test since we have documented that we have Standard Methods Type II reagent water.

Treatment of water in our laboratory consists of an anion/cation exchange resin bed that is considered excellent for the removal of dissolved ionized solids and dissolved ionized gases. Further treatment is necessary for some sections of the laboratory for removal of dissolved organics, particulates, and/or bacteria. A nanopure filtration unit with UV is used in these cases as needed.

The primary ion exchange resin bed tank is monitored daily to ensure the system is working. As added protection, the water then flows from the resin bed tank through a polisher tank that is capable of deionizing the water if the first bed fails. Tanks are monitored using the indicator lights on the DI tanks. When the tanks are working,

each will show a Green indicator light. Once a tank is close to going out (needing to be changed) the indicator light will turn Red. When one of the indicator lights turns red the water company is contacted so that the tanks can be changed. When both indicator lights turn Red the tanks are not used until they have been changed.

Section 25

COLLECTION OF SAMPLES
(TNI V1:M2 – Section 5.7)

Babcock Laboratories, Inc. provides sampling services upon request. Sampling procedures are available to all sampling staff. An example procedure is in Appendix G of this *Quality Manual*.
When sampling is not provided, the laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

25.1 Sampling Containers

The laboratory offers clean sampling containers for use by clients. Containers are purchased from approved vendors and meet method specifications.

25.1.1 Preparing Container Orders

Containers (containing any required preservatives) are provided to the client upon request.

Refer to G210-Bottle Preservation SOP for details on preparing containers.
Refer to G211-Bottle Orders and Subcontracting SOP for details on requesting bottle orders and shipping procedures.

25.1.2 Sampling Containers, Preservation Requirements, Holding Times

Sampling container, preservation and holding time requirements can be found in Appendix K of this *Quality Manual*

25.2 Sampling Plan

The laboratory uses sampling plans provided by clients or prepared in consultation with the client. The plan must include any factors that must be controlled to ensure the validity of the test. Sampling plans and written sampling procedures are used for sampling substances, materials or products for testing. The plan and procedures are made available at the sampling location.

The laboratory's procedures for dealing with nonconformances are used when the client requests any deviations from the sampling plan or sampling procedures. The requests are documented and included in the final test report.

25.3 Sampling Records

The following relevant sampling data are recorded: sampling procedure used, the date and time of sampling, the identification of the sampler, environmental conditions (if relevant), the sampling location, deviations from sampling procedure if applicable, comments and project plan information (ie. the statistics upon which the sampling procedures are based) where applicable.

Section 26

HANDLING SAMPLES AND TEST ITEMS
(TNI V1:M2 – Section 5.8 and Section 1.7 of Technical Modules TNI V1:M 4,5)

All staff associated with administration of the sample handling system are properly trained on the policies and procedures outlined below.

26.1 Sample Receipt

When samples are received at the laboratory, chain-of-custody is reviewed, condition is documented, samples are given unique identifiers, and they are logged into the sample tracking system.

26.1.1 Chain of Custody

The chain of custody or sample submission sheet from the field is reviewed. This documentation is completed in the field and provides a written record of the handling of the samples from the time of collection until they are received at the laboratory. Section 25 – "Collection of Samples" outlines what information is needed on this record. The chain of custody form also provides information on what type of testing is being requested and can act as an order for laboratory services in the absence of a formal contract. An example chain of custody form can be found in Figure 26-1. Chain of custody and any additional records received at the time of sample submission are scanned into Element LIMS.

26.1.1.1 Legal Chain of Custody

The laboratory has procedures for legal chain of custody services. If samples are noted as being used for legal/evidentiary purposes, special chain of custody procedures are put into place by the laboratory. Custody seals are sent by the lab if the sampling containers are ordered from the laboratory, shipping records are maintained with the chain of custody, internal chain of custody is initiated that provides additional documentation of internal handling by analysts and a disposal record is provided. Refer to Legal Evidentiary Custody SOP G-240 for details.

26.2 Sample Acceptance

The laboratory has a sample acceptance policy that is made available to sample collection personnel. An example is provided in Figure 26-2. It emphasizes the need for use of water resistant ink, providing proper documentation (to include sample ID, location, date and time of collection, collector's name, preservation type, sample type and any special remarks about the sample), labeling of sample containers to include a unique sample ID, use of appropriate containers, adherence to holding times, and sample volume requirements. In addition the laboratory has nonconformance/corrective action procedures to handle samples that don't meet the requirements above or show signs of damage, contamination or inadequate

preservation. Data will be appropriately qualified where samples are reported that do not meet sample acceptance requirements.

The laboratory checks samples for the conditions above where appropriate, to evaluate sample acceptance. Criteria regarding preservation, holding time and sample volume requirements can be found in Appendix K of this *Quality Manual*. If these conditions are not met, the client is contacted prior to any further processing, then 1) the sample is rejected as agreed with the client, 2) the decision to proceed is documented and agreed upon with the client, 3) the condition is noted on the Chain of Custody form and/or lab receipt documents, and 4) the data are qualified in the report.

26.2.1 Preservation Checks

The following preservation checks are performed and documented upon receipt:

Thermal preservation:

a) Samples requiring thermal preservation from sampling until analysis as stipulated by the method are as follows:
   - Nonmetal aqueous and non-aqueous Chemistry analyses- above freezing to 6°C.
   - Wastewater Bacteriological analyses - above freezing to 10°C
b) Samples that are delivered to the lab the same day as they are collected are likely not to have reached a fully chilled temperature. This is acceptable if the samples were received on ice and the chilling process has begun.
c) Record on the receipt form if ice is present and the temperature.
d) Samples do not require thermal preservation if analysis is started within fifteen (15) minutes of collection.

pH checks:

The pH of samples requiring acid/base preservation is checked upon sample receipt or upon initiation of analysis. For volatile organic compound analyses; chemical preservation is checked after analysis.

Chlorine checks:

In some cases a chlorine screen is necessary upon receipt or upon initiation of analysis. For volatile organic compound analyses; chemical preservation is checked after analysis. See method SOPs for details.

26.2.2 Holding Times

During sample receipt and login, if sample receiving personnel receive a sample requesting an analysis that is close to its recommended holding time the lab/manager is notified so analysis can be initiated as soon as possible. The following guidelines are used for analytical holding times:

- Test methods where recommended maximum holding time is provided in **hours** such as 8 hours, 24 hours, 48 hours, etc. will be tracked by hour.
    - Example: Turbidity-48 hour holding time. Sample collected on 7/25/18 at 0800 must be analyzed by 7/27/18 at 0759 to meet holding time.
- Test methods where recommended maximum holding time is provided in **days** such as 7 days, 14 days, 28 days, etc. will be tracked by the day. Holding time expires at midnight of the last day.
    - Example: TDS-7 day holding time. Sample collected on 7/25/18 at 0800 must be analyzed by 8/1/18 at midnight to meet holding time.
- Test methods where recommended maximum holding time is provided in **months** such as 6 months will be tracked by the month. One month is defined as 30 days. Holding time expires after the 30th day.

26.3 Sample Identification

Samples, including subsamples, extracts and digestates, are uniquely identified in a permanent chronological record in our LIMS system to prevent mix-up and to document receipt of all sample containers.

Samples are assigned work order numbers that reference more detailed information kept in the LIMS system. Samples are logged into the LIMs system under a facility code to note which laboratory location the analyses are completed. Sample work order numbers are assigned in LIMS based on the laboratory performing the analyses.

A durable water resistant, computer generated sample label is printed and affixed to each sample. Every sample container received from the client is uniquely identified on the label with the work order number and an alpha character (A,B,C) indicating the specific container.

When sub-samples, extracts and/or digestates are made, each additional container is uniquely identifiable. Sub-samples taken for preservation indicate the preservative added in addition to the work order number.

The following information is included in the LIMS system

- Client or project name
- Date and time of receipt at lab
- Laboratory location
- Unique laboratory identification number
- Signature or initials of person making the entries

In addition, the following information is maintained and linked to the log-in record:

- Date and time of sampling linked to the date and time of laboratory receipt.

- Analyses requested (including applicable approved method numbers) linked to the laboratory sample ID.
- Comments regarding rejection (if any).

All documentation received regarding the sample, such as memos or chain of custody, are retained. Refer to SOP G-104 "Records Management" for details.

26.4 Sample Aliquots / Subsampling

In order for analysis results to be representative of the sample collected in the field, the laboratory has the following subsampling procedures:

Ensure that the sample is properly homogenized using the following actions:

- Shake aqueous samples vigorously. Pour out the subsample before solids have a chance to settle.
- Stir soils and sludges with a scapula. If the sample is dry and difficult to mix, the analyst may dump the entire sample out onto a clean surface and mix in a larger container prior to taking a subsample. Care must be taken however not to alter the moisture content of the sample.
- For multiphase samples, analysts may use a wide mouth pipette to collect both solids and liquid phases. Care must be taken to ensure that the subsample has the same proportion of liquids to solids as the original sample.
- Extraneous material such as large rocks and sticks may be ignored when taking a subsample, if the item is clearly an anomaly.
- Ensure that the sample lid is closed tightly and the sample is returned to the refrigerator as soon as possible.
- Samples for volatile analysis should not be agitated or stirred. Volatile aliquots should be removed from the sample container prior to other analyses.
- Scrap off the surface layer and remove a core aliquot from the middle of the sample container.

26.5 Digests and Extracts

Follow analytical procedures carefully for digestions and extractions.

Watch the progress of a digestion to prevent drying or overheating. Be careful when handling acids or bases. When venting separatory funnels, make sure the spout is pointed away from yourself or other laboratory personnel.

Organic sample volumes are recorded as follows:

Use the pre-marked volume jar that matches your sample jar to visually assess sample volume. Sample volumes at or above 900mLs are recorded to the nearest 5 or 10mL by rounding to the nearest mark on the jar. Sample volumes below 900mL must be determined exactly by marking sample level on the jar and determining volume after analysis or by pouring sample into a 1L graduated cylinder.

Sample Volumes:

In some cases, sample volumes are measured based on a tared bottle weight. Pre-weighed empty sample bottle weights are subtracted when bottle and sample weight is obtained.

Water Extracts:

Samples requiring water extraction are prepared per the analytical method. In the absence of a specific extraction ratio listed in the method, Babcock will default to the ratio specified in this section.

1:10 Water Extracts:

Weigh up aliquot of sample.

Add Nanopure or D.I water at a volume ten times the above aliquot of sample. For example, add 50 mL of D.I. on top of 5 grams of sample. This is documented as 5g:50mL.

The extract should be agitated during the extraction period. The amount of time required for the extraction varies between analytical methods.

Check with the analytical SOP to determine whether to report the result "in the extract" or whether to multiply the result by 10 and report the result "in the original sample".

26.6 Sample Storage

Storage conditions are monitored for any required criteria, verified, and the verification recorded in logs.

Samples that require thermal preservation are stored under refrigeration that is +/-2°C of the specified preservation temperature unless regulatory or method specific criteria require something different. For samples with a specified storage temperature of 4°C, storage at a temperature above the freezing point of water to 6°C is acceptable.

Samples are held secure, as required. Samples are accessible only to laboratory personnel.

Samples are stored apart from standards, reagents, food or potentially contaminating sources, and such that cross-contamination is minimized. All portions of samples, including extracts, digestates, leachates, or any product of the sample is maintained according to the required conditions.

26.7 Sample Disposal

Samples are retained a minimum of four weeks unless other arrangements have been made with the client.

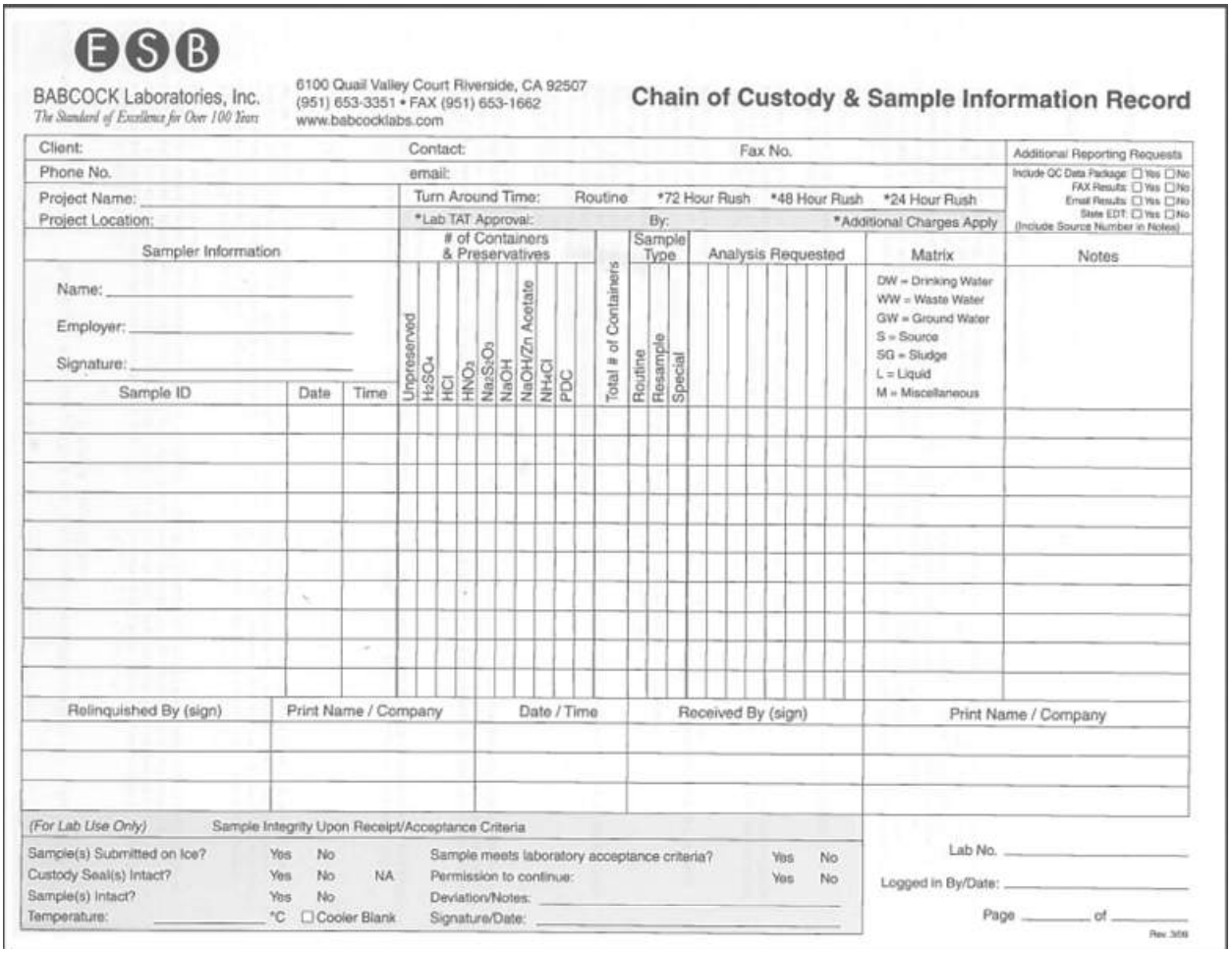
Samples are disposed of according to Federal, State and local regulations. Procedures are described in the Babcock Health and Safety program for the disposal of samples, digestates, leachates, and extracts.

*For additional DOD sample disposal requirements see Appendix L Section 26

26.8 Sample Transport

Samples that are transported under the responsibility of the laboratory, where necessary, are done so safely and according to storage conditions. This includes moving bottles within the laboratory. Specific safety operations are addressed outside of this document.

Figure 26-1 Example Chain-of-Custody



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Chain of Custody & Sample Information Record

Client: | Contact: | Fax No. | Additional Reporting Requests
Phone No. | email: | Include QC Data Package ☐ Yes ☐ No; FAX Results ☐ Yes ☐ No; Email Results ☐ Yes ☐ No; State EDT ☐ Yes ☐ No (Include Source Number in Notes)
Project Name: | Turn Around Time: Routine *72 Hour Rush *48 Hour Rush *24 Hour Rush
Project Location: | *Lab TAT Approval: | By: | *Additional Charges Apply

Sampler Information
Name:
Employer:
Signature:

Sample ID	Date	Time	# of Containers & Preservatives: Unpreserved	H_2SO_4	HCl	HNO_3	$Na_2S_2O_3$	NaOH	NaOH/Zn Acetate	NH_4Cl	PDC	Total # of Containers	Sample Type: Routine	Resample	Special	Analysis Requested	Matrix	Notes
																	DW = Drinking Water WW = Waste Water GW = Ground Water S = Source SG = Sludge L = Liquid M = Miscellaneous	

Relinquished By (sign)	Print Name / Company	Date / Time	Received By (sign)	Print Name / Company

(For Lab Use Only) Sample Integrity Upon Receipt/Acceptance Criteria

Sample(s) Submitted on Ice? Yes No
Custody Seal(s) Intact? Yes No NA
Sample(s) Intact? Yes No
Temperature: _____ °C ☐ Cooler Blank

Sample meets laboratory acceptance criteria? Yes No
Permission to continue: Yes No
Deviation/Notes: _____
Signature/Date: _____

Lab No. _____
Logged In By/Date: _____
Page _____ of _____

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Figure 26-2 Example Sample Acceptance Policy

Sample Acceptance Policy

All samples accepted by Babcock Laboratories, Inc. must meet the following acceptance criteria. If criteria are not met, this will be noted on sample receipt documentation.

a) a completed Chain of Custody form including proper, full, and complete documentation, which shall include sample identification, the location, date and time of collection, collector's name, preservation type, sample type and any special remarks concerning the sample;

b) proper sample labeling to include unique identification and a labeling system for the samples with requirements concerning the durability of the labels (water resistant) and the use of indelible ink;

c) use of appropriate sample containers; adherence to specified holding times and preservation requirements;

d) sufficient sample volume to perform the necessary tests;

Client will be contacted to provide sampling information (a) if missing and approval must be given to proceed with analysis if (b-d) are not met or when samples show signs of damage or contamination. Reports will contain qualification of any data that do not meet the above requirements (b-d).

Section 27

QUALITY ASSURANCE FOR ENVIRONMENTAL TESTING*(TNI V1:M1, V1:M2 – Section 5.9 and Section 1.7 of Technical Modules TNI V1:M 3-7)*

Babcock Laboratories has procedures for monitoring the validity of the testing it performs. The qualities of test results are recorded in such a way that trends are detectable, and where practicable, are statistically evaluated. To evaluate the quality of test results, the laboratory utilizes quality control samples, certified reference materials, control charting, proficiency testing samples, replicate analysis, confirmation analyses, comparisons to historical data, etc.

In addition to procedures for calibration, the laboratory monitors quality control measurements such as blanks, laboratory control samples/blank spike samples (LCS/BS), matrix spikes (MS), duplicates, surrogates and internal standards to assess precision and accuracy. Proficiency Testing samples are also analyzed to assess laboratory performance.

Quality control data is analyzed and when found to be outside pre-defined criteria, corrective action is taken to correct the problem and to prevent the reporting of incorrect results. Data associated with quality control data outside of criteria and still deemed reportable will be qualified so the end user of the data may make a determination of the usability of the data - see Section 28 – "Reporting of Results".

27.1 Essential Quality Control Procedures

Laboratory personnel follow the quality control procedures specified in test methods and SOPs. Quality control samples are processed just like client samples following the same procedures. The most stringent of control procedures is used in cases where multiple controls are offered. If it is not clear which is the most stringent, that mandated by test method or regulation is followed. Quality control samples are reported with the associated batch of samples.

For test methods that do not provide acceptance criteria for an essential quality control element or where no regulatory criteria exist, acceptance criteria are developed. In-house developed acceptance criteria are reviewed per matrix on an annual basis, usually during internal audits and updated as needed. Additional updates are performed as needed such as major changes made to an analysis or instrument. Control limits are monitored for shifts in mean recovery, changes in standard deviation, and development of trends. Criteria may be generated statistically using control charts in Element LIMS. Compiled data points in LIMS are charted and acceptance criteria are obtained utilizing calculated standard deviations from historical data. The use of three standard deviations is generally used but two or four standard deviations may be used if the data supports it and by the discretion of the QA department. Statistically derived historical control limits may be narrow and fall outside method stated expected recoveries or general QC criteria guidelines. To prevent "QC failures" in analytical data with recoveries at or around 100%, any generated limits with a statistically derived upper limit of less than 100% the upper limit is set at 120%. The lower recovery limit is never set to less than 10% regardless of the statistically derived limit. Failed LCS recovery data

and statistical outliers are not removed from the calculation, unless there is a scientifically valid and documented reason. Outlying data points, which are obvious deviations from the normal trend of data, are not included in statistical analysis. Depending on the test method, replicate or duplicate results may be used to statistically generate acceptance criteria if needed. All acceptance criteria are stored in LIMS and accessible to all personnel. For some specialized projects, the client may set criteria for their samples. These project specific criteria are stored in LIMS under the project specific requirements.

Written procedures to monitor routine quality controls including acceptance criteria are located in technical SOPs except where noted and include such procedures as:

- use of laboratory control samples and blanks to serve as positive and negative controls for chemistry and microbiological methods;
- use of laboratory control samples to monitor test variability of laboratory results;
- use of calibrations, continuing calibrations, certified reference materials and/or PT samples to monitor accuracy of the test method;
- measures to monitor test method capability, such as limit of detection, limit of quantitation, and/or range of test applicability, such as linearity;
- use of regression analysis, internal/external standards, or statistical analysis to reduce raw data to final results;
- use of reagents and standards of appropriate quality and use of second source materials as appropriate;
- procedures to ensure the selectivity of the test method for its intended use;
- measures to assure constant and consistent test conditions, such as temperature, humidity, rotation speed, etc., when required by test method;
- use of sterility checks for equipment, media and dilution water for microbiology; and
- use of positive and negative culture controls for microbiology.

*For additional DOD in-house limit requirements see Appendix L Section 27

27.2 Internal Quality Control Practices

Analytical data generated with QC samples that fall within all prescribed acceptance limits indicate the test method is deemed to be in control.

QC samples that fall outside QC limits indicate the test method is deemed to be out of control (nonconforming) and that corrective action is required and/or that the data are qualified (see Section 12 – "Control of Nonconforming Environmental Testing Work" and Section 14 - "Technical Corrective Actions").

Detailed QC procedures and QC limits are included in the technical standard SOPs.

All QC measures are assessed and evaluated on an on-going basis, so that trends are detected.

27.2.1 General Controls

The following general controls are used:

27.2.1.1 Positive and Negative Controls such as:

a) Blanks (negative)
b) Laboratory control sample/Blank spike (positive)
c) Sterility checks and control cultures (positive and negative).

27.2.1.2 Selectivity is assured through:

a) absolute and relative retention times in chromatographic analyses;
b) two-column confirmation when using non-specific detectors;
c) use of acceptance criteria for mass-spectral tuning (found in test method SOPs);
d) use of the correct method according to its scope assessed during method validation; and
e) use of reference cultures (positive and negative) from a recognized manufacturer (where applicable).

27.2.1.3 Consistency, Variability, Repeatability, and Accuracy are assured through:

a) proper installation and operation of instruments according to manufacturer's recommendations or according to the processes used during method validation;
b) monitoring and controlling environmental conditions (temperature, access, proximity to potential contaminants);
c) selection and use of reagents and standards of appropriate quality;
d) cleaning glassware appropriate to the level required by the analysis as demonstrated with method blanks. (Technical SOPs)
e) For microbiology, glassware care includes use of borosilicate glassware, use of detergents designed for laboratory use and testing for alkaline or acid residue with bromothymol blue, and conduct of the Inhibitory Residue test when the detergent is changed or annually, whichever is more frequent.
f) following SOPs and documenting any deviation, assessing for impact, and treating data appropriately;
g) testing to define the variability and/or repeatability of the laboratory results, such as replicates;
h) rotation of equipment used to ensure variability; Lab glassware/supplies are not devoted to use solely for QC samples such as batch Blanks and BS

i) use of measures to assure the accuracy of the test method, including calibration and/or continuing calibrations, use of certified reference materials, proficiency test samples, or other measures; and

j) use of duplicate plate counts on positive samples (microbiology only).

27.2.1.4 Test Method Capability (also see Section 22 – "Test Methods and Method Validation") is assured through:

a) establishment of the limit of detection where appropriate;

b) establishment of the limit of quantitation or reporting level; and/or

c) establishment of the range of applicability such as linearity.

27.2.1.5 Data reduction is assured to be accurate by:

a) selection of appropriate formulae to reduce raw data to final results such as regression;

b) following specific procedures for data reduction such as manual integration procedures;

c) periodic review of data reduction processes to assure applicability;

d) microbiological calculations, data reduction, and statistical interpretations specified by each test method.

27.2.1.6 Sample Specific Controls (MS/MSD) are used to evaluate the effect of sample matrix on the performance of the selected analytical method (not a measure of laboratory performance):

Examples:

- Matrix Spike and Matrix Spike Duplicate (MS/MSD)
- Surrogate Spikes
- Sample Duplicates

27.2.1.7 The following tables summarize the key elements of a quality control system for a laboratory performing chemistry and microbiology testing. Quality Control procedures shall be in place for both quantitative and qualitative methods.

Table 27-1 Essential Quality Control Elements for Chemistry

Item	Frequency	Acceptance Criteria	Corrective action
Negative Control (Method Blank)	1/batch	Method specific or reporting limit	Qualify data and take corrective action
Positive Control (Laboratory Control Sample/Blank spike)	1/batch	Method specific or determined by laboratory	Reprocess, reanalyze, or qualify data and take corrective action.

Table 27-1 Essential Quality Control Elements for Chemistry			
Item	**Frequency**	**Acceptance Criteria**	**Corrective action**
Matrix Spike; Matrix Spike Duplicates	Per method requirement	Method specific or determined by laboratory	Corrective action and qualify data.
Surrogate spikes	Per method requirement	Method specific or determined by laboratory	Corrective action and qualify data
Matrix Duplicates	Per method requirement	Method specific or determined by laboratory	Corrective action and qualify data
Continuing Calibration Verification	Per method requirement	Method specific or determined by the laboratory	Reanalyze standard immediately; Corrective action
Initial calibration Verification	Start of each analytical run	Method specific or determined by laboratory	Reanalyze standard immediately; Corrective action

Table 27-2 Essential Quality Control Requirements for Microbiology – All Methods			
Item	**Frequency**	**Acceptance Criteria**	**Corrective Action[2]**
Sterility check	Each lot of media and with each day of use.	No growth	Investigate cause
Sterility check containers	One container (bottle) for each lot.	No growth	Investigate cause
Sterility check dilution water	One per batch or lot of dilution water	No growth	Investigate cause
Positive control[1]	pure culture of target organisms/ each lot or batch	Positive reaction	Investigate cause If necessary reject the medium
Negative control[1]	Pure culture of non-target organisms/each lot or batch	Negative reaction	Investigate cause If necessary reject the medium
Duplicate colony counts (For numeric results only)	Monthly on one positive sample for each month performed.	Investigate cause Qualify data	
1)			

Table 27-2 Essential Quality Control Requirements for Microbiology – All Methods			
Item	**Frequency**	**Acceptance Criteria**	**Corrective Action[2]**
Sterility check	Each lot of media and with each day of use.	No growth	Investigate cause
Sterility check containers	One container (bottle) for each lot.	No growth	Investigate cause
Sterility check dilution water	One per batch or lot of dilution water	No growth	Investigate cause
Positive control[1]	pure culture of target organisms/ each lot or batch	Positive reaction	Investigate cause If necessary reject the medium
Negative control[1]	Pure culture of non-target organisms/each lot or batch	Negative reaction	Investigate cause If necessary reject the medium
Duplicate colony counts (For numeric results only)	Monthly on one positive sample for each month performed.	Same analyst <5% difference between counts Two analysts <10% difference between counts	Investigate cause Qualify data
1) Microorganisms may be single use preparations or cultures maintained by documented procedures that demonstrate the continued purity and viability of the organism. 2) Corrective Action may include the need to retrain. 3) Microorganisms may be single use preparations or cultures maintained by documented procedures that demonstrate the continued purity and viability of the organism. 4) Corrective Action may include the need to retrain.			

Item	**Frequency**	**Acceptance Criteria**	**Corrective action**
Method Blank	Minimum of one plate per day	Less than reporting limit	Investigate cause, qualify/ reject data

Table 27-4 Stock Cultures		
Item	**Frequency**	**Handling**
Reference cultures	Single use	Preserved and handled per mfg. specifications
Reference culture Reference stock	Culture stocks to make working stocks	Preserved and not refrozen Handling per mfg specs
Working stocks	Not transferred more than five times. Not sub-cultured to replace reference stocks	

27.2.2 Specific Controls

27.2.2.1 Method Blanks

The method blank is used to assess the samples in the preparation batch for possible contamination during the preparation and processing steps. Method blanks are processed along with and under the same conditions as the associated samples to include all steps in the method. Equipment, supplies, etc. are not to be used exclusively for QC samples. A method blank must be analyzed at a minimum of one per preparation batch unless not required by analytical method. When no separate preparation method is used the batch is defined as the environmental samples that are analyzed with the same method and personnel, using the same lots of reagents, not to exceed the analysis of twenty environmental samples, not including method blanks, LCS, matrix spikes and matrix duplicates. The matrix of the method blank must be similar to the associated samples and be free from any analytes of interest. Method blanks are not required for some analyses such as pH, settable solids and flashpoint.

Matrix type refers to one of following possible groups: water, liquid (including extracts), solid/soil/sludge, or gas. If possible it is preferred to group sludge separately from the others solids and CAM/TCLP extracts separately from other liquids. If the water and liquid procedures are identical, one MB may be performed for both matrices as long as it still represents a frequency of 5%.

While the goal is to have no detectable contaminants, each method blank shall be critically evaluated as to the nature of the interference and the effect on the analysis of each sample within the batch. Contaminated blanks are identified according to the acceptance limits in the test method SOPs or laboratory documentation.

The laboratory identifies a blank as contaminated when analyte results are greater than the reporting limit, greater than 1/10 of that found in any sample, or where the contamination affects the sample results according to test method requirements or client project requirements.

When a blank is determined to be contaminated, the cause must be investigated and measures taken to minimize or eliminate the problem.

Data that are unaffected by the blank contamination (non-detects, sample results at a concentration greater than ten times the blank result or other analytes) are reported unqualified.

Sample data that are suspect due to the presence of a contaminated blank are reanalyzed, qualified or cancelled.

Travel Blanks: If provided, travel blanks must be analyzed whenever a drinking water sample has a result at or above the reporting limit or a liquid sample has a reportable result less than10 times the reporting limit. Certain commonly occurring analytes (i.e. PCE, TCE, THMs, HAAs, MtBE) may be considered an exception. See specific method SOPs. If an analyte is present in the travel blank at or above the method reporting limit, attach the proper qualifier (NTBcv) to corresponding sample analytes. If analyte is not present in the travel blank at or above the method reporting limit, attach NTBnd to the sample or analyte where applicable.

27.2.2.2 Laboratory Control Samples/Blank Spikes

The LCS is used to evaluate the performance of the total analytical system, including all preparation and analysis steps. Results of the LCS are compared to established criteria and, if found to be outside of these criteria, indicates that the analytical system is "out of control." Any affected samples associated with an out of control LCS shall be reprocessed for re-analysis or the results reported with appropriate data qualifiers.

Laboratory Control Samples/Blank Spikes (LCS/BS) are prepared from analyte free water or other clean matrix, and spiked with verified and known amounts of analytes for the purpose of establishing precision or bias measurements. All analyte concentrations shall be within the calibration range of the methods.

Laboratory control samples are analyzed at a frequency mandated by method, regulation, or client request, whichever is more stringent. The standard frequency of LCS preparation and analysis is one per analytical batch or as otherwise stated in a technical SOP. Exceptions would be for those analytes where no spiking solution is available, such as odor, temperature, settleable solids or dissolved oxygen. When no separate preparation method is used the batch is defined as the environmental samples that are analyzed with the same method and personnel, using the same lots of reagents, not to exceed the analysis of twenty environmental samples, not including method blanks, LCS, matrix spikes and matrix duplicates.

LCS's are reported per matrix type. Matrix type refers to one of following possible groups: water, liquid (including extracts), solid/soil/sludge, or gas. If possible it is preferred to group sludge separately from the others solids and CAM/TCLP extracts separately from other liquids. If the water and liquid procedures are identical, one LCS may be performed for both matrices as long as it still represents a frequency of 5%.
The analytes to be spiked in the LCS are specified in the test method SOP. In some cases, a client may specify a list of analytes for spiking for a particular project.

The laboratory fortifies LCS samples with all reportable components with the following exceptions:

Components that interfere with each other may be excluded or handled separately. Semiannual QCS and processed PT samples may be used to satisfy the LCS requirement for those analytes.

Test methods with a long list of target analytes may spike a full list of compounds or only a core group of compounds. This core group of spiking compounds represents all chemistries, elution patterns and masses. The core group must consist of the following number of spiking compounds:

# of target analytes	# of spiking compounds in LCS mix
1-10	100%
11-20	80%(at least 10 compounds)
>20	16 compounds

Semiannual QCS and processed PT samples may be used to satisfy the LCS requirement for those analytes not included in the core group of spiking compounds. Where method control limits are not available, default limits are used until historical data can provide better guidance. Due to the limited number of spike events, historical limits may be based on a smaller number of data points. Data points may also be taken from yearly PT/QC samples or IDoC studies. Poorly performing analytes are investigated. If it is determined that preparation and quantification has been performed properly, limits may be adjusted with QA approval.

The results of laboratory control samples (LCS) are calculated in percent recovery or other appropriate statistical technique that allows comparison to established acceptance criteria. The following calculation is used to determine LCS/BS percent recovery:

$$\%R = \frac{AV}{TV} \times 100$$

Where:

AV = Analyzed Value
TV = True Value

The individual LCS is compared to the acceptance criteria as published in the mandated test method, or where there are no established criteria, the laboratory established limits.

If the percent recovery for the LCS does not fall within the acceptance range, corrective actions must be taken. See SOP G-255 "Technical Corrective Action" for further corrective action.

27.2.2.3 Matrix Spikes and Matrix Spike Duplicates

Matrix Spikes and Matrix Spike Duplicates (MS/MSD) are environmental samples fortified with a known amount of analyte to help assess the effect of the matrix on method performance.

Matrix duplicates are defined as replicate aliquots of the same sample taken through the entire analytical procedure. The results from this analysis indicate the precision of the results for the specific sample using the selected method. The matrix duplicate may provide a usable measure of sample homogeneity. It may also provide a measure of precision when target analytes are present.

Matrix spikes/duplicates are performed on appropriate analyses. (Check method SOPs to determine if a matrix spike is to be performed.)

Matrix spikes/duplicates are performed at a frequency that meets data quality objectives or specified test method requirements.

The laboratory fortifies matrix spikes with all reportable components with the following exceptions:

The method specifies specific spiking components.

Components that interfere with each other may be excluded or handled separately.

Test methods with a long list of target analytes may spike **a full list of compounds or** only a core group of compounds. This core group of spiking compounds represents all chemistries, elution patterns and masses. The core group must consist of the following number of spiking compounds:

# of target analytes	# of spiking compounds in MS mix
1-10	100%
11-20	80%(at least 10 compounds)
>20	16 compounds

Semiannual QCS and processed PT samples may be used to satisfy the MS requirement for those analytes not included in the core group of spiking compounds.

Samples for matrix fortification are chosen at random, rotated among clients. Samples that pose unusual, obvious matrix problems however, are rejected as an unrepresentative choice for the batch.

The laboratory procedure for MS/MSD includes spiking appropriate analytes at appropriate concentrations, calculating percent recoveries and relative percent difference (RPD), and evaluating and reporting the results. The following calculations are used to determine MS/MSD percent recovery and RPD:

$$\%R = \frac{AV}{TV} \times 100$$

Where:
AV = Spike Result – Sample Result
TV = True Value

$$RPD = \frac{|S - D|}{\frac{(S + D)}{2}} \times 100$$

Where:
S=Sample Concentration
D=Duplicate Concentration

Where the method criteria is not established, MS/MSD control limits are generated from laboratory control charts using the mean recovery plus or minus three standard deviations.

For MS/MSD results outside established criteria corrective action is documented or the data are reported with appropriate data qualifying codes. Only the data from the spiked sample is qualified.

Matrix-specific QC samples indicate the effect of the sample matrix on the precision and accuracy of the results generated using the selected method. The information from these controls is sample/matrix specific and would not normally be used to determine the validity of the entire batch.

27.2.2.4 Precision Data (Matrix Spike Duplicates-MSD, Sample Duplicates-DUP, or Laboratory Control Duplicates - LCSD):

In general, precision data is a measurement of the reproducibility of results within the sample matrix.

Using good laboratory technique, duplicate results from a homogeneous sample should agree closely.

Results from a non-homogeneous sample might not agree as well, but if a representative sample is taken, the results should still be fairly close. The larger the sample taken from a non-homogeneous matrix, the more representative the sample is likely to be.

Samples for duplication are chosen at random, rotated among clients. Samples that pose unusual, obvious matrix problems however are rejected as an unrepresentative choice for the batch.

Precision data is obtained from duplicate spikes or from duplicate runs of the sample or Lab Control. Duplicate sample runs are used when analyte is normally present at high enough concentrations for precision analysis. (Check the SOP for the analysis in question to determine if a matrix spike is to be performed.) If for some reason the required sample volume is unavailable, precision data may be taken from a LCSD.

Precision data is performed at a frequency that meets data quality objectives or specified test method requirements.

Relative percent difference (RPD) and acceptance criteria are calculated by software programs such as LIMS and as indicated in this Quality Assurance Manual.

Quality control charts are available in LIMS for precision data indicating the RPD, mean and acceptance criteria.

If recoveries do not fall within acceptance criteria, laboratory personnel should review laboratory techniques used in the procedure, check for oddities in the matrix, and ensure that the precision results were the best possible using the prescribed method. See SOP G-255 "Technical Corrective Action" for further corrective action requirements. If it is still unclear how to proceed, discuss the problem with the Manager or QA Manager.

Duplicate samples may be analyzed for confirmation purposes as needed. If the result confirms by duplicate analyses, attach N-DUP or Nconf to the sample analyte. Results supported by historical data are not re-analyzed, unless requested, but may be qualified (N-HST).

Where replicate sample results are available, see SOP G-253 "Data Review and Validation" for reporting guidance and retest policy.

27.2.2.5 Surrogate Spikes

Surrogate spikes are substances with chemical properties and behaviors similar to the analytes of interest used to assess method performance in individual samples. They are often specified by the mandated method and are deliberately chosen for their being unlikely to occur as an

environmental contaminant. Often this is accomplished by using deuterated analogs of select compounds.

Surrogates are added to all samples and quality control (in test methods where surrogate use is appropriate, the matrix does not preclude its use, and it is commercially available) prior to sample preparation or extraction.

Surrogate recovery results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory uses the mean plus or minus three standard deviations from control charting of actual sample surrogate recoveries.

For surrogate results outside established criteria, data are evaluated to determine the impact. Data is qualified if possible or corrective action is performed.

27.3 Proficiency Test Samples or Interlaboratory Comparisons

27.3.1 Compliance to Accreditation Requirements

The laboratory analyzes at least two TNI and ISO-compliant PT samples per calendar year for each accreditation Fields of Proficiency Testing (FoPT) for which the laboratory is accredited. One PT a year is required by ELAP. An exception is made for analytes where there is no PT available from any PTPA approved PT provider at least twice per year. In these cases the lab will run the PTs in the minimum time frame the PTs are available and not at all if they are not available.

The successive PTs are analyzed at least five months (TNI) or three months (ISO) apart and no more than 7 months apart unless the PT is being used for corrective action to maintain or reinstate accreditation, in which case the dates of successive PT samples for the same accreditation FoPT is at least fifteen days apart.

The values and ranges for these samples are completely unknown to anyone in the laboratory.

For those test methods accredited under ISO 17025 through a third party accrediting body, such as A2LA or ANAB, all additional requirements provided by the accrediting body are followed. (Please see A2LA document R103-"General Requirements-Proficiency Testing for ISO-IEC 17025 Laboratories" for guidance). Upon completion and receipt of the Final PT Report from the PT provider, the laboratory is responsible for submitting the Final PT Report to the third party agency within 30 days upon receipt. A detailed corrective action is also submitted for any PT result in which an outlying or unacceptable result is obtained. In addition, with each Final PT Report submitted to A2LA the laboratory is also required to provide a four year PT Plan (A2LA Document F237) to demonstrate how the laboratory will meet the PT requirements to cover all test methods on the laboratories' scope of accreditation.

27.3.2 PT Sample Handling, Analysis and Reporting

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

Proficiency Testing (PT) samples are treated as typical samples in the normal production process where possible, including the same analysts, preparation, calibration, quality control and acceptance criteria, sequence of analytical steps, number of replicates, and sample login in LIMS. PT samples are not analyzed multiple times unless routine environmental samples are analyzed multiple times. Where PT samples present special problems in the analysis process, they will be treated as laboratory samples where clients have special requests.

The type, composition, concentration and frequency of quality control samples analyzed with the PT samples are the same as with typical samples.

Prior to the closing date of a study, laboratory personnel do not:

- Subcontract analysis of a PT sample to another laboratory being run for accreditation purposes.
- Knowingly receive and analyze a PT for another laboratory being run for accreditation purposes.
- Communicate with an individual from another laboratory concerning the analysis of the PT sample.
- Attempt to find out the assigned value of a PT from the PT Provider.

The laboratory institutes corrective action procedures for failed PT samples following the guidelines in Section 14 – "Corrective Action".

Retention of PT records is similar to that maintained for regular environmental samples. In addition the lab maintains a copy of the online data entry summary when the PT results are submitted online.

27.3.2 Blind Samples:

Blind samples are spiked samples or duplicate samples that are logged in as if they were normal client samples.

Blind samples may come from management or an outside source such as a client or an agency.

Analysts do not know that blind samples are QC samples. If the sample comes from an outside source, the laboratory management might not know that the blind samples are QC samples.

If it becomes necessary to investigate an analytical issue, the laboratory management shall periodically log in blind samples as a diagnostic tool.

27.4 Data Review

The laboratory reviews all data generated in the laboratory for compliance with method, laboratory and, where appropriate, client requirements.

All data, whether electronically transferred from instrumentation or manually entered into the LIMs is reviewed through a tier system of reviews. Procedures and instructions for manual data entry into LIMs are available in ELEMENT LIMs and on QA server C-Controlled Documents\Chemistry Controlled Documents\Element Promium- Batching and Data Entry Instructions.

Initially, the analyst reviews data for acceptability of quality control measures and accuracy of the final result(s).

After the initial review, a second reviewer or peer reviewer examines analytical data and calculations in detail and spot checks electronic transfers of data.

Final reports are compared to raw data either directly or through several reviewed steps.

Please refer to the SOP G-253 "Data Review and Validation" for detailed data review procedures.

*For additional DOD data review requirements see Appendix L Section 27

Section 28

REPORTING THE RESULTS
(TNI V1:M2 – Section 5.10)

The result of each test performed is reported accurately, clearly, unambiguously, and objectively and complies with all specific instructions contained in the test method.

Laboratory results are reported in a test report that includes all the information requested by the client and necessary for the interpretation of the test results and all information required by the method used.

Reports are generated by authorized personal that have password protected access to the LIMS database. This prevents the production of unauthorized reports.

Data is reported without qualification if results are greater than the reporting limit, lower than the highest calibration standard, and without compromised sample or method integrity.

Approved signatories for reported results are any authorized members of the project management team, customer service team and any member of management identified with an asterisk (*) on the concurrences page.

28.1 Test Reports

The report format has been designed to accommodate each type of test performed and to minimize the potential for misunderstanding or misuse.

Only authorized reporting formats are used for reporting purposes. Any edits or amendments to existing formats, or addition of new formats, must be approved prior to use.

Each test report generated contains the following information:

a) a title, such as Analytical Report

b) the name and address of the laboratory and phone number

c) unique identification of the test report by work order number, and each page is paginated to ensure that each page is recognized as part of the test report and a clear identification of the end of the report.

d) the name and address of the client;

e) the identification of the method used;

f) a description of, the condition of, and unambiguous identification of the sample(s) tested, including the client identification code;

g) the date of sample receipt, date and time of sample collection, dates the tests were performed, and the time of analysis

h) client project name and project number, if applicable and client sample ID name

i) the test results, units of measurement, an indication of when results are reported on any basis other than as received (e.g. dry weight), failures identified by qualifiers and also a report case narrative if requested by client.

*For DOD project specific qualifier requirements see Appendix L Section 28

j) the name, function, and signature or an equivalent electronic identification of the person authorizing the test report, and the date of issue;

k) where relevant, a statement to the effect that the results relate only to the samples;

l) any non-accredited tests or parameters shall be clearly identified as such to the client when claims of accreditation are made in the analytical report or in the supporting electronic or hardcopy deliverables; and

m) a copy of the Chain of Custody document if received by laboratory

n) name and location of any subcontract laboratories used and corresponding test method performed.

*For additional DOD reporting requirements see Appendix L Section 28

28.2 Supplemental Test Report Information

When necessary for interpretation of the results or when requested by the client, test reports include the following additional information:

a) deviations from, additions to, or exclusions from the test method, information on specific test conditions, such as environmental conditions, and any non-standard conditions that may have affected the quality of the results, and any information on the use and definitions of data qualifiers;

b) a statement of compliance/non-compliance when requirements of the management system are not met, including identification of test results that did not meet the laboratory and regulatory sample acceptance requirements, such as holding time, preservation, etc.;

c) where applicable and when requested by the client, a statement on the estimated uncertainty of the measurement;

d) additional information which may be required by specific methods or client;

e) qualification of results with values outside the calibration range as appropriate.

In addition to the items above, for test reports that contain the results of sampling, the following is provided when necessary for the interpretation of the results:

a) the date of sampling;

b) unambiguous identification of the material sampled;

c) Location of sampling and sampling plan, or reference to sampling plan via sample id and/or project name;

d) details of any environmental conditions during sampling that may affect the interpretations of the test results;

e) any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

28.3 Quality Control Reports

28.3.1

QC data is available for all chemical batches and reported to the client upon request. Each client and project will be assigned a type of data package (or QC Level) based on the objectives of the project and this will determine the amount of QC data included in the final report.

28.3.2

The Level I or "short report" data packages are created from data in the Laboratory Information Management System (LIMS, Element). Level I data packages receive our general data review procedure and include Client Information, Work Order, Sample Information, Analyte(s), Result, Reportable Detection Limit (RDL), Units, Method, Analysis Date, and Analyst information. Data qualifier flags will only appear as needed.

28.3.3

The Level II or "standard report" data packages are created from data in the LIMS. Level II data packages receive our general data review procedures and review by a Project Manager or QA Manager (the Work Order Report will indicate that the report "Needs QC"). Standard reports include all elements of the short report. In addition, the Batch Quality Control data for the QC samples is provided. The Batch ID and Method appear as the heading above each set of Batch QC. Each QC sample will have information on the Date Prepared, Date Analyzed, Analyte(s), Result, Reportable Detection Limit (RDL), and Units. As discussed in Section 24, the QC samples will vary by method but LIMS reports may include data on the Blanks, Laboratory Control Samples/Spikes, Laboratory Control Samples/Spikes Duplicates, Matrix Spikes, Matrix Spike Duplicates, and Sample Duplicates.

Where applicable, the following data are included with each type of QC sample:

- Laboratory Control Samples/Spikes:
- Spike Level and
- Accuracy (Percent Recovery [%Rec] and %Rec Limits)
- Laboratory Control Samples/Spikes Duplicates:
- Spike Level
- Accuracy (%Rec and %Rec Limits), and

- Precision (Relative Percent Difference [RPD] and RPD Limit)
- Matrix Spikes:
- Source Result,
- Spike Level, and
- Accuracy (%Rec and %Rec Limits)
- Matrix Spike Duplicates:
- Source Result,
- Spike Level,
- Accuracy (%Rec and %Rec Limits), and
- Precision (RPD and RPD Limit)
- Sample Duplicates:
- Source Result and
- Precision (RPD and RPD Limit)

28.3.4 Higher level data packages are created from data in the LIMS and include special data packages created by a Project Manager or QA. Higher level data packages receive our general data review procedures and review by a Project Manager. Level III data packages include all elements of the standard report with the addition of run logs/bench sheets and calibration curves. Level III+ data packages include all elements of the standard report with the addition of run logs/bench sheets, calibration curves, and raw data (chromatograms etc.). Level IV data packages include all elements of the standard report with the addition of run log/bench sheet, calibration curves, raw data (chromatograms etc.), and standard logs. Custom QC packages, electronic versions of the data, and other variations are also available to meet the specific needs of each project and will be established on client/project basis. Stage 4 data packages are provided for all work completed under DoD (Department of Defense) requirements. Stage 4 reports include all information in a Level IV data package and a case narrative regarding all analyses and QC performed as well as qualifiers and any identified non-conformances. See Appendix L section 28 for additional Stage 4 requirements.

28.3.5 In addition, reports are available with J-flag data. J-flag reports include estimated values for results that fall between the Method Detection Limit (MDL) and Reportable Detection Limit (RDL) or RL. The MDL is listed for each analyte. A J-flag report receives our general data review procedures and a review by a Project Manager or QA Manager (the Work Order Report will indicate that the report needs "J-flag").

28.4 Environmental Testing Obtained from Subcontractors

Test results obtained from tests performed by subcontractors are clearly identified on the test report by subcontractor name and/or accreditation number.

The subcontractors report their results in writing or electronically. A copy of the subcontractors report is included in the client's final report so it is clear to the client that the work was completed by another laboratory.

28.5 Verbal Transmission of Final Results and Preliminary Results

To ensure the accurate reporting of all analytical results, verbal or draft results are provided on a case-by-case basis and only after the results have been verified by the laboratory. Customarily, preliminary results are not provided to the customer as they have not yet been through, at a minimum, the secondary review process.

Verbal results are not released to the client until the results have gone through all levels of the laboratory's internal review procedures including final review by the department manager or designated final reviewer. Results must be at a status of "Reviewed" prior to release.

To ensure client confidentiality, verbal results are only provided to authorized contacts identified by the client. Please see the Babcock Client Confidentiality Agreement in Section 10.1- "Client Confidentiality".

Preliminary results are those that have not yet been through a peer review process and therefore may be subject to change pending the secondary review step. As some clients contractually require the laboratory to report results as soon as available, the laboratory may be required to provide results ahead of the secondary review step. Therefore, the laboratory requires these customers to provide a signed waiver (or email) acknowledging that the results provided are preliminary in nature and subject to change and / or confirmation. The customer agrees that they will bear the responsibility and liability for the use of such data and hold harmless the laboratory from any consequence or liability tied to the use of the preliminary results.

28.6 Electronic Transmission of Results

All test results transmitted by telephone, fax, e-mail, or other electronic means comply with the requirements of the TNI and ISO Standards and associated procedures to protect the confidentiality and proprietary rights of the client (see Section 22- "Test Methods and Method Validation" and Section 10.1- "Client Confidentiality").

28.6.1 Electronic Data Deliverables

Electronic Data Deliverables (EDD) reports requested by clients are created in the LIMS system by Project Management during final report generation. EDD reports are stored on the Babcock server. EDD reports which require submittal to the state in a State Form EDT format are created at the time the EDD is created. State Form EDTs are submitted to the state by the 10th day of the month following the report's creation or sooner if requested by client.

28.7 Amendments to Test Reports

Material amendments to a test report after it has been issued are made only in the form of another document or data transfer. All supplemental reports meet all the requirements for the initial report and the requirements of this *Quality Manual*.

Amended test reports include the statement, "Included in this Data Package please find an amended report for the laboratory number(s) referenced below". The reason stating why the amended report was needed is also provided in addition to the date of the original report which the amended report supersedes.

ETHICS and DATA INTEGRITY MANUAL

for

Babcock Laboratories, Inc.

Located at:

6100 & 6110 Quail Valley Ct.
Riverside, CA 92507

And

1550 Pepper Drive

El Centro, CA 92243

Mailing address:
PO Box 432, Riverside, CA 92502

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Website:
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Revision Number:	5.0	Effective Date:	2/28/2021

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Section 3

STATEMENT OF ETHICAL VALUES

The purpose of this Ethics and Data Integrity Manual is to outline the Ethics program and responsibilities for all employees of Babcock Laboratories, Inc. The Ethics Manual defines the policies, procedures and documentation that assure the companies' continued commitment to the highest ethical standards throughout all sections of the company. Our policies and procedures provide guidance for the ethical values stated in this document in our daily work as employee owners of Babcock Laboratories, Inc. In addition to this Ethic's Manual, Accounting and Finance employees also receive training in Finance specific Ethic's and Fraud policies and procedures. This information is available in the Babcock Laboratories, Inc. Financial Policies and Procedures Manual.

All employees of Babcock Laboratories, Inc. must conduct themselves in an honest, straightforward and ethical manner at all times. To ensure adherence with the Babcock Statement of Ethical Values and Standards of Ethical Conduct outlined below, all staff are committed to:

- **Following high ethical standards in every area of our jobs**
- **Conducting ourselves with integrity at all times**
- **Being accountable for our ethical conduct as a member of the Babcock community.**

Babcock Laboratories, Inc. is dedicated to ensuring the integrity of our data and meeting the quality needs of our clients by living the Babcock Honor Code, Purpose, Core Values and Standards of Ethical Conduct outlined below.

Babcock Honor Code: Endeavor to always do the *right* thing.

Babcock Purpose: To safeguard public health and the environment.

Babcock Core Values:

- ***Go the extra mile: We exceed the expectations of our clients, colleagues, vendors and community.***
- ***Find better ways: we constantly seek improvements in processes and activities to deliver outcomes that benefit our clients, co-workers, vendors, and community.***
- ***Work Together: We work together collaboratively with respect, honesty and reliability. Our ability to work as one team enables us to build strong relationships, take action and achieve our goals. Working together we foster meaningful, long-term relationships with our clients, community and staff.***
- ***Do the right thing: We behave ethically, honestly and with integrity. We honor this commitment even when no one is watching.***
- ***Own it: We are responsible for our individual and collective behaviors, actions and decisions and hold ourselves accountable to the outcomes.***

Standards of Ethical Conduct (Code of Ethics)

- **To produce results that are technically sound and legally defensible;**
- **To assert competency only for work for which adequate equipment and personnel are available;**
- **To present services in a confidential, honest, and forthright manner;**
- **To make every effort to establish a clear understanding with the client as to the extent and kind of services to be rendered;**
- **To provide employees with guidelines and an understanding of the ethical and quality standards required in the industry;**
- **To operate facilities in a manner that protects the environment and the health and safety of employees and the public;**
- **To obey all pertinent federal, state, and local laws and regulations;**
- **To continually seek ways to improve product service and quality;**
- **To treat employees equitably, acknowledge their scientific contributions, and provide them opportunities for growth and development;**
- **To recognize and respond to community concerns;**
- **To deal openly, honestly, and fairly in all business and financial matters with employees, clients, and the public.**
- **In addition to these values:**
    - **We share in each other's successes and challenges, and share the success and challenges of the company.**
    - **We respect each employee's need for a balanced, complete and healthy life.**
    - **We respect each other's cultural diversity and are tolerant and supportive of alternate lifestyles.**

Section 4

ETHICS, DATA INTEGRITY and FRAUD

Ethics

Definition

- **A set of moral principles that govern a person's or group's behavior.**
- **The discipline dealing with what is good and bad and with moral duty and obligation.**

Characteristics

- **Being honest and straightforward.**
- **Values morality and performs all areas of job with honesty.**
- **Takes responsibility of acting ethically seriously in all areas of job and life.**
- **Admitting mistakes rather than cover them up.**

Importance of Ethics in the workplace

- **Ethical behavior is good for business; a laboratory lives and dies by its credibility and reputation.**
- **Coworkers must trust each other to perform their functions properly and work together successfully.**
- **Chemical professionals should serve clients faithfully and incorruptibly, respect confidentiality, advise honestly, and charge fairly. (ACS-The Chemical Professional's Code of Conduct)**
- **Most management decisions and client decisions regarding environmental compliance are based on the analytical results supplied by the laboratory.**
- **An ethics program and adherence to it by all staff is required by accrediting bodies such as TNI-NELAP, CA ELAP, A2LA and ANAB.**

Data Integrity

Definition

- **Maintaining and assuring the accuracy and consistency of data over its entire life cycle, and is a critical aspect to the design, implementation and usage of any system which stores, processes or retrieves data.**
- **The completeness, consistency, and accuracy of data. Complete, consistent, and accurate data should be attributable, legible, contemporaneously recorded (recorded in real time), original or a true copy, and accurate. (As defined by FDA)**
- **Data integrity is the assurance that data records are accurate, complete, intact and maintained within their original context, including their relationship to other data records.**

Characteristics

- **Accuracy- Data is accurate and reliable**
- **Completeness- Data is complete, thoroughly documented. Data can stand alone.**
- **Consistency- Data obtained and documented in a consistent manner**
- **Distinct- Data can be uniquely identified**
- **Timeliness- Data is recorded at the time of the event in real time**

Fraud

Definition

- **A *false* representation of a matter of fact whether by words or by conduct, by false or misleading allegations, or by concealment of what should have been disclosed that is *intended* to deceive others.**
- **The *deliberate* falsification of analytical and quality assurance results, where failed method and contractual requirements are made to appear acceptable. (EPA)**
- **Intentional and deliberate falsification of any documentation.**

Characteristics

- **Intent to deceive.**
- **Purposeful and intentional misrepresentation.**
- **Data obtained by deviating from procedures or policies.**
- **False statements (lies).**

Examples of Fraud (Unethical Practices)

- **Covering up an honest mistake.**
- **Intentionally deviating from an SOP or skipping a step.**
- **Deliberately documenting or reporting incorrect information.**
- **Signing for a SOP, Employee Handbook, company policy, etc. that you have not read, understand or intend to follow.**
- **Performing an analysis on your own without a complete, documented and authorized IDOC (by Manager).**
- **Sharing passwords with others such as for Element LIMS or the timekeeping system.**
- **Juicing- adding extra quantities of a specific analyte to falsely make it pass criteria.**
- **Dry labbing- Not analyzing any samples but reporting results, documenting measurements without performing the action, making up results or documentation.**
- **Improper manual integration including peak shaving or peak enhancement to obtain acceptable results, undocumented manual integrations, failure to follow Babcock manual integration procedures outlined the Babcock "Chromatographic Quantitation of Data" SOP G-251 and annual manual integration training.**
- **Time traveling-falsifying the date/time of analysis performed, sampling information, sample receipt to lab, etc.**
- **Filing a false Worker's Compensation claim.**
- **Accessing or removing company documents/property (SOPs, Employee Handbook, etc.) from the premises without prior approval from management.**

Section 5

ETHICS and DATA INTEGRITY RESPONSIBILITIES

All employees of Babcock Laboratories, Inc. are responsible for adhering to and following all policies and procedures relating to Ethics and Data Integrity. Outlined below are areas of responsibility for all levels of staff.

Management Responsibilities

All members of management at Babcock Laboratories, Inc. are committed to the following responsibilities. In addition, management is accountable for promoting the Babcock ethics and data integrity policies and procedures in all areas of their job.

- **Lead by example.**
- **Create a strong ethics and data integrity program.**
- **Provide training on ethics and data integrity.**
- **Ensure employees understand ethics and data integrity policies and attend annual ethics training.**
- **Promptly investigate all allegations of unethical behavior.**
- **Support and assist with ethic's investigations.**
- **Maintain working conditions conducive to ethical behavior and proper data integrity.**
- **Encourage open discussions of ethics and data integrity issues or concerns.**
- **Eliminate undue pressure on analysts and staff-internal or external.**

Employee Responsibilities

All Babcock employees are responsible and committed to following all ethics and data integrity policies and, at a minimum, the responsibilities outlined below.

- **Adhere to all company Standard Operating Procedures (SOP).**
- **Adhere to all company policies.**
- **Ensure that you are properly trained and proficient in your job.**
- **Use stop work authority when working conditions threaten to become an ethical or safety concern.**
- **Seek guidance when course of action is unclear.**
- **Be conscious of other employee's actions and report any suspected unethical behavior.**
- **Present any concerns regarding unethical or possible unethical behavior immediately and in an honest and forthright manner.**
- **Cooperate with all ethics investigations and maintain confidentiality of those involved.**

Section 6

STOP WORK AUTHORITY

All employees of Babcock Laboratories, Inc. have the right to cease any work activities when conditions arise that may result in an ethical dilemma or unsafe environment. All employees have the authority to apply Stop Work Authority (SWA) if, when using his/her judgment or opinion, an activity is deemed unethical or unsafe. Once a Stop Work Action has been reported, management will investigate the action, implement the improved correction (if required) to allow work to resume and provide follow-up to ensure effectiveness of the correction.

Definition

- **Procedure that establishes the authority and responsibility of any individual to stop work when an unethical or unsafe condition or act could result in an undesirable event or hazard.**
- **The Stop Work Authority process involves a stop, notify, correct, and resume approach for resolving an issue or condition.**

Management Responsibilities

- **Create a culture that promotes Stop Work Authority.**
- **Demonstrates support for using SWA without potential for retribution.**
- **Holds employees accountable for full compliance with SWA.**
- **Provide training, support, documentation and monitors compliance with SWA.**
- **Addresses and resolves all SWA requests before operations are resumed.**
- **Follow-up to ensure SWA corrections have been effective.**

Employee Responsibilities

- **Initiate stop work (in good faith) and support stop work initiated by others.**
- **Report any stop work actions to management immediately.**
- **Work with management to ensure effectiveness of SWA corrections.**

Examples of Situations That May Require Stop Work Authority

- **Safety hazards or concerns.**
- **Unsafe working conditions.**
- **Ethical concern discovered.**
- **Required PPE not available or damaged.**
- **Performing work without approved training documentation.**
- **Do not feel comfortable performing a job duty on own.**
- **Lack of knowledge, understanding or information.**
- **Inadequate instructions provided.**
- **Emergencies.**
- **Equipment used improperly.**

Section 7

CONFLICT OF INTEREST and UNDUE PRESSURE

Conflict of Interest

Employees may find themselves in situations where the possibility of a conflict may arise between their work responsibilities and the interests of the laboratory. It is recognized that Conflict of Interest may occur from time to time, but it is the responsibility of the employee to know how to recognize and disclose the situation appropriately.

At Babcock Laboratories, Inc. any current employee who is employed at another company or seeks outside employment during their term of employment at Babcock must notify management to ensure that no Conflict of Interest exists. In cases of outside employment, the Babcock employee must inform management and request and complete an "Application for Approval of Outside Employment" from HR. The form is submitted and reviewed by the employee's manager and Human Resources or CEO to ensure no conflict exists with the outside employment. There are three main situations which require Conflict of Interest determination at Babcock Laboratories:

- **Working for a direct competitor (regardless of department or position) is <u>not</u> permitted.**
    - **This situation represents a direct Conflict of Interest and is not acceptable.**
- **Employment with a current client.**
    - **To prevent any Conflict of Interest, the employee's duties/workload may be altered as to not have them work directly with that client's samples.**
- **Conflicting work schedules between Babcock and the outside employer.**
    - **If management determines that a conflict of interest does occur, the employee must choose whether to accept the outside employment or remain with Babcock Laboratories, Inc.**
    - **If, at a later date, the employee realizes a potential conflict of interest (i.e. the outside employer becomes a client of Babcock Laboratories, Inc.), the employee must bring this information to the attention of management or face possible disciplinary action.**

Employees must also ensure that their work responsibilities do not conflict with each other such as overlapping tasks. For example, Quality Assurance personnel shall not perform any analyses that they are responsible for as an auditor. Doing so, would raise a conflict between the analyst's interest, which tends to favor practical procedure, and the auditor's interest, which tends to favor regulation and method protocol.

Undue Pressure

All employees must protect themselves from internal and external undue pressures that may lead to unethical behavior or compromise the quality of work. Any employee who feels that unwarranted pressures are placed on them in a manner that may infringe on their ability to perform their job ethically or may affect the validity of analytical results must address the issue immediately with their manager. If the employee does not feel comfortable discussing the issue with their manager or the manager is the source of the undue pressure the employee should address the issue with another member of management including Human Resources.

Internal pressures may include stress from management or other employees to meet Turn Around Times, rush samples, failed QC or instrument issues affecting work flow, unscheduled changes in work, training and personal plans.

External pressures include stress from clients such as needing their results "ASAP", expecting results below regulatory or compliance levels or MCL violations with monetary fines.

Section 8

REPORTING PROCEDURES and RESPONSE TO ETHICAL and DATA INTEGRITY ISSUES

Reporting Procedures

When reporting unsafe practices, ethics and/or data integrity concerns, the chain of command should be followed. First, report concerns to the immediate manager. If the manager does not follow up in a timely manner, or is personally involved in the concern, then report concerns to the Laboratory Director, Technical Director, Human Resources or the Quality Assurance Manager. If there is belief that no action was taken or the action that was taken did not fully address the issue, report the concerns to the President/CEO of the company. The employee must take responsibility for ensuring action is taken regarding their concern.

Assuring good quality and ethical practices is the responsibility of all employees not just management. Any employee who is aware of unethical conduct within any area of the company is required to report it. No employee will be disciplined for raising ethics and/or data integrity concerns. The reporting employee's identity will be kept as confidential as possible. If an employee is aware of or suspects any unethical behavior and fails to report it, the employee may become an accomplice to the unreported behavior and could be included in any disciplinary action resulting from the behavior.

Any employee who is aware of unethical conduct within the laboratory is required to report it. Failure to report unethical behavior may result in the employee being an accomplice to the unethical behavior.

Response to Ethical and Data Integrity Issues

When an employee brings ethics and/or data integrity concerns to the attention of management, there are several types of responses that may occur. If the answer is immediately known, the employee will be advised as to what action to take in the situation. In some cases this type of issue may lead to an internal corrective action or root cause investigation. If the answer is not immediately known, management will investigate the concern and determine the resulting course of action.

If any possibility of serious potential unethical behavior has been raised, an official Ethics Investigation will be initiated. A committee will be chosen by the Laboratory Director to conduct the investigation. The committee will be comprised of the Laboratory Director, or designated alternate, one member from the managerial level and one member from the peer level. Human Resources will be available to serve on or advise the committee. Each committee member will not be directly affiliated with the alleged ethics and/or data integrity concern or violation. The committee will take every measure possible to protect the confidentiality of any employee who has raised any ethics and/or data integrity concerns that trigger investigations.

Unethical behavior or practices are taken very seriously at Babcock Laboratories, Inc. Therefore the investigation committee will perform a thorough investigation to determine if the suspected behavior was done intentionally and requires disciplinary action or unintentional and may require additional training or procedural changes. All areas of the concern are reviewed in detail including interviews with staff and management. The employee suspected of the unethical behavior is interviewed and asked questions to clarify the employee's actions and understanding of the issue in question. In addition, the employee's manager may also be interviewed to assess the manager's knowledge and involvement in the suspected behavior. Some possible areas that may be covered during the interviews are listed below:

Assessing Employee Responsibility and Actions

- **Did the employee know the right action to take?**
- **Did the employee receive adequate instructions?**
- **Did the action appear to be intentional?**
- **Was the employee instructed by a co-worker or manager to take the incorrect action?**
- **What was the severity of the potential ethical infraction?**

Assessing Manager Responsibility and Actions

- **Did the manager know the right action to take?**
- **Did the manager direct the employee to take the wrong action?**
- **Was the manager aware of any prior instances with the employee regarding the same type of issue that was not addressed at that time?**

Upon completion of the investigation all findings and recommendations will be reported to the CEO/President and Human Resources to determine if disciplinary action is warranted and at what degree. Depending on the severity of the unethical behavior, discipline may vary from a verbal warning up to immediate termination of employment. If findings involve illegal activities, the investigation will be turned over to outside agencies for possible criminal litigation of the involved individual(s).

Unethical behavior will not be tolerated at Babcock Laboratories, Inc. All employees are made aware that any unethical behavior that involves falsification of data, company documentation, authorizations, time-keeping systems, etc. will result in serious consequences to all involved parties.

Knowingly falsifying data or documentation is grounds for immediate termination of employment, and possible criminal litigation.

Section 9

PROACTIVE FRAUD PROTECTION and DETECTION

The laboratory has practices in place for the prevention and detection of fraud through a system of reviews, audits and ongoing data review procedures. Internal method audits are scheduled to occur on a regular basis for all applicable analyses. All reviews and audits are fully documented and any suspicious activities discovered are brought to the attention of management and addressed immediately through the procedures outlined in section 8 of this manual and Section 17.5 of the QA Manual-"Handling Audit Findings". Some examples of the reviews and audits performed to monitor and prevent fraudulent practices are listed below.

- **Internal audits- Audits performed by or under the direction of the QA department covering analytical methods, processes, personnel or departments. Internal audits are conducted to ensure adherence to SOPs, company policies and procedures, proper technique or execution of a task, employee understanding of the task and compliance to all Standards such as TNI, ISO, AOAC, etc.**

- **External audits- Babcock Labs is audited annually (A2LA) or every two years (NELAP/ELAP) by accrediting bodies to ensure compliance with all standards and certification requirements. All resulting findings are addressed and corrected in a given time frame. All involved staff is included in the Corrective Action process used to address each finding. Clients also periodically perform on-site audits of the laboratory to ensure the client's needs and project requirements are being met as well as adherence to regulatory standards.**

- **Electronic audits- Each analyst that operates instrumentation undergoes an audit to ensure competence and adherence to Babcock procedures such as manual integration. Audits are performed by QA during audits, managers or technical managers using the Laboratory Practices Review – Electronic Audit. (See Attachment 1)**

- **Annual manual integration training- On an annual basis all staff who operate instrumentation are provided refresher training on manual integration including proper technique, consistency of manual integrations, documentation requirements, corrective action procedures, etc. This training is provided in addition to manual integration procedures outlined in SOP G-251 "Chromatographic Quantification of Data".**

- **Peer/Secondary Review and Final Review- All analytical data and client/sample documentation entered into Element LIMs is reviewed by either a peer or manager to ensure compliance and completeness.**

Section 10

ETHICAL CONDUCT DURING AUDITS

All employees of Babcock Laboratories are responsible for their conduct with auditors during internal audits as well as external audits performed by state or government agencies and third party assessors. Audits may be performed to maintain certification, ensure adherence to SOPs or in response to suspected ethics violations. All employees must participate in audits as needed and cooperate with all auditors and assessors. Employee responsibilities during audits are listed below.

- **Be available and present for auditors.**
- **Answer all questions honestly.**
- **During auditor observations perform all tasks as you normally would.**
- **If unsure if you know the answer to a question, ask the auditor to re-ask the question, look for the answer in your SOP or ask the auditor to rephrase the question using different terminology.**
- **If you do not know the answer to a question, answer "I don't know" or "I don't know. I will need to check with my manager".**
- **NEVER make up answers or respond dishonestly.**

Section 11

ETHICS and DATA INTEGRITY TRAINING

At a minimum every employee of Babcock Laboratories receives mandatory ethics/data integrity training as a new employee during new employee orientation training and annually through companywide refresher training. All staff sign both a "Statement of Ethics and Data Integrity" (Attachment 2) and an "Annual Ethics and Data Integrity Manual and Training Certificate" (Attachment 3) during new hire orientation and on an annual basis to document the training and the employee's commitment to following all company ethics and data integrity policies. In addition, all new employees read the Ethics and Data Integrity Manual and complete a quiz to confirm comprehension. Please refer to QA Manual Section 19.2 "Ethics and Data Integrity Training" for more information on training.

Section 12

ATTACHMENTS

Laboratory Practices Review – Electronic Audit

Instrument: _____

Method: _____

Analyst: _____
Reviewer: _____

Date of Review: _____

The following questions apply to instrumental analyses – especially to chromatographic methods such as IC, HPLC, GC, and GCMS. Not all items will apply to other types of methods. See Ethics Manual for further information. Circle Y for Yes, N for No.
If answers lead to further investigation or require an explanation, add notes on page 3.

1. **Batch/Samples:**
   Go into Element (the LIMS) and select a recent batch that is reviewed:

   Batch:_____ Date of Batch:_____

   Pick a few random samples and verify the time of analysis and results between the data collection software and LIMS:

   _____

   _____

   _____

   Are the reported dates in a data package consistent (does the date of the extraction precede the date of analysis, is the time between sample at least as long as a run)? **Y / N**
   Are there overlapping analysis times for the same instrument? **Y / N**

2. **Blank:**
   View the calibration associated with that batch on the computer.
   Is there an indication that blank data may have been manipulated? **Y / N / NA**

   _____

3. **Calibrations:**
   View the calibration associated with that batch on the computer.
   Verify the data points used to create the calibrations and that the curve looks appropriate.
   Okay? **Y / N**

Verify that this was the calibration used on the samples in the batch (give the date).
Okay? **Y / N** _____
Is there an indication that calibration data may have been manipulated? **Y / N**
Is there an indication that tuning data may have been manipulated? **Y / N / NA**

---

4. **Integration:**
Look closely at the most difficult calibration point (such as the low calibrator).
Integration okay? **Y / N**
Are manual integrations obviously noted and appropriate? **Y / N / NA**
Are there repeated manual integrations – especially of QC data? **Y / N**
If yes,
a) Does it appear the peaks were reintegrated to achieve some preset criteria? **Y / N**
b) Were manually integrated peaks obviously indicated? **Y / N**

---

5. **Quality Control Samples**:
Were the operating conditions for the QC samples and client samples different (are the run lengths different)? **Y / N**
Is there any indication that the analyst is running extra QC? **Y / N**
If yes, are they selectively choosing desirable QC results while suppressing other data? **Y / N**
If yes, is the selection within acceptable laboratory practices and/or decision making and is the reasoning well documented? **Y / N**
Is there a pattern of high response factors for compounds where relatively low response factors are expected? **Y / N / NA**
Is the response of the LCS consistent between runs (check a previous run)? ? **Y / N**

---

6. **Data Back-up:**
Do full sets of hard copies also exist (meaning that soft copies are not the official back-up)? **Y / N**
Is the electronic data backed-up? **Y / N**
If yes,
How is the electronic data backed-up?_____
How often is the electronic data backed-up?_____
Are the files write-protected? ? **Y / N**
Where are the back-ups stored?_____

---

7. Comments and Notes:

Babcock Laboratories, Inc.
6100 & 6110 Quail Valley Court, Riverside, CA 92507
1550 Pepper Drive, El Centro CA 92243

Statement of Ethics and Data Integrity

I understand the following:

1) **All analytical results are to be presented as honestly and accurately as possible.**

2) **Analytical difficulties are to be dealt with in a forthright manner. Any errors that affect an analysis must be brought to the attention of management as soon as discovered.**

3) **Data may not in any way be changed or deleted. Any data corrections must be clearly documented – showing both the original data and the correction with date and initials of the person making the correction, plus a discussion of the reason for the change whenever the reason is not readily apparent.**

4) **Falsification of data is grounds for immediate termination of employment.**

5) **Failure to follow the policies, procedures and ethical standards set by Babcock Laboratories, Inc. is grounds for immediate termination in addition to possible civil or criminal charges.**

I also understand that failure to comply with the above will result in disciplinary action up to and including termination of employment.

_____ _____ _____ _____

Signature of Employee **Date**

_____ _____

Name of Employee ***(Please print clearly.)***

_____ _____ _____ _____

Signature of Witness **Date**

Babcock Laboratories, Inc.
6100 & 6110 Quail Valley Court, Riverside, CA 92507
1550 Pepper Drive, El Centro, CA 92243

Ethics and Data Integrity Training Certificate

I have received and completed my annual training on ethics and data integrity.

Date:_____

Trainer/Presentation: Stacey Fry

The documentation reviewed for this annual training session included:

- **A review of the information outlined in the Ethics and Data Integrity Manual.**
- **A review of the Babcock Honor Code, Mission and Vision**
- **Review of real world examples of ethical or data integrity issues**
- **Review of how to make ethical decisions**

I understand that I must also sign a new Statement of Ethics and Data Integrity each year to renew my commitment to the Babcock Laboratories Ethic's Program and Policies.

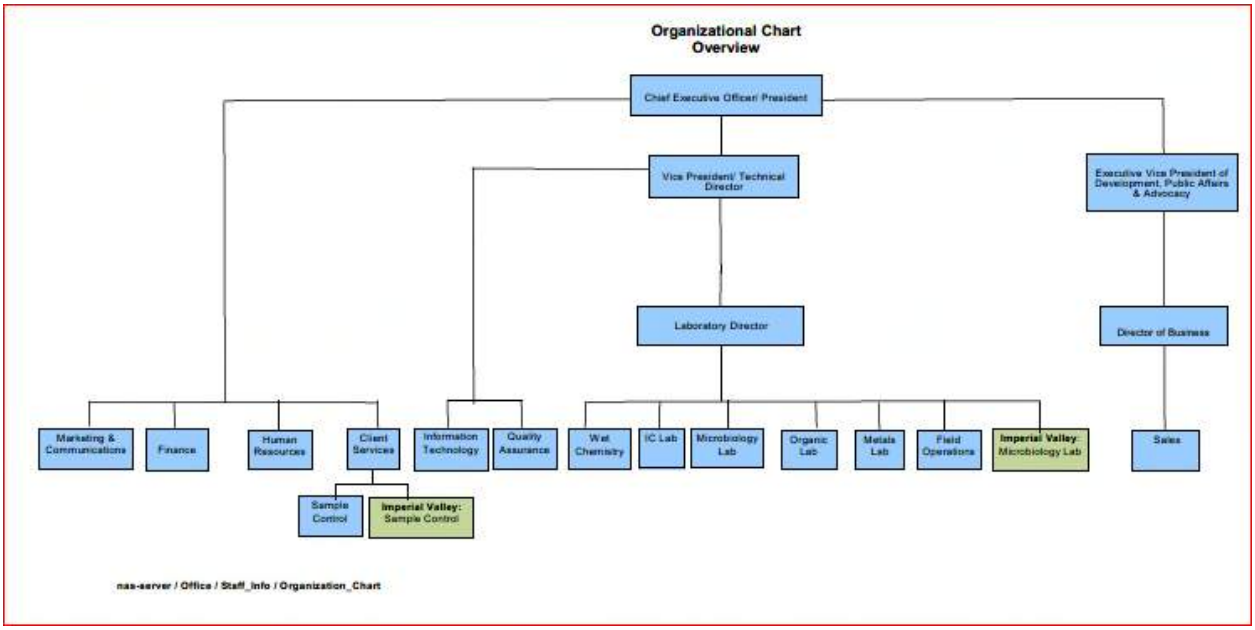
_____ _____
Signature of Employee Date

_____
Name of Employee *(Please print clearly.)*

Appendix B

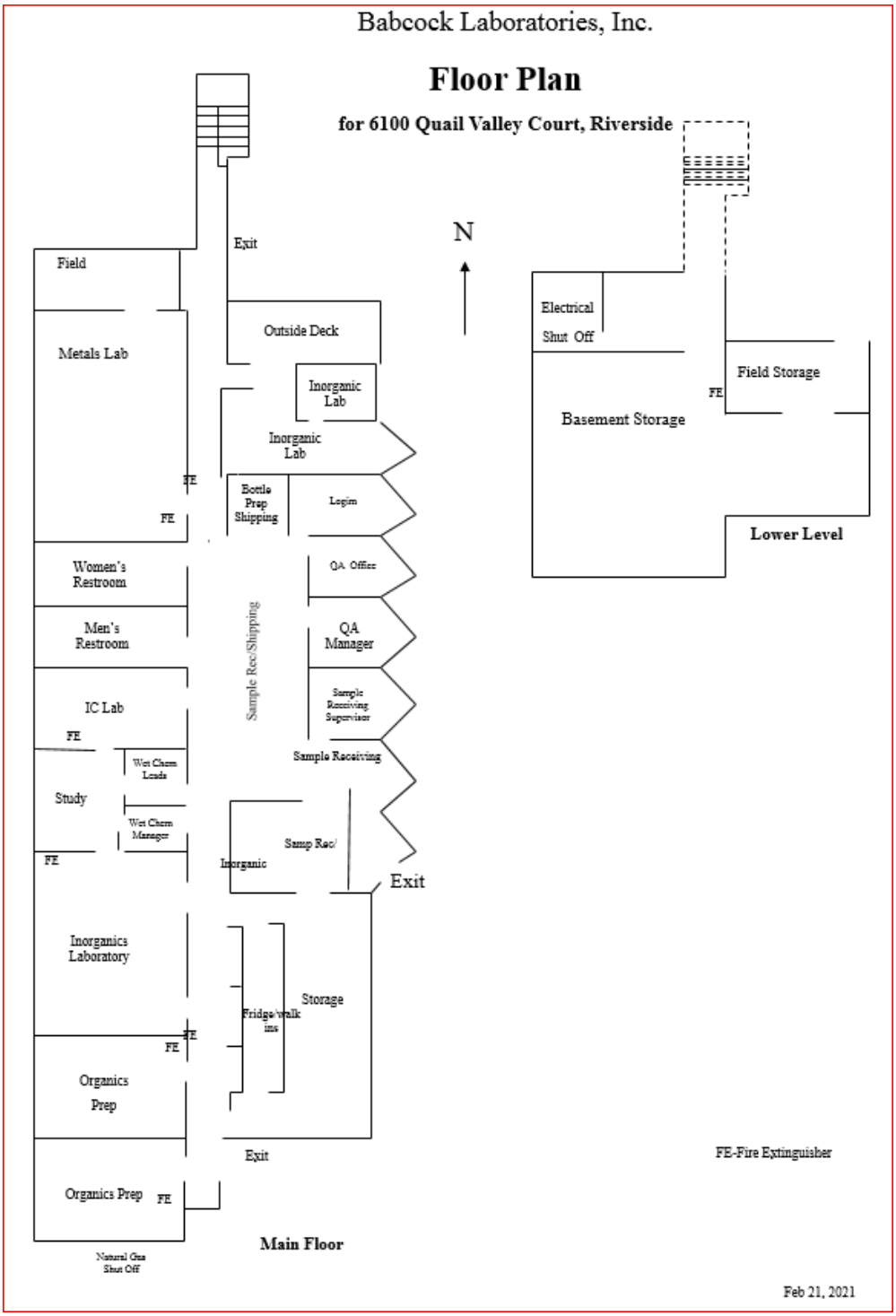
Example Laboratory Organization Chart

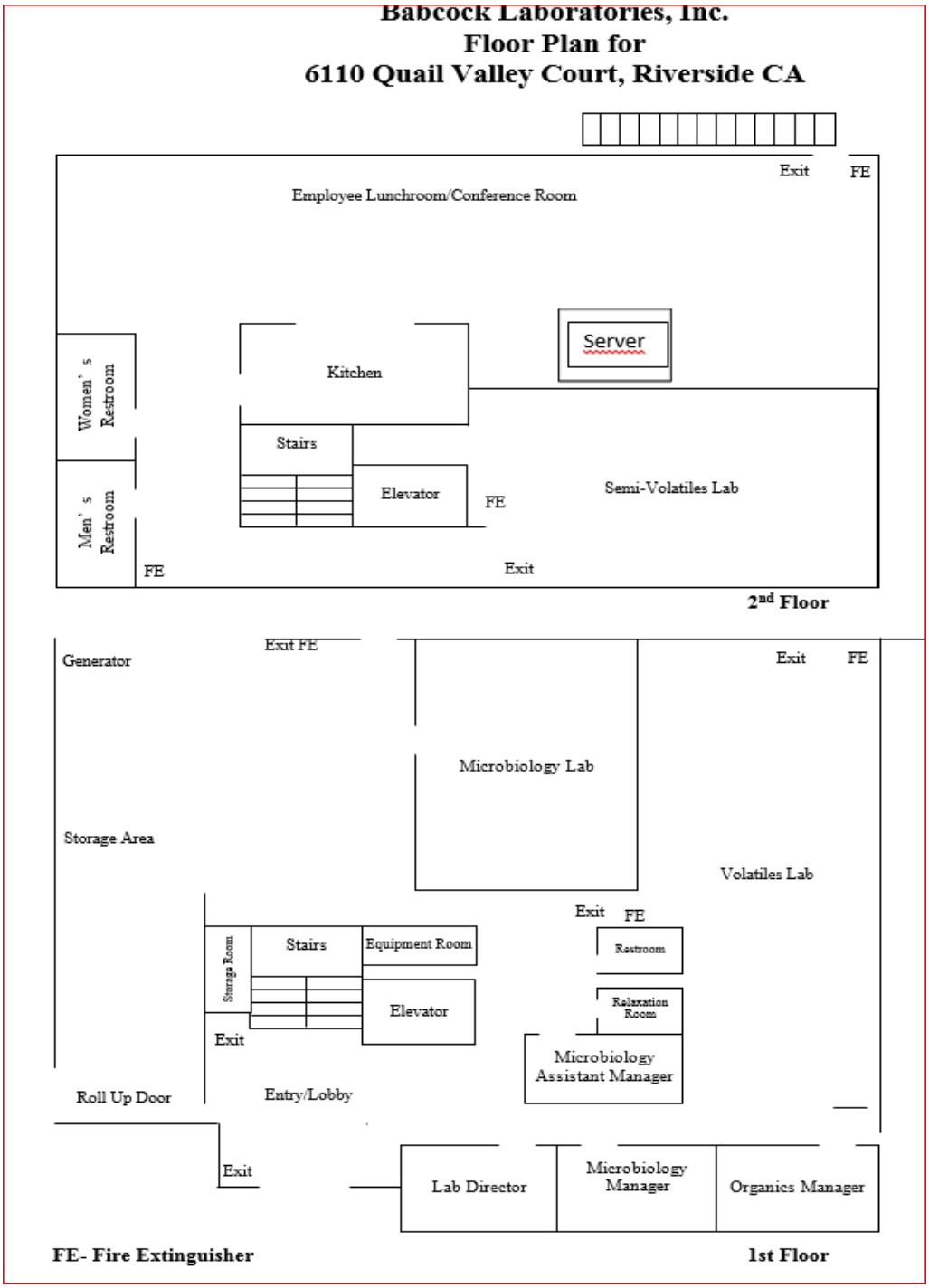
(The most current detailed chart can be obtained from Human Resources.)



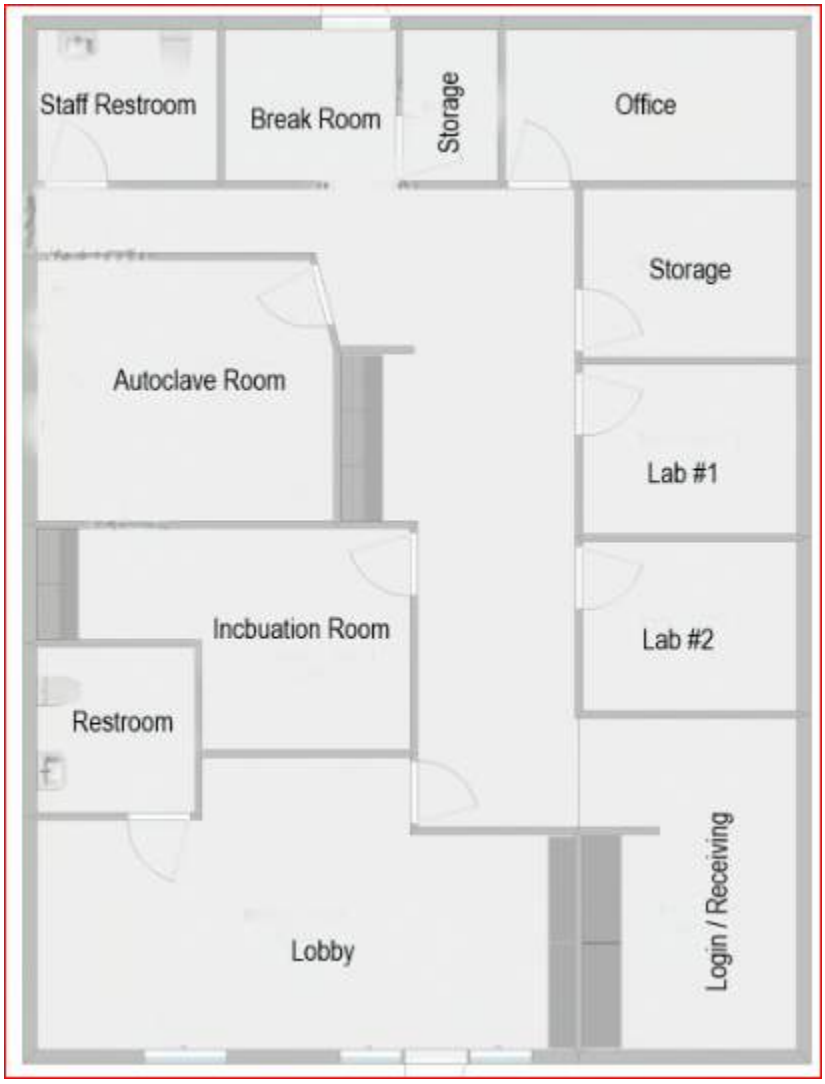
Appendix C

Laboratory Floor Plans





Babcock Laboratories, Inc.
Floor Plan for
1550 Pepper Drive, El Centro CA 92243



2/26/2021

Appendix D

Definitions

Acceptance Criteria - Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accuracy - The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.
Analyte - The chemical element or compound determined by the method.
Analytical run–One or more analytical batches analyzed in a series.
Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Analyst - The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.
ASTM – American Society for Test Materials: A resource of testing methods.
Batch - Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same *or similar* quality systems matrix, meeting the before-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical run** is composed of prepared samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical run can include prepared samples originating from various quality system matrices.
Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value
Blank - A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.
Blank Spike – See **Laboratory Control Sample (LCS)**
Blind Sample- a sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards.

1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Blank (Instrument Blank)-A volume of reagent water prepared in the same matrix as the calibration standards. The calibration blank is also used during the analytical run to check for the cleanliness of the system. The calibration blank may be used as a zero standard and is often used to auto-zero the instrument.
Calibration Curve–The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration standard - A substance or reference material used to calibrate an instrument. A standard solution prepared from the stock or intermediate standard solution (including internal standards and surrogate analytes where applicable). The calibration standards are used to calibrate instrument response with respect to analyte concentration.
Certified Reference Material(CRM): Reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute.
Chain of Custody Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses.
Composite Sample – Sample that is collected gradually, consisting of at least eight distinct aliquots, over a period of time usually 24 hours.
Compromised Samples - Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions compromised samples are not analyzed. If emergency situations require analysis, the results must be appropriately qualified.
Confirmation - Verification of the identity or concentration of a component through re-analysis or the use of an approach with a different scientific principle from the original method.
Conformance - An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.
Continuing Calibration Check (CCC) or Continuing Calibration Verification (CCV) – A standard check of the calibration spaced periodically throughout the run.
Corrective Action–The action taken to eliminate the cause(s) of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.
Data Audit - A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria).
Data Reduction - The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form.
Deionized Water (DI) – Tap water that has been passed through an Acid/Base/Mixed Resin deionization system for the purpose of removing dissolved solids, metals, and most organics.
Demonstration of Capability (DOC) - See **Initial Demonstration of Capability (IDoC)**
Demonstration of Continuing Proficiency (DOCP): On an annual basis, each analyst must turn in valid LCS data from four consecutive LCS samples or results from a successful Proficiency Testing Study for every certified analytical procedure performed that year. LCS percent recovery and Relative Standard Deviation (RSD) must meet laboratory prescribed acceptance criteria.

Demonstration of Method Capability - A series of tests that the lab performs to gain certification for a new analysis. These tests could include: analysis of a PT sample, MDL study, Retention time window study, or IDoC.

Detection Limit for Reporting Purposes (DLR) – See **Reporting Limit**

Document Control-The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Duplicate (DUP), Laboratory duplicate or Replicate Analyses - Two aliquots of the same sample taken in the analytical laboratory and analyzed separately using identical procedures.

Equipment Blank (EB)-An aliquot of reagent water that is passed through sampling equipment after cleaning to monitor the effectiveness of equipment cleaning process.

Estimated Detection Limit – (EDL): Either the MDL, or a level of compound in a sample yielding a peak in the final extract with a signal to noise ratio (S/N) ratio of approximately five, whichever is greater.

Estimated Quantitation Limit (EQL) – See **Reporting Limit**

Field blank (FB) aka Field Reagent Blank (FRB) - An aliquot of reagent water that is either placed in a sample container in the laboratory and opened in the field during sampling, or is placed in the sample container in the field. It is treated as a sample in all respects, including exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the field blank is to determine if the field or sample transporting procedures and environments have contaminated the sample**.**

Field duplicates (FD1 and FD2) - Two separate samples collected at the same time and place under identical circumstances and treated exactly the same throughout field and laboratory procedures. Analyses of FD1 and FD2 give a measure of the precision associated with sample collection, preservation and storage, as well as with laboratory procedures.

Field Measurement - The determination of physical, biological, or radiological properties, or chemical constituents; that are measured on-site, close in time and space to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.

Field Reagent Blank (FRB) – See Field Blank

Grab Sample – Sample that is collected all at once (maximum of 15 minutes) representing one moment in time.

Holding Times (Maximum Allowable Holding Times) - The maximum time that can elapse between two (2) specified activities (such as sampling to preparation or preparation to analysis) and still be considered valid or not compromised.

Initial Calibration Check (ICC)/Initial Calibration Verification (ICV) (or Calibration Check standard) - A solution of analytes prepared in the laboratory by adding appropriate volumes of the non-calibration stock standard solutions to reagent water or appropriate solvent used to evaluate the performance of the instrument system immediately after a calibration is performed.

Initial demonstration of Capability (IDoC)/Demonstration of Capability (DOC) A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. A study of four (at a minimum) standards analyzed to establish the ability to generate acceptable precision and accuracy. (See the method or SOP for specific criteria.) An IDoC is performed the first time the method is used, when the analyst changes, and any time there is a major method modification.

Instrument Blank – See **Calibration Blank**

Instrument Detection Limit (IDL) – The concentration equivalent to the analyte signal which is equal to three times the standard deviation of a series of ten replicate measurements of the calibration blank signal or producing a signal to noise ratio of 5:1.

Instrument Performance Check (IPC) aka Laboratory performance check solution (LPC) - A solution of method analytes, surrogate compounds, and internal standards used to evaluate the performance of the instrument system with respect to a defined set of method criteria.

Intermediate Standard aka Primary dilution standard solution - A solution of method analytes prepared in the laboratory from stock standard solutions and diluted as needed to prepare calibration solutions and other needed analyte solutions.

Internal standard -- A pure analyte(s) added to a solution in known amount(s) and used to measure the relative responses of other method analytes and surrogates that are components of the same solution. It is a reference for evaluating and controlling the precision and bias of the applied analytical method. The internal standard must be an analyte that is not a sample component and is rarely found in the natural environment.

J Flag – A "J" is placed on a result that considered is to be at a trace level, which is below the RL but above the MDL.

Laboratory Control Sample (LCS) aka Laboratory fortified blank (LFB) aka Blank Spike (BS) - A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system and assure that the results produced by the laboratory remain within the limits specified in this method. A working LCS validates the batch.

Laboratory Duplicate – See **Duplicate**

Laboratory Fortified Blank (LFB) - See **Laboratory Control Sample (LCS)**

Laboratory Fortified Sample matrix (LFM) – See **Matrix Spike (MS)**

Laboratory Information Management System (LIMS) – The computer software used to enter, reorganize, store and report laboratory results.

Laboratory reagent blank (LRB) - See **Method blank (MB)**

Laboratory Performance Check Solution (LPC) - See **Instrument Performance Check (IPC)**

Limit of Detection (LOD) -See **Method Detection Limit (MDL)**

Limit of Quantitation (LOQ) – See **Reporting Limit (RL)**

Linear Dynamic Range (LDR) - The concentration range over which the instrument response to an analyte is linear.

Lower Control Limit (LCL) – The lower acceptance limit for a QC sample. This may be specified by the method or by a project plan or statistically derived. It is calculated statistically by taking the average of a minimum of 20 of data points, minus three standard deviations. This limit is updated as needed.

Lower Warning Limit (LWL) – A cautionary lower limit for a QC sample. If this limit is missed more than in two analytical runs in a row, a follow-up to determine the cause is recommended. It is calculated statistically by taking the average of a minimum of 20 of data points, minus two standard deviations. This limit is updated as needed.

Safety Data Sheet (SDS) – Written information provided by vendors concerning a chemical's toxicity, health hazards, physical properties, fire, and reactivity data including storage, spill, and handling precautions.

Matrix or Matrix Type- The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Food Beverage Liquid: consumable liquid having additives.
Food Beverage Solid: spices, ingredients, raw and finished consumables.
Gas: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device.
Liquid (Aqueous): Surface water, groundwater, wastewater, effluents, and TCLP or other extracts.
Non-aqueous Liquid: any organic liquid with <15% settleable solids.
Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake.
Sludge: sludge material
Soil: Agricultural soils
Solids: Environmental soils, sediments, and other matrices with >15% settleable solids.
Water: Drinking Water-any aqueous sample that has been designated a potable or potential potable water source

Matrix Duplicate: A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision
Matrix Spike (MS) aka Laboratory fortified sample matrix (LFM) - An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The MS is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations.
Matrix spike duplicate (MSD) – Duplicate of the above matrix spike analyzed to demonstrate precision.
Maximum Contaminant Level (MCL)- A limit on the concentration or amount of a pollutant or contaminant specified in a nationwide standard, in a permit, or otherwise established by a regulatory authority. This limit is monitored to protect the public health.
Method: A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.
Method blank (MB) aka Laboratory reagent blank (LRB) - A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.
Method Detection Limit (MDL) aka Limit of Detection (LOD) aka Detection Limit (under NELAP)- The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results. It is determined under the guidelines outlined in Appendix H of this QAM (Reference- TNI 2016 Std, MUR-40CFR, part 136, Appendix B.) An MDL is analyte and matrix specific and laboratory dependent. When reported to the client, it is adjusted for any prep or dilution factors.
Midpoint Check (MPC) – Midlevel calibration standard used to verify the existing curve.
Minimum Level (ML) - The lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that all method-specified sample weights, volumes, and cleanup procedures have been employed. This number must be $\geq$ the MDL.

Minimum Reporting Limit (MRL) – See **Reporting Limit**
Nanopure Water – DI water that is further polished through the Nanopure System ®.
National Institute of Standards and Technology (NIST) - An agency of the US Department of Commerce's Technology Administration that is working with EPA, States, NELAC, and other public and commercial entities to establish a system under which private sector companies and interested States can be accredited by NIST to provide NIST-traceable proficiency testing (PT) to those laboratories testing drinking water and wastewater.
Negative Control - Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.
None Detected (ND) – Analyte of interest was not detected at or above the specified level, usually the reporting limit.
Outlier - statistical outlier. This is determined using the Grubbs Test. A 95% confidence level is used to determine if a data point may be rejected for an MDL or IDoC study.
Percent Recovery – %rec = 100 (Analytical result / true value of standard added)
Positive Control - Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. **Practical Quantitation Limit (PQL) –** See **Reporting Limit**
Precision - The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.
Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis.
Primary Dilution Standard Solution – See **Intermediate Standard**
Procedure - Specified way to carry out an activity or a process. Procedures can be documented or not. (ISO 9000:2000 and Note 1)
Proficiency Testing -A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.
Proficiency Testing Program-The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.
Proficiency Test Sample (PT) - A sample, the composition of which is unknown to the analyst or lab, the sample composition is known only to the provider. It is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.
Protocol - A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed.
Pure Reagent Water - Shall be water (defined by national or international standard) in which no target analytes or interferences are detected as required by the analytical method.
Qualifier - A statement attached to a client or QC sample that explains a QC failure or deviation from normal protocol.
Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.
Quality Assurance [Project] Plan (QAPP) - A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.

Quality control sample (QCS) – Preferably, a solution containing known (certified) concentrations of analytes, received from an outside vender such as Certified Reference Materials; otherwise a quality system matrix fortified by spiking, or actual samples fortified by spiking with a standard obtained from a source different from the calibration standards. This standard checks the analytical system and also verifies the accuracy of the calibration concentration.

Quality Assurance Manual - A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System - A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities.

Quantitation Limit – See **Reporting Limit**

Range - The difference between the minimum and the maximum of a set of values.

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, un-tabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records.

Reagent water - Water demonstrated to be free from the analyte of interest and potentially interfering substances at or above the minimum level of the method for which it is being used.

Record Retention - The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material - A material or substance one or more of whose properties values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Method - A method of known and documented accuracy and precision issued by an organization recognized as competent to do so.

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or at a given location.

Relative Percent Difference (RPD) – Criteria used to evaluate precision of duplicates. It is calculated by taking the difference of the two data points divided by the average of the two data points and multiplying this result by 100.

Relative Standard Deviation (RSD) – The coefficient of variation expressed as a percentage: RSD = 100 (standard deviation / average)

Reporting Level Check - A standard is run at the reporting limit to demonstrate that the laboratory is capable of making accurate and precise measurements at the required reporting detection limit. Once a year this standard is run seven times in a row as part of a detection limit study

Reporting Detection Limit (RDL) – See **Reporting Limit**

Reporting Limit (RL) aka: Detection Limit for Reporting Purposes (DLR – state defined value), Level of Quantitation (LOQ - NELAP), Practical Quantitation Limit (PQL), Estimated Quantitation Limit (EQL), Quantitation Limit (QL), Reporting Detection Limit (RDL), Minimum Reporting Limit (MRL) – The minimum value which is reported to the client and can be reported at a confidence level required by the client. It must be ≥ the MDL, optimally it is 5 to 10 times the MDL. It is adjusted for any prep or dilution factors prior to reporting**.**

Requirement - Denotes a mandatory specification; often designated by the term "shall".

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.

Sensitivity - The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

Shipping blank - See **Travel blank (TB)**

Source water–Drinking water source that is surface water or ground water under direct influence of surface water (Surface Water Treatment Rule – SWTR).

Standard - The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.

Standard Addition -The addition of a known amount of analyte to the sample in order to determine the relative response of the detector to an analyte within the sample matrix. The relative response is then used to assess either an operative matrix effect or the sample analyte concentration.

Standard Methods - Official book of methods for wastewater sample **-** Standard Methods for the Examination of Water and Wastewater,

Standard Operating Procedures (SOPs): A written document that details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.

Standardized Reference Material (SRM) - A certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method.

Stock standard solution - A concentrated solution or salt containing one or more method analytes, purchased from a reputable commercial source. Stock standard solutions are used to prepare intermediate and working standards.

Surrogate analyte - A pure analyte(s), which is extremely unlikely to be found in any sample, and which is added to a sample aliquot in known amount(s) before extraction and is measured with the same procedures used to measure other sample components. The purpose of a surrogate analyte is to monitor method performance with each sample.

SW846 – Test methods for evaluating solid waste - physical and chemical methods.

Systems Audit (also Technical Systems Audit) - A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system.

Travel blank (TB)/Shipping blank - Reagent water placed in a sample container in the laboratory, remaining unopened and transported as a sample, including exposure to sampling site conditions, storage, preservation and all analytical procedures. The purpose of the TB is to determine if method analytes or other interferences are present in the field and or storage environment.

Technical Director - Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory.
Technology: a specific arrangement of analytical instruments, detection systems, and/or preparation techniques.
Tuning Solution – A solution used to determine acceptable instrument performance prior to calibration and sample analysis. This solution is usually used in mass spectrometric procedures.
Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.
United States Environmental Protection Agency (EPA) - The federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends. They establish policy, official methods of analysis, and oversee laboratory certification.
Upper Control Limit (UCL) – The upper acceptance limit for a QC sample. This may be specified by the method or by a project plan or statistically derived. It is calculated statistically by taking the average of a minimum of 20 of data points, plus three standard deviations. This limit is updated as needed.
Upper Warning Limit (UWL) – A cautionary upper limit for a QC sample. If this limit is exceeded more than in two analytical runs in a row, a follow-up to determine the cause is recommended. It is calculated statistically by taking the average of a minimum of 20 of data points, minus two standard deviations. This limit is updated as needed.
Validation - the confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. The process of substantiating specified performance criteria.
Verification - Confirmation by examination and provision of evidence that specified requirements have been met.
Water extract – Extraction technique whereby reagent water is added to a non-aqueous matrix at a default proportion of 1:10, agitated for a period of time and filtered. Constituents that move in the reagent water layer are tested.
Working Range: the difference between the Limit of Quantitation and the upper limit of measurement system calibration.
Working standard–A solution prepared from either the stock standard or working standard used as a calibrator, spiking solution, or lab control.

NELAP Specific Terms:

Accreditation: the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one.
Accrediting Authority: the Territorial, State, or federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation.
Assessment: the evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of NELAC).
Assessor: one who performs on-site assessments of accrediting authorities and laboratories' capability and capacity for meeting NELAC requirements by examining the

records and other physical evidence for each one of the tests for which accreditation has been requested.

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

Critical Finding: a finding or a combination of findings that results in a significant negative effect on data quality or defensibility, if not corrected. (NELAC)

Deficiency: an unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Estimation of Uncertainty of Measurement: procedures for estimating uncertainty of measurement. Where a well-recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied this clause by following the test method and reporting instructions. Reasonable estimation shall be based on knowledge of the performance of the method and on the measurement scope and shall make use of, for example, previous experience and validation data.

Environmental Laboratory Advisory Board (ELAB): a Federal Advisory Committee, with members appointed by EPA and composed of a balance of non-state, non-federal representatives, from the environmental laboratory community, and chaired by an ELAB member

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Finding: An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement.

Marginal Exceedance (ME): An LCS analyte beyond the LCS control limit of 3 standard deviations but within ME limits of 3 and 4 standard deviations around the mean.

May: denotes permitted action, but not required action. (NELAC)

Must: denotes a requirement that must be met. (Random House College Dictionary)

National Environmental Laboratory Accreditation Program (NELAP): the overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (NELAC)

National Voluntary Laboratory Accreditation Program (NVLAP): a program administered by NIST that is used by providers of proficiency testing to gain accreditation for all compounds/matrices for which NVLAP accreditation is available, and for which the provider intends to provide NELAP PT samples. (NELAC)

NELAC Standards: the plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the National Environmental Laboratory Accreditation Conference. (NELAC)

NELAP Recognition: the determination by the NELAP Director that an accrediting authority meets the requirements of the NELAP and is authorized to grant NELAP accreditation to laboratories. (NELAC)

Primary Accrediting Authority: the agency or department designated at the Territory, State or Federal level as the recognized authority with responsibility and accountability for granting NELAC accreditation for a specified field of testing. (NELAC)

Proficiency Testing Study Provider: any person, private party, or government entity that meets stringent criteria to produce and distribute NELAC PT samples, evaluate study results against published performance criteria and report the results to the laboratories, primary accrediting authorities, PTOB/PTPA, and NELAP. (NELAC)

Reciprocity: the mutual agreement of two or more parties (i.e., States) to accept each other's findings regarding the ability of environmental testing laboratories in meeting NELAC standards. (NELAC)
Sample Tracking: procedures employed to record the possession of the samples from the time of sampling until analysis, reporting, and archiving. These procedures include the use of Chain of Custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity if the samples. (NELAC)
Shall: Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled. (ANSI)
Should: Denotes a guideline or recommendation whenever noncompliance with the specification is permissible. (ANSI)
Suspension: temporary removal of a laboratory's accreditation for a defined period of time, which shall not exceed six months, to allow the laboratory time to correct deficiencies or area of non-compliance with the NELAC standards.
Voting Member: officials in the employ of the Government of the United States, and the States, the Territories, the Possessions of the United States, or the District of Columbia and who are actively engaged in environmental regulatory programs or accreditation of environmental laboratories. (NELAC)

Units of weight and measure and their abbreviations :

ºC degrees	Celsius
CFU/100mL	Colony Forming Units per 100 milliliters
ºF degrees	Fahrenheit
≤	less than or equal to
≥	greater than or equal to
%	percent
±	plus or minus
g	gram
h	hour
L	liter
me/L	milliequivalence per liter
mg	milligram
mg/kg	milligram per kilogram
mg/L	milligram per liter
mg/mL	milligram per milliliter
mL	milliliter
MPN/g	most probable number per gram
ng/L	nanogram per liter
N/A	not applicable
No.	number
NTU	Nephelometric turbidity units
ohm/cm	ohms per centimeter
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion

rpm	revolutions per minute
TON	threshold odor number
µg/kg	micrograms per kilograms
µg/L	micrograms per liter
µS/cm	microsiemens per centimenter
µmhos/cm	micromos per centimenter (Note µS/cm = µMhos/cm)
1:10	an aliquot of 10 added on top of an aliquot of 1 (ex. 10 mL of D.I. added on top of 1 gram of soil for a WEX.)
1/10	an aliquot of 1 brought up to an aliquot of 10 (ex. 1 mL of standard brought up to a final volume of 10 mL With D.I. in a volumetric flask.)

Appendix E

Laboratory Accreditation/Certification/Recognition

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

CALIFORNIA STATE

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

CERTIFICATE OF ENVIRONMENTAL ACCREDITATION

Is hereby granted to

Babcock Laboratories, Inc.

6100 Quail Valley Court

Riverside, CA 92507

Scope of the certificate is limited to the
"Fields of Testing"
which accompany this Certificate.

Continued accredited status depends on successful completion of on-site inspection, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of
Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **2698**

Expiration Date: **5/31/2022**

Effective Date: **6/1/2020**

Sacramento, California
subject to forfeiture or revocation

Christine Sotelo, Chief
Environmental Laboratory Accreditation Program

CALIFORNIA STATE
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Accredited Fields of Testing

Babcock Laboratories, Inc.

6100 Quail Valley Court
Riverside, CA 92507
Phone: 9516533351

Certificate No. **2698**
Expiration Date **5/31/2022**

Field of Testing: 101 - Microbiology of Drinking Water

101.010	001	Heterotrophic Bacteria	SM 9215 B
101.020	004	Total Coliform (Enumeration)	SM 9221 B,C
101.020	005	Fecal Coliform (Enumeration)	SM 9221 B,E
101.020	006	E. coli (Enumeration)	SM 9221 B,F
101.050	001	Total Coliform P/A	SM 9223 B Colilert
101.050	002	E. coli P/A	SM 9223 B Colilert
101.050	003	Total Coliform (Enumeration)	SM 9223 B Colilert
101.050	004	E. coli (Enumeration)	SM 9223 B Colilert
101.050	005	Total Coliform P/A	SM 9223 B Colilert 18
101.050	006	E. coli P/A	SM 9223 B Colilert 18
101.050	007	Total Coliform (Enumeration)	SM 9223 B Colilert 18
101.050	008	E. coli (Enumeration)	SM 9223 B Colilert 18
101.100	001	Total Coliform P/A	Colitag
101.100	002	E. coli P/A	Colitag

Field of Testing: 102 - Inorganic Chemistry of Drinking Water

102.026	001	Calcium	EPA 200.7
102.026	002	Magnesium	EPA 200.7
102.026	003	Potassium	EPA 200.7
102.026	004	Silica	EPA 200.7
102.026	005	Sodium	EPA 200.7
102.026	006	Hardness (Calculation)	EPA 200.7
102.030	001	Bromide	EPA 300.0
102.030	003	Chloride	EPA 300.0
102.030	005	Fluoride	EPA 300.0
102.030	006	Nitrate (as N)	EPA 300.0
102.030	007	Nitrite (as N)	EPA 300.0
102.030	008	Phosphate,Ortho (as P)	EPA 300.0
102.030	009	Sulfate (as SO4)	EPA 300.0
102.040	001	Bromide	EPA 300.1
102.040	002	Chlorite	EPA 300.1
102.040	003	Chlorate	EPA 300.1
102.040	004	Bromate	EPA 300.1
102.045	001	Perchlorate	EPA 314.0

102.047	001	Perchlorate	EPA 331.0
102.048	001	Perchlorate	EPA 332.0
102.095	001	Turbidity	SM 2130 B-2001
102.100	001	Alkalinity	SM 2320 B-1997
102.120	001	Hardness (Calculation)	SM 2340 B-1997
102.130	001	Specific Conductance	SM 2510 B-1997
102.140	001	Residue, Filterable TDS	SM 2540 C-1997
102.175	001	Chlorine, Free	SM 4500-Cl G-2000
102.175	002	Chlorine, Total Residual	SM 4500-Cl G-2000
102.180	001	Chlorine Dioxide	SM 4500-ClO2 D-2000
102.190	001	Cyanide, Total	SM 4500-CN E-1999
102.192	001	Cyanide, Amenable	SM 4500-CN G-1999
102.200	001	Fluoride	SM 4500-F C-1997
102.203	001	Hydrogen Ion (pH)	SM 4500-H+ B-2000
102.220	001	Nitrite (as N)	SM 4500-NO2 B-2000
102.240	001	Phosphate,Ortho (as P)	SM 4500-P E-1999
102.260	001	Organic Carbon-Total (TOC)	SM 5310 B-2000
102.261	001	Dissolved Organic Carbon (DOC)	SM 5310 B-2000
102.270	001	Surfactants	SM 5540 C-2000
102.280	001	UV254	SM 5910 B-2011
102.570	001	Cyanide, Free	OIA-1677, DW

Field of Testing: 103 - Toxic Chemical Elements of Drinking Water

103.030	001	Mercury	SM 3112 B
103.130	001	Aluminum	EPA 200.7
103.130	003	Barium	EPA 200.7
103.130	005	Cadmium	EPA 200.7
103.130	007	Chromium	EPA 200.7
103.130	008	Copper	EPA 200.7
103.130	009	Iron	EPA 200.7
103.130	011	Manganese	EPA 200.7
103.130	012	Nickel	EPA 200.7
103.130	015	Silver	EPA 200.7
103.130	017	Zinc	EPA 200.7
103.130	018	Boron	EPA 200.7
103.140	001	Aluminum	EPA 200.8
103.140	002	Antimony	EPA 200.8
103.140	003	Arsenic	EPA 200.8
103.140	004	Barium	EPA 200.8
103.140	005	Beryllium	EPA 200.8
103.140	006	Cadmium	EPA 200.8
103.140	007	Chromium	EPA 200.8
103.140	008	Copper	EPA 200.8

103.140	009	Lead	EPA 200.8
103.140	010	Manganese	EPA 200.8
103.140	011	Mercury	EPA 200.8
103.140	012	Nickel	EPA 200.8
103.140	013	Selenium	EPA 200.8
103.140	014	Silver	EPA 200.8
103.140	015	Thallium	EPA 200.8
103.140	016	Zinc	EPA 200.8
103.140	018	Vanadium	EPA 200.8
103.310	001	Chromium VI (Hexavalent Chromium)	EPA 218.6
103.311	001	Chromium VI (Hexavalent Chromium)	EPA 218.7

Field of Testing: 104 - Volatile Organic Chemistry of Drinking Water

104.030	001	1,2-Dibromoethane (EDB)	EPA 504.1
104.030	002	1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1
104.035	001	1,2,3-Trichloropropane (TCP)	SRL 524M-TCP
104.040	000	Volatile Organic Compounds	EPA 524.2
104.040	001	Benzene	EPA 524.2
104.040	007	n-Butylbenzene	EPA 524.2
104.040	008	sec-Butylbenzene	EPA 524.2
104.040	009	tert-Butylbenzene	EPA 524.2
104.040	010	Carbon Tetrachloride	EPA 524.2
104.040	011	Chlorobenzene	EPA 524.2
104.040	015	2-Chlorotoluene	EPA 524.2
104.040	016	4-Chlorotoluene	EPA 524.2
104.040	019	1,3-Dichlorobenzene	EPA 524.2
104.040	020	1,2-Dichlorobenzene	EPA 524.2
104.040	021	1,4-Dichlorobenzene	EPA 524.2
104.040	022	Dichlorodifluoromethane	EPA 524.2
104.040	023	1,1-Dichloroethane	EPA 524.2
104.040	024	1,2-Dichloroethane	EPA 524.2
104.040	025	1,1-Dichloroethylene (1,1-Dichloroethene)	EPA 524.2
104.040	026	cis-1,2-Dichloroethylene (cis 1,2 Dichloroethene)	EPA 524.2
104.040	027	trans-1,2-Dichloroethylene (trans- 1,2 Dichloroethene)	EPA 524.2
104.040	028	Dichloromethane (Methylene Chloride)	EPA 524.2
104.040	029	1,2-Dichloropropane	EPA 524.2
104.040	033	cis-1,3-Dichloropropylene (cis 1,3 Dichloropropene)	EPA 524.2
104.040	034	trans-1,3-Dichloropropylene (trans-1,3 Dichloroprope	EPA 524.2
104.040	035	Ethylbenzene	EPA 524.2
104.040	037	Isopropylbenzene	EPA 524.2
104.040	039	Naphthalene	EPA 524.2
104.040	041	N-propylbenzene	EPA 524.2
104.040	042	Styrene	EPA 524.2

104.040	043	1,1,1,2-Tetrachloroethane	EPA 524.2
104.040	044	1,1,2,2-Tetrachloroethane	EPA 524.2
104.040	045	Tetrachloroethylene (Tetrachloroethene)	EPA 524.2
104.040	046	Toluene	EPA 524.2
104.040	047	1,2,3-Trichlorobenzene	EPA 524.2
104.040	048	1,2,4-Trichlorobenzene	EPA 524.2
104.040	049	1,1,1-Trichloroethane	EPA 524.2
104.040	050	1,1,2-Trichloroethane	EPA 524.2
104.040	051	Trichloroethylene (Trichloroethene)	EPA 524.2
104.040	052	Trichlorofluoromethane	EPA 524.2
104.040	054	1,2,4-Trimethylbenzene	EPA 524.2
104.040	055	1,3,5-Trimethylbenzene	EPA 524.2
104.040	056	Vinyl Chloride	EPA 524.2
104.040	057	Xylenes, Total	EPA 524.2
104.040	061	Carbon Disulfide	EPA 524.2
104.040	062	Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	EPA 524.2
104.045	000	Trihalomethanes, Total	EPA 524.2
104.045	001	Bromodichloromethane	EPA 524.2
104.045	002	Bromoform	EPA 524.2
104.045	003	Chloroform	EPA 524.2
104.045	004	Dibromochloromethane (Chlorodibromomethane)	EPA 524.2
104.050	000	Gasoline Additives	EPA 524.2
104.050	002	Methyl tert-butyl Ether (MTBE)	EPA 524.2
104.050	003	tert-Amyl Methyl Ether (TAME)	EPA 524.2
104.050	004	Ethyl tert-butyl Ether (ETBE)	EPA 524.2
104.050	005	Trichlorotrifluoroethane	EPA 524.2
104.050	006	tert-Butyl Alcohol (TBA)	EPA 524.2

Field of Testing: 105 - Semi-volatile Organic Chemistry of Drinking Water

105.010	000	Organochlorine Pesticides and PCBs	EPA 505
105.010	004	Chlordane	EPA 505
105.010	006	Endrin	EPA 505
105.010	007	Heptachlor	EPA 505
105.010	008	Heptachlor Epoxide	EPA 505
105.010	009	Hexachlorobenzene	EPA 505
105.010	011	Lindane (HCH-gamma)	EPA 505
105.010	012	Methoxychlor	EPA 505
105.010	014	Toxaphene	EPA 505
105.010	015	PCBs as Aroclors (screen)	EPA 505
105.082	000	Chlorinated Acids	EPA 515.3
105.082	001	2,4-D	EPA 515.3
105.082	002	Dinoseb	EPA 515.3
105.082	003	Pentachlorophenol	EPA 515.3

105.082	004	Picloram	EPA 515.3
105.082	005	2,4,5-TP (Silvex)	EPA 515.3
105.082	006	Bentazon	EPA 515.3
105.082	007	Dalapon	EPA 515.3
105.082	008	Dicamba	EPA 515.3
105.090	000	Semi-volatile Organic Compounds	EPA 525.2
105.090	001	Alachlor	EPA 525.2
105.090	003	Atrazine	EPA 525.2
105.090	004	Benzo(a)pyrene	EPA 525.2
105.090	005	Butachlor	EPA 525.2
105.090	008	Di(2-ethylhexyl) Adipate	EPA 525.2
105.090	009	Di(2-ethylhexyl) Phthalate	EPA 525.2
105.090	022	Molinate	EPA 525.2
105.090	025	Simazine	EPA 525.2
105.090	028	Thiobencarb	EPA 525.2
105.101	000	Carbamates	EPA 531.2
105.101	001	Carbofuran (Furadan)	EPA 531.2
105.101	002	Oxamyl	EPA 531.2
105.101	003	Aldicarb (Temik)	EPA 531.2
105.101	004	Aldicarb Sulfone	EPA 531.2
105.101	005	Aldicarb Sulfoxide	EPA 531.2
105.101	006	Carbaryl (Sevin)	EPA 531.2
105.101	007	3-Hydroxycarbofuran	EPA 531.2
105.101	008	Methomyl (Lannate)	EPA 531.2
105.106	000	Per- and Polyfluorinated Alkyl Substances (PFAS)	EPA 537.1
105.120	001	Glyphosate	EPA 547
105.140	001	Endothall	EPA 548.1
105.190	001	Bromoacetic Acid	SM 6251 B
105.190	003	Chloroacetic Acid	SM 6251 B
105.190	005	Dibromoacetic Acid	SM 6251 B
105.190	006	Dichloroacetic Acid	SM 6251 B
105.190	007	Trichloroacetic Acid	SM 6251 B
105.190	008	Haloacetic Acids (HAA5)	SM 6251 B
105.191	001	Haloacetic Acids (HAA5)	SM 6251 B
105.201	001	Haloacetic Acids (HAA5)	EPA 552.3

Field of Testing: 106 - Radionuclides in Drinking Water

106.092	001	Uranium	EPA 200.8

Field of Testing: 107 - Microbiological Methods for Non-Potable Water and Sewage Sludge

107.001	001	Total Coliform (Enumeration)	SM 9221 B,C-2006
107.001	002	Fecal Coliform (Enumeration)	SM 9221 C,E-2006
107.001	003	E. coli (Enumeration)	SM 9221 C,F-2006
107.005	001	E. coli (Enumeration)	SM 9223 B-2004

107.007	001	Enterococci	SM 9230 B-2007
107.007	002	Fecal Streptococci	SM 9230 B-2007
107.011	001	Enterococci	SM 9230 D-2007
107.015	001	E. coli (Enumeration)	Colilert 18
107.017	001	Enterococci	Enterolert

Field of Testing: 108 - Inorganic Constituents in Non-Potable Water

108.007	001	Residue, Volatile	EPA 160.4 (1971)
108.013	001	Calcium	EPA 200.7 (1994 Rev. 4.4)
108.013	002	Magnesium	EPA 200.7 (1994 Rev. 4.4)
108.013	004	Potassium	EPA 200.7 (1994 Rev. 4.4)
108.013	005	Silica, Dissolved	EPA 200.7 (1994 Rev. 4.4)
108.013	006	Sodium	EPA 200.7 (1994 Rev. 4.4)
108.017	001	Bromide	EPA 300.0 (1993 Rev. 2.1)
108.017	002	Chloride	EPA 300.0 (1993 Rev. 2.1)
108.017	003	Fluoride	EPA 300.0 (1993 Rev. 2.1)
108.017	004	Nitrate (as N)	EPA 300.0 (1993 Rev. 2.1)
108.017	005	Nitrate-Nitrite (as N)	EPA 300.0 (1993 Rev. 2.1)
108.017	006	Nitrite (as N)	EPA 300.0 (1993 Rev. 2.1)
108.017	007	Phosphate,Ortho (as P)	EPA 300.0 (1993 Rev. 2.1)
108.017	008	Sulfate (as SO4)	EPA 300.0 (1993 Rev. 2.1)
108.019	001	Bromide	EPA 300.1 (1997 Rev.1.0)
108.029	001	Kjeldahl Nitrogen,Total (as N)	EPA 351.2 (1993 Rev. 2.0)
108.049	001	Phenols, Total	EPA 420.4 (1993 Rev. 2.0)
108.053	002	Oil & Grease Total	EPA 1664 B
108.055	001	Color	SM 2120 B-2011
108.059	001	Turbidity	SM 2130 B-2011
108.063	001	Alkalinity	SM 2320 B-2011
108.065	001	Hardness (Calculation)	SM 2340 B-2011
108.069	001	Specific Conductance	SM 2510 B-2011
108.071	001	Residue, Total	SM 2540 B-2011
108.073	001	Residue, Filterable TDS	SM 2540 C-2011
108.075	001	Residue, Non-filterable TSS	SM 2540 D-2011
108.077	001	Residue, Volatile	SM 2540 E-2011
108.079	001	Residue, Settleable	SM 2540 F-2011
108.080	001	Temperature	SM 2550 B-2010
108.114	001	Chlorine, Total Residual	SM 4500-Cl G-2011
108.114	002	Chlorine, Free	SM 4500-Cl G-2011
108.125	001	Cyanide, Total	SM 4500-CN E-2011
108.129	001	Cyanide, Available	SM 4500-CN G-2011
108.131	001	Fluoride	SM 4500-F C-2011
108.137	001	Hydrogen Ion (pH)	SM 4500-H+ B-2011
108.147	001	Ammonia (as N)	SM 4500-NH3 G-2011

108.153	001	Nitrite (as N)	SM 4500-NO2 B-2011
108.163	001	Oxygen, Dissolved	SM 4500-O B-2011
108.173	001	Oxygen, Dissolved	SM 4500-O G-2011
108.175	001	Phosphate,Ortho (as P)	SM 4500-P E-2011
108.175	002	Phosphorus,Total	SM 4500-P E-2011
108.201	001	Sulfide (as S)	SM 4500-S D-2011
108.207	001	Biochemical Oxygen Demand	SM 5210 B-2011
108.207	002	Carbonaceous BOD	SM 5210 B-2011
108.213	001	Chemical Oxygen Demand	SM 5220 D-2011
108.215	001	Organic Carbon-Total (TOC)	SM 5310 B-2011
108.225	001	Surfactants	SM 5540 C-2011
108.339	001	Cyanide, Available	OIA-1677-09
108.339	002	Cyanide, Free	OIA-1677-09

Field of Testing: 109 - Metals and Trace Elements in Non-Potable Water

109.623	001	Aluminum	EPA 200.7 (1994 Rev. 4.4)
109.623	002	Antimony	EPA 200.7 (1994 Rev. 4.4)
109.623	003	Arsenic	EPA 200.7 (1994 Rev. 4.4)
109.623	004	Barium	EPA 200.7 (1994 Rev. 4.4)
109.623	006	Boron	EPA 200.7 (1994 Rev. 4.4)
109.623	007	Cadmium	EPA 200.7 (1994 Rev. 4.4)
109.623	008	Chromium	EPA 200.7 (1994 Rev. 4.4)
109.623	009	Cobalt	EPA 200.7 (1994 Rev. 4.4)
109.623	010	Copper	EPA 200.7 (1994 Rev. 4.4)
109.623	011	Iron	EPA 200.7 (1994 Rev. 4.4)
109.623	012	Lead	EPA 200.7 (1994 Rev. 4.4)
109.623	013	Manganese	EPA 200.7 (1994 Rev. 4.4)
109.623	014	Molybdenum	EPA 200.7 (1994 Rev. 4.4)
109.623	015	Nickel	EPA 200.7 (1994 Rev. 4.4)
109.623	016	Selenium	EPA 200.7 (1994 Rev. 4.4)
109.623	017	Silver	EPA 200.7 (1994 Rev. 4.4)
109.623	018	Thallium	EPA 200.7 (1994 Rev. 4.4)
109.623	019	Tin	EPA 200.7 (1994 Rev. 4.4)
109.623	020	Titanium	EPA 200.7 (1994 Rev. 4.4)
109.623	021	Vanadium	EPA 200.7 (1994 Rev. 4.4)
109.623	022	Zinc	EPA 200.7 (1994 Rev. 4.4)
109.625	001	Aluminum	EPA 200.8 (1994 Rev. 5.4)
109.625	002	Antimony	EPA 200.8 (1994 Rev. 5.4)
109.625	003	Arsenic	EPA 200.8 (1994 Rev. 5.4)
109.625	004	Barium	EPA 200.8 (1994 Rev. 5.4)
109.625	005	Beryllium	EPA 200.8 (1994 Rev. 5.4)
109.625	007	Cadmium	EPA 200.8 (1994 Rev. 5.4)
109.625	008	Chromium	EPA 200.8 (1994 Rev. 5.4)

109.625	009	Cobalt	EPA 200.8 (1994 Rev. 5.4)
109.625	010	Copper	EPA 200.8 (1994 Rev. 5.4)
109.625	013	Lead	EPA 200.8 (1994 Rev. 5.4)
109.625	014	Manganese	EPA 200.8 (1994 Rev. 5.4)
109.625	015	Molybdenum	EPA 200.8 (1994 Rev. 5.4)
109.625	016	Nickel	EPA 200.8 (1994 Rev. 5.4)
109.625	017	Selenium	EPA 200.8 (1994 Rev. 5.4)
109.625	018	Silver	EPA 200.8 (1994 Rev. 5.4)
109.625	019	Thallium	EPA 200.8 (1994 Rev. 5.4)
109.625	020	Tin	EPA 200.8 (1994 Rev. 5.4)
109.625	022	Vanadium	EPA 200.8 (1994 Rev. 5.4)
109.625	023	Zinc	EPA 200.8 (1994 Rev. 5.4)
109.629	001	Chromium VI (Hexavalent Chromium)	EPA 218.6 (1994 Rev. 3.3)
109.667	001	Mercury	SM 3112 B-2011
109.685	002	Chromium VI (Hexavalent Chromium)	SM 3500-Cr B-2011

Field of Testing: 110 - Volatile Organic Constituents in Non-Potable Water

110.040	001	Acetone	EPA 624.1
110.040	002	Acetonitrile	EPA 624.1
110.040	003	Acrolein	EPA 624.1
110.040	004	Acrylonitrile	EPA 624.1
110.040	005	Benzene	EPA 624.1
110.040	006	Bromodichloromethane	EPA 624.1
110.040	007	Bromoform	EPA 624.1
110.040	008	Bromomethane (Methyl Bromide)	EPA 624.1
110.040	009	tert-Butyl Alcohol (TBA)	EPA 624.1
110.040	010	Carbon Tetrachloride	EPA 624.1
110.040	011	Chlorobenzene	EPA 624.1
110.040	012	Chloroethane	EPA 624.1
110.040	013	2-Chloroethyl vinyl Ether	EPA 624.1
110.040	014	Chloroform	EPA 624.1
110.040	015	Chloromethane (Methyl Chloride)	EPA 624.1
110.040	016	Dibromochloromethane (Chlorodibromomethane)	EPA 624.1
110.040	017	1,2-Dichlorobenzene	EPA 624.1
110.040	018	1,3-Dichlorobenzene	EPA 624.1
110.040	019	1,4-Dichlorobenzene	EPA 624.1
110.040	020	1,1-Dichloroethane	EPA 624.1
110.040	021	1,2-Dichloroethane	EPA 624.1
110.040	022	1,1-Dichloroethylene (1,1-Dichloroethene)	EPA 624.1
110.040	023	trans-1,2-Dichloroethylene (trans- 1,2 Dichloroethene)	EPA 624.1
110.040	024	1,2-Dichloropropane	EPA 624.1
110.040	025	cis-1,3-Dichloropropylene (cis 1,3 Dichloropropene)	EPA 624.1
110.040	026	trans-1,3-Dichloropropylene (trans-1,3 Dichloroprope	EPA 624.1

110.040	028	Ethyl Acetate	EPA 624.1
110.040	029	Ethylbenzene	EPA 624.1
110.040	031	Methylene Chloride (Dichloromethane)	EPA 624.1
110.040	032	4-Methyl-2-pentanone (MIBK)	EPA 624.1
110.040	034	1,1,2,2-Tetrachloroethane	EPA 624.1
110.040	035	Tetrachloroethylene (Tetrachloroethene)	EPA 624.1
110.040	036	Tetrahydrofuran	EPA 624.1
110.040	037	Toluene	EPA 624.1
110.040	038	1,1,1-Trichloroethane	EPA 624.1
110.040	039	1,1,2-Trichloroethane	EPA 624.1
110.040	040	Trichloroethylene (Trichloroethene)	EPA 624.1
110.040	041	Vinyl Chloride	EPA 624.1
110.040	042	m-Xylene	EPA 624.1
110.040	043	o-Xylene	EPA 624.1
110.040	044	p-Xylene	EPA 624.1
110.040	045	Trichlorofluoromethane	EPA 624.1

Field of Testing: 111 - Semi-volatile Organic Constituents in Non-Potable Water

111.055	001	Aldrin	EPA 608.3
111.055	002	alpha-BHC	EPA 608.3
111.055	003	beta-BHC	EPA 608.3
111.055	004	delta-BHC	EPA 608.3
111.055	005	gamma-BHC (Lindane)	EPA 608.3
111.055	006	Chlordane	EPA 608.3
111.055	007	4,4'-DDD	EPA 608.3
111.055	008	4,4'-DDE	EPA 608.3
111.055	009	4,4'-DDT	EPA 608.3
111.055	010	Dieldrin	EPA 608.3
111.055	011	Endosulfan I	EPA 608.3
111.055	012	Endosulfan II	EPA 608.3
111.055	013	Endosulfan Sulfate	EPA 608.3
111.055	014	Endrin	EPA 608.3
111.055	015	Endrin Aldehyde	EPA 608.3
111.055	016	Heptachlor	EPA 608.3
111.055	017	Heptachlor Epoxide	EPA 608.3
111.055	019	PCB-1016	EPA 608.3
111.055	020	PCB-1221	EPA 608.3
111.055	021	PCB-1232	EPA 608.3
111.055	022	PCB-1242	EPA 608.3
111.055	023	PCB-1248	EPA 608.3
111.055	024	PCB-1254	EPA 608.3
111.055	025	PCB-1260	EPA 608.3
111.055	046	Methoxychlor	EPA 608.3

111.055	060	Toxaphene	EPA 608.3
111.160	001	Acenaphthene	EPA 625.1
111.160	002	Acenaphthylene	EPA 625.1
111.160	003	Anthracene	EPA 625.1
111.160	004	Benzidine	EPA 625.1
111.160	005	Benzo(a)anthracene	EPA 625.1
111.160	006	Benzo(a)pyrene	EPA 625.1
111.160	007	Benzo(b)fluoranthene	EPA 625.1
111.160	008	Benzo(g,h,i)perylene	EPA 625.1
111.160	009	Benzo(k)fluoranthene	EPA 625.1
111.160	010	Bis(2-chloroethoxy) Methane	EPA 625.1
111.160	011	Bis(2-chloroethyl) Ether	EPA 625.1
111.160	012	Bis(2-chloroisopropyl) Ether	EPA 625.1
111.160	013	Bis(2-ethylhexyl)phthalate	EPA 625.1
111.160	014	4-Bromophenyl Phenyl Ether	EPA 625.1
111.160	015	Butyl Benzyl Phthalate	EPA 625.1
111.160	016	2-Chloronaphthalene	EPA 625.1
111.160	017	4-Chlorophenyl Phenyl Ether	EPA 625.1
111.160	018	Chrysene	EPA 625.1
111.160	019	Dibenzo(a,h)anthracene	EPA 625.1
111.160	020	3,3'-Dichlorobenzidine	EPA 625.1
111.160	021	Diethyl Phthalate	EPA 625.1
111.160	022	Dimethyl Phthalate	EPA 625.1
111.160	023	Di-n-butyl Phthalate	EPA 625.1
111.160	024	2,4-Dinitrotoluene	EPA 625.1
111.160	025	2,6-Dinitrotoluene	EPA 625.1
111.160	026	Di-n-octyl Phthalate	EPA 625.1
111.160	027	Fluoranthene	EPA 625.1
111.160	028	Fluorene	EPA 625.1
111.160	029	Hexachlorobenzene	EPA 625.1
111.160	030	Hexachlorobutadiene	EPA 625.1
111.160	031	Hexachloroethane	EPA 625.1
111.160	032	Indeno(1,2,3-c,d)pyrene	EPA 625.1
111.160	033	Isophorone	EPA 625.1
111.160	034	Naphthalene	EPA 625.1
111.160	035	Nitrobenzene	EPA 625.1
111.160	036	N-nitrosodi-n-propylamine	EPA 625.1
111.160	037	Phenanthrene	EPA 625.1
111.160	038	Pyrene	EPA 625.1
111.160	039	1,2,4-Trichlorobenzene	EPA 625.1
111.160	040	4-Chloro-3-methylphenol	EPA 625.1
111.160	041	2-Chlorophenol	EPA 625.1

111.160	042	2,4-Dichlorophenol	EPA 625.1
111.160	043	2,4-Dimethylphenol	EPA 625.1
111.160	044	2,4-Dinitrophenol	EPA 625.1
111.160	045	2-Methyl-4,6-dinitrophenol	EPA 625.1
111.160	046	2-Nitrophenol	EPA 625.1
111.160	047	4-Nitrophenol	EPA 625.1
111.160	048	Pentachlorophenol	EPA 625.1
111.160	049	Phenol	EPA 625.1
111.160	050	2,4,6-Trichlorophenol	EPA 625.1
111.160	052	Aldrin	EPA 625.1
111.160	058	alpha-BHC	EPA 625.1
111.160	059	beta-BHC	EPA 625.1
111.160	060	delta-BHC	EPA 625.1
111.160	061	gamma-BHC (Lindane)	EPA 625.1
111.160	076	4,4'-DDD	EPA 625.1
111.160	077	4,4'-DDE	EPA 625.1
111.160	078	4,4'-DDT	EPA 625.1
111.160	083	Dieldrin	EPA 625.1
111.160	086	Endosulfan I	EPA 625.1
111.160	087	Endosulfan II	EPA 625.1
111.160	088	Endosulfan Sulfate	EPA 625.1
111.160	089	Endrin	EPA 625.1
111.160	096	Heptachlor	EPA 625.1
111.160	097	Heptachlor Epoxide	EPA 625.1
111.160	098	Hexachlorocyclopentadiene	EPA 625.1
111.160	108	N-nitrosodimethylamine	EPA 625.1
111.160	110	N-nitrosodiphenylamine	EPA 625.1
111.345	001	N-Ethylperfluorooctane Sulfonamido Acetic Acid (NEt	DoD QSM Version 5.3
111.345	002	4:2 Fluorotelomer Sulfonic Acid (4:2 FTS)	DoD QSM Version 5.3
111.345	003	6:2 Fluorotelomer Sulfonic Acid (6:2 FTS)	DoD QSM Version 5.3
111.345	004	8:2 Fluorotelomer Sulfonic Acid (8:2 FTS)	DoD QSM Version 5.3
111.345	005	N-Methylperfluorooctane Sulfonamido Acetic Acid (N	DoD QSM Version 5.3
111.345	006	Perfluorobutanoic Acid (PFBA)	DoD QSM Version 5.3
111.345	007	Perfluorobutane Sulfonic Acid (PFBS)	DoD QSM Version 5.3
111.345	008	Perfluorodecanoic Acid (PFDA)	DoD QSM Version 5.3
111.345	009	Perfluorododecanoic Acid (PFDoA)	DoD QSM Version 5.3
111.345	010	Perfluorodecane Sulfonic Acid (PFDS)	DoD QSM Version 5.3
111.345	011	Perfluoroheptanoic Acid (PFHpA)	DoD QSM Version 5.3
111.345	012	Perfluoroheptane Sulfonic Acid (PFHpS)	DoD QSM Version 5.3
111.345	013	Perfluorohexane Sulfonic Acid (PFHxS)	DoD QSM Version 5.3
111.345	014	Perfluorohexanoic Acid (PFHxA)	DoD QSM Version 5.3
111.345	015	Perfluorononanoic Acid (PFNA)	DoD QSM Version 5.3

111.345	016	Perfluorooctanoic Acid (PFOA)	DoD QSM Version 5.3
111.345	017	Perfluorooctane Sulfonic Acid (PFOS)	DoD QSM Version 5.3
111.345	018	Perfluorooctane Sulfonamide (PFOSAm)	DoD QSM Version 5.3
111.345	019	Perfluoropentanoic Acid (PFPeA)	DoD QSM Version 5.3
111.345	020	Perfluoropentane Sulfonic Acid (PFPeS)	DoD QSM Version 5.3
111.345	021	Perfluorotetradecanoic Acid (PFTA)	DoD QSM Version 5.3
111.345	022	Perfluorotridecanoic Acid (PFTrDA)	DoD QSM Version 5.3
111.345	023	Perfluoroundecanoic Acid (PFUnDA)	DoD QSM Version 5.3
111.345	024	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	DoD QSM Version 5.3
111.345	025	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	DoD QSM Version 5.3
111.345	026	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	DoD QSM Version 5.3
111.345	027	N-Ethylperfluorooctane Sulfonamide (EtFOSAm)	DoD QSM Version 5.3
111.345	028	N-Ethylperfluorooctane Sulfonamido Ethanol (EtFOS	DoD QSM Version 5.3
111.345	029	10:2 Fluorotelomer Sulfonic Acid (10:2 FTS)	DoD QSM Version 5.3
111.345	030	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	DoD QSM Version 5.3
111.345	031	N-Methylperfluorooctane Sulfonamide (MeFOSAm)	DoD QSM Version 5.3
111.345	032	N-Methylperfluorooctane Sulfonamido Ethanol (MeF	DoD QSM Version 5.3
111.345	033	Perfluorohexadecanoic Acid (PFHxDA)	DoD QSM Version 5.3
111.345	034	Perfluorononane Sulfonic Acid (PFNS)	DoD QSM Version 5.3
111.345	035	Perfluorooctadecanoic Acid (PFODA)	DoD QSM Version 5.3
111.345	036	2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)	DoD QSM Version 5.3
111.345	037	2H,2H,3H,3H-Perfluorohexaanoic Acid (3:3 FTCA)	DoD QSM Version 5.3
111.345	038	2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	DoD QSM Version 5.3

Field of Testing: 114 - Inorganic Chemistry of Hazardous Waste

114.010	001	Antimony	EPA 6010 B
114.010	002	Arsenic	EPA 6010 B
114.010	003	Barium	EPA 6010 B
114.010	004	Beryllium	EPA 6010 B
114.010	005	Cadmium	EPA 6010 B
114.010	006	Chromium	EPA 6010 B
114.010	007	Cobalt	EPA 6010 B
114.010	008	Copper	EPA 6010 B
114.010	009	Lead	EPA 6010 B
114.010	010	Molybdenum	EPA 6010 B
114.010	011	Nickel	EPA 6010 B
114.010	013	Silver	EPA 6010 B
114.010	014	Thallium	EPA 6010 B
114.010	015	Vanadium	EPA 6010 B
114.010	016	Zinc	EPA 6010 B
114.020	002	Arsenic	EPA 6020
114.020	003	Barium	EPA 6020
114.020	004	Beryllium	EPA 6020

114.020	005	Cadmium	EPA 6020
114.020	006	Chromium	EPA 6020
114.020	007	Cobalt	EPA 6020
114.020	008	Copper	EPA 6020
114.020	009	Lead	EPA 6020
114.020	010	Molybdenum	EPA 6020
114.020	011	Nickel	EPA 6020
114.020	012	Selenium	EPA 6020
114.020	013	Silver	EPA 6020
114.020	014	Thallium	EPA 6020
114.020	015	Vanadium	EPA 6020
114.020	016	Zinc	EPA 6020
114.025	001	Mercury	EPA 6020 A
114.106	001	Chromium VI (Hexavalent Chromium)	EPA 7199
114.140	001	Mercury	EPA 7470 A
114.141	001	Mercury	EPA 7471 A
114.221	001	Cyanide, Total	EPA 9012 A
114.240	001	Corrosivity - pH Determination	EPA 9040 B
114.241	001	Corrosivity - pH Determination	EPA 9045 C

Field of Testing: 115 - Extraction Test of Hazardous Waste

115.020	001	Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311
115.021	001	TCLP Inorganics	EPA 1311
115.022	001	TCLP Extractables	EPA 1311
115.023	001	TCLP Volatiles	EPA 1311
115.030	001	Waste Extraction Test (WET)	CCR Chapter11, Article 5, Appendix II
115.040	001	Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312

Field of Testing: 116 - Volatile Organic Chemistry of Hazardous Waste

116.010	000	EDB and DBCP	EPA 8011
116.030	001	Gasoline Range Organics (GRO)	EPA 8015 B
116.080	000	Volatile Organic Compounds	EPA 8260 B
116.080	120	Oxygenates	EPA 8260 B

Field of Testing: 117 - Semi-volatile Organic Chemistry of Hazardous Waste

117.010	001	Diesel Range Organics (DRO)	EPA 8015 B
117.017	001	TRPH Screening	EPA 418.1
117.110	000	Extractable Organics	EPA 8270 C
117.111	071	Pesticides	EPA 8270 C
117.210	000	Organochlorine Pesticides	EPA 8081 A
117.220	000	PCBs	EPA 8082
117.250	000	Chlorinated Herbicides	EPA 8151 A
117.290	000	Per- and Polyfluorinated Alkyl Substances (PFAS)	DoD QSM Version 5.1 (or newer)

Field of Testing: 120 - Physical Properties of Hazardous Waste

120.010	001	Ignitability	EPA 1010
120.070	001	Corrosivity - pH Determination	EPA 9040 B
120.080	001	Corrosivity - pH Determination	EPA 9045 C

Field of Testing: 126 - Microbiological Methods for Ambient Water

126.003	001	Total Coliform (Enumeration)	SM 9221 B,C-2006
126.003	002	Fecal Coliform (Enumeration)	SM 9221 C,E-2006
126.003	003	E. coli (Enumeration)	SM 9221 C,F-2006
126.007	001	E. coli (Enumeration)	SM 9223 B-2004
126.009	001	Fecal Streptococci	SM 9230 B-2007
126.017	001	E. coli (Enumeration)	Colilert 18
126.019	001	Enterococci	Enterolert

OREGON

Environmental Laboratory Accreditation Program

NELAP Recognized

Babcock Laboratories, Inc.

4035

6100 Quail Valley Court

Riverside, CA 92507

IS GRANTED APPROVAL BY ORELAP UNDER THE 2009 TNI STANDARDS, TO PERFORM ANALYSES ON ENVIRONMENTAL SAMPLES IN MATRICES AS LISTED BELOW :

Air	*Drinking Water*	*Non Potable Water*	*Solids and Chem. Waste*	*Tissue*
	Chemistry	Chemistry	Chemistry	
	Microbiology	Microbiology	Toxicity Testing	
		Toxicity Testing		

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES, METHODS, ANALYTICAL TECHNIQUES, AND FIELDS OF TESTING ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

ACCREDITED STATUS DEPENDS ON SUCCESSFUL ONGOING PARTICIPATION IN THE PROGRAM AND CONTINUED COMPLIANCE WITH THE STANDARDS.

CUSTOMERS ARE URGED TO VERIFY THE LABORATORY'S CURRENT ACCREDITATION STATUS IN OREGON.

Travis Bartholomew
Oregon State Public Health Laboratory
ORELAP Program Manager
7202 NE Evergreen Parkway, Suite 100
Hillsboro, OR 97124

EFFECTIVE DATE : 12/19/2020

EXPIRATION DATE : 12/18/2021

Certificate No : 4035 - 007

OREGON

Environmental Laboratory Accreditation Program

ORELAP Fields of Accreditation

ORELAP ID: 4035

Babcock Laboratories, Inc.

EPA CODE: CA00102

6100 Quail Valley Court

Certificate: 4035 - 007

Riverside, CA 92507

Issue Date: 12/19/2020 Expiration Date: 12/18/2021

As of 12/19/2020 this list supersedes all previous lists for this certificate number.

MATRIX	Reference	Code	Analyte	Code	Description
Drinking Water	EPA 1312			10119003	Synthetic Precipitation Leaching Procedure
		1460	Synthetic Precipitation Leaching Procedure (SPLP)		
	EPA 200.2 2.8			10013204	Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements - Revision 2.8
		1424	Metals Sample Prep		
	EPA 200.7 4.4			10013806	ICP - metals
		1000	Aluminum		
		1015	Barium		
		1025	Boron		
		1030	Cadmium		
		1035	Calcium		
		1040	Chromium		
		1055	Copper		
		1760	Hardness (calc.)		
		1070	Iron		
		1075	Lead		
		1085	Magnesium		
		1090	Manganese		
		1105	Nickel		
		1125	Potassium		
		1990	Silica as SiO2		
		1150	Silver		
		1155	Sodium		
		1185	Vanadium		
		1190	Zinc		
	EPA 200.7 5			10014003	ICP - metals
		1050	Cobalt		
	EPA 200.8 5.4			10014605	Metals by ICP-MS
		1000	Aluminum		
		1005	Antimony		
		1010	Arsenic		
		1015	Barium		
		1020	Beryllium		
		1030	Cadmium		
		1040	Chromium		
		1055	Copper		
		1075	Lead		

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Drinking Water

EPA 200.8 5.4			10014809	Metals by ICP-MS
	1090	Manganese		
	1095	Mercury		
	1100	Molybdenum		
	1105	Nickel		
	1140	Selenium		
	1150	Silver		
	1165	Thallium		
	1184	Uranium (mass)		
	1185	Vanadium		
	1190	Zinc		
EPA 200.8 5.5			10014809	Metals by ICP-MS
	1050	Cobalt		
EPA 218.6			10027802	Dissolved Hexavalent Chromium by Ion Chromatography
	1045	Chromium VI		
EPA 218.7 1			10268414	Determination of Hexavalent Chromium in Drinking Water by Ion Chromatography with Post-column Derivatization and UV-VIS Spectroscopic Determination
	1045	Chromium VI		
EPA 300.0 2.1			10053200	Methods for the Determination of Inorganic Substances in Environmental Samples
	1540	Bromide		
	1575	Chloride		
	1730	Fluoride		
	1810	Nitrate as N		
	1820	Nitrate plus Nitrite as N		
	1840	Nitrite as N		
	1870	Orthophosphate as P		
	2000	Sulfate		
EPA 300.1 1.0			10275602	Determination of Inorganic Anions in Drinking Water by Ion Chromatography
	1535	Bromate		
	1540	Bromide		
	1570	Chlorate		
	1595	Chlorite		
EPA 314.0			10055400	Perchlorate in Drinking Water by Ion Chromatography
	1895	Perchlorate		
EPA 331.0 1.0			10059708	Determination of Perchlorate in Drinking Water by Liquid Chromatography Electrospray Mass Spectrometry (LC/ESI/MS)
	1895	Perchlorate		

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Drinking Water

EPA 332.0 1.0			10059742	Determination of Perchlorate in Drinking Water by Ion Chromatography and Electrospray Mass Spectrometery
	1895	Perchlorate		
EPA 351.2 2			10065404	Total Kjeldahl Nitrogen - Block Digest, Phenate
	1795	Total Kjeldahl Nitrogen (TKN)		
EPA 420.4			10080203	Phenolics, Total Recoverable by Semi-Automated Colorimetry
	1905	Total phenolics		
EPA 504.1			10082607	EDB/DBCP/TCP micro-extraction, GC/ECD
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
EPA 505 2.1			10083406	Organohalide pesticides/PCBs (Drinking Water)
	7025	Aldrin		
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	7250	Chlordane (tech.)		
	7470	Dieldrin		
	7540	Endrin		
	7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	6285	Hexachlorocyclopentadiene		
	7810	Methoxychlor		
	8870	PCBs		
	8250	Toxaphene (Chlorinated camphene)		
EPA 515.3 1			10088401	Chlorinated acids Liquid/Solid and GC/ECD
	8655	2,4,5-T		
	8545	2,4-D		
	8560	2,4-DB		
	8600	3,5-Dichlorobenzoic acid		
	8505	Acifluorfen		
	8530	Bentazon		
	8550	Dacthal (DCPA)		

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Drinking Water	EPA 515.3 1	8555	Dalapon	
		8595	Dicamba	
		8605	Dichloroprop (Dichlorprop)	
		8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	
		6605	Pentachlorophenol	
		8645	Picloram	
		8650	Silvex (2,4,5-TP)	
	EPA 524.2 4.1			10088809 Volatile Organic Compounds GC/MS Capillary Column
		5105	1,1,1,2-Tetrachloroethane	
		5185	1,1,1-Trichloro-2,2,2-trifluoroethane (Freon 113a)	
		5160	1,1,1-Trichloroethane	
		5110	1,1,2,2-Tetrachloroethane	
		5165	1,1,2-Trichloroethane	
		4630	1,1-Dichloroethane	
		4640	1,1-Dichloroethylene	
		4670	1,1-Dichloropropene	
		5150	1,2,3-Trichlorobenzene	
		5180	1,2,3-Trichloropropane	
		5155	1,2,4-Trichlorobenzene	
		5210	1,2,4-Trimethylbenzene	
		4610	1,2-Dichlorobenzene	
		4635	1,2-Dichloroethane (Ethylene dichloride)	
		4655	1,2-Dichloropropane	
		5215	1,3,5-Trimethylbenzene	
		4615	1,3-Dichlorobenzene	
		4660	1,3-Dichloropropane	
		4620	1,4-Dichlorobenzene	
		4665	2,2-Dichloropropane	
		4535	2-Chlorotoluene	
		4540	4-Chlorotoluene	
		4910	4-Isopropyltoluene (p-Cymene)	
		4995	4-Methyl-2-pentanone (MIBK)	
		4375	Benzene	
		4385	Bromobenzene	
		4390	Bromochloromethane	
		4395	Bromodichloromethane	
		4400	Bromoform	
		4450	Carbon disulfide	
		4455	Carbon tetrachloride	
		4475	Chlorobenzene	
		4575	Chlorodibromomethane	

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ORELAP ID: 4035

Babcock Laboratories, Inc.

EPA CODE: CA00102

6100 Quail Valley Court

Certificate: 4035 - 007

Riverside, CA 92507

Issue Date: 12/19/2020 Expiration Date: 12/18/2021

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Drinking Water	EPA 524.2 4.1	4485	Chloroethane (Ethyl chloride)		
		4505	Chloroform		
		4705	cis & trans-1,2-Dichloroethene		
		4645	cis-1,2-Dichloroethylene		
		4680	cis-1,3-Dichloropropene		
		4595	Dibromomethane (Methylene bromide)		
		4625	Dichlorodifluoromethane (Freon-12)		
		9375	Di-isopropylether (DIPE)		
		4765	Ethylbenzene		
		4770	Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)		
		4835	Hexachlorobutadiene		
		4900	Isopropylbenzene (Cumene)		
		5240	m+p-xylene		
		4950	Methyl bromide (Bromomethane)		
		4960	Methyl chloride (Chloromethane)		
		5000	Methyl tert-butyl ether (MTBE)		
		4975	Methylene chloride (Dichloromethane)		
		5005	Naphthalene		
		4435	n-Butylbenzene		
		5090	n-Propylbenzene		
		5250	o-Xylene		
		4440	sec-Butylbenzene		
		5100	Styrene		
		4370	T-amylmethylether (TAME)		
		4420	tert-Butyl alcohol		
		4445	tert-Butylbenzene		
		5115	Tetrachloroethylene (Perchloroethylene)		
		5140	Toluene		
		5205	Total trihalomethanes		
		4700	trans-1,2-Dichloroethylene		
		4685	trans-1,3-Dichloropropylene		
		5170	Trichloroethene (Trichloroethylene)		
		5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
		5235	Vinyl chloride		
		5260	Xylene (total)		
	EPA 525.2 2			10090003	Semi-Volatile by SPE extraction and GC/MS
		5500	Acenaphthene		
		5505	Acenaphthylene		
		7005	Alachlor		
		5555	Anthracene		
		7065	Atrazine		

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Drinking Water

EPA 525.2 2			
	5575	Benzo(a)anthracene	
	5580	Benzo(a)pyrene	
	5600	Benzo(k)fluoranthene	
	5585	Benzo[b]fluoranthene	
	6062	bis(2-Ethylhexyl)adipate	
	7130	Bromacil	
	7160	Butachlor	
	5670	Butyl benzyl phthalate	
	5855	Chrysene	
	6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	
	5895	Dibenz(a,h) anthracene	
	6070	Diethyl phthalate	
	6135	Dimethyl phthalate	
	5925	Di-n-butyl phthalate	
	6200	Di-n-octyl phthalate	
	6265	Fluoranthene	
	6270	Fluorene	
	6315	Indeno(1,2,3-cd) pyrene	
	7835	Metolachlor	
	7845	Metribuzin	
	7875	Molinate	
	5005	Naphthalene	
	6615	Phenanthrene	
	8035	Prometon	
	6665	Pyrene	
	8125	Simazine	
EPA 531.2 1		10091302	Carbamate Pesticides by Post-column Derivitization HPLC/Fluorescence
	7710	3-Hydroxycarbofuran	
	7010	Aldicarb (Temik)	
	7015	Aldicarb sulfone	
	7020	Aldicarb sulfoxide	
	7195	Carbaryl (Sevin)	
	7205	Carbofuran (Furaden)	
	7800	Methiocarb (Mesurol)	
	7805	Methomyl (Lannate)	
	7940	Oxamyl	
	8080	Propoxur (Baygon)	

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Drinking Water	EPA 533		10091619	Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Istope Dilution Anion Exchange Soid Phase Extraction and Liquid Chromotography/Tandem Mass Spectrometry
	9490	11-chloreicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)		
	6951	4,8-dioxa-3H-perfluorononanoic acid (ADONA)		
	6946	4:2 Fluorotelomersulfonic acid (4:2 FTS)		
	6947	6:2 Fluorotelomersulfonic acid		
	6948	8:2 Fluorotelomersulfonic acid (8:2 FTS)		
	6952	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	6956	Nonfluoro-3,6-dioxaheptanoic acid (NFDHA)		
	6957	Perfluoro(2-ethoxyethane) sulfonic acid (PFEESA)		
	6965	Perfluoro-3-methoxypropanoic acid (PFMPA)		
	6966	Perfluoro-4-methoxybutanoic acid (PFMBA)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6915	Perfluorobutanoic acid (PFBA)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6906	Perfluorononanoic acid (PFNA)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6934	Perfluoropentane sulfonic acid (PFPeS)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
	EPA 537.1 1.0		10091642	Per- and Polyfluorinated Alkyl Substances in Drinking Water by LC/MS/MS
	9490	11-chloreicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)		
	6951	4,8-dioxa-3H-perfluorononanoic acid (ADONA)		
	6952	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)		

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EPA 537.1 1.0	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)		
	6911	Perfluorobutane Sulfonate (PFBS)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6910	Perfluorohexane sulfonate (PFHxS)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6906	Perfluorononanoic acid (PFNA)		
	6909	Perfluorooctane sulfonate (PFOS)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6902	Perfluorotetradecanoic acid (PFTA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
EPA 544 1.0			10091697	Determination of Microsystins and Nodularin in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)
	7517	Microcystin-LA (MC-LA)		
	7519	Microcystin-LF (MC-LF)		
	7523	Microcystin-LR (MC-LR)		
	7524	Microcystin-LY (MC-LY)		
	7526	Microcystin-RR (MC-RR)		
	7528	Microcystin-YR (MC-YR)		
	7529	Nodularin-R (NOD)		
EPA 545			10991711	Cylindrospermopsin and Anatoxin-a in Drinking Water by Liquid Chromatography Electrospray Ionization Tandem Mass SpectrometryLC/ESI-MS/MS
	7038	Anatoxin-a		
	7039	Cylindrospermopsin		
EPA 546			10019724	Determination of Total Microcystins and Nodularins in Drinking Water and Ambient Water by Adda Enzyme-Linked Immunosorbent Assay
	7523	Microcystin-LR (MC-LR)		

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EPA 546	7529	Nodularin-R (NOD)		
	8049	Total Microcystin		
EPA 547			10092009	Glyphosate by Direct Aqueous Injection by Post-column Derivitization and HPLC/Fluorescence
	9411	Glyphosate		
EPA 548.1 1			10092805	Endothall by Ion Exchange, Methylation and GC/MS
	7525	Endothall		
EPA 552.3 1			10239608	Haloacetic Acid/Dalapon, Microextraction, Derivitization and GC/ECD
	9312	Bromoacetic acid		
	9315	Bromochloroacetic acid		
	8535	Bromodichloroacetic acid(BDCAA)		
	9336	Chloroacetic acid		
	9339	Chlorodibromoacetic acid(CDBAA)		
	9357	Dibromoacetic acid		
	9360	Dichloroacetic acid		
	9414	Total haloacetic acids		
	9639	Tribromoacetic acid (TBAA)		
	9642	Trichloroacetic acid		
OIA 1677 OIA 1677			60031405	Available Cyanide by FIA, Ligand Exchange and Amperometry
	1523	Available Cyanide		
ORDEQ DEQ18 -LAB-0050-MTH 1.0			90019800	Oregon DEQ - Determination of Cyanotoxins in Raw and Finished Water by ELISA Method
	7039	Cylindrospermopsin		
OTHER CPI International ColiTag OTHER CPI International ColiTag			60030004	Chromogenic/Fluorogenic Qualitative (Colitag®): Total Coliform and E. coli
	2525	Escherichia coli		
	2500	Total coliforms		
SM 2120 B-93 online			20039207	Color by Visual Comparison Method
	1605	Color		
SM 2130 B-2001			20048219	Turbidity by Nephelometric Method
	2055	Turbidity		
SM 2130 B-94 online			20042802	Turbidity by Nephelometric Method
	2055	Turbidity		
SM 2150 B 21st ED			20043601	Odor by Threshold Odor Test
	1855	Odor		
SM 2320 B-97 SM 2320 B-97			20045607	Alkalinity by Titration Method
	1505	Alkalinity as CaCO3		

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SM 2340 B-97 SM 2340 B-97			20046600	Hardness by calculation
	1550	Calcium hardness as CaCO3		
	1750	Hardness		
	1755	Total hardness as CaCO3		
SM 2510 B 22nd Ed			20048413	Conductivity by Probe
	1610	Conductivity		
SM 2510 B-97 SM 2510 B-97			20048606	Conductivity by Probe
	1610	Conductivity		
SM 2540 C 22nd Ed			20050424	Total Dissolved Solids Dried at 180 deg C
	1955	Residue-filterable (TDS)		
SM 2540 D-2011			20051212	Total Suspended Solids Dried at 103 - 105 C
	1960	Residue-nonfilterable (TSS)		
SM 2540 G-1997 SM 2540 G-1997			20005269	Total, Fixed, and Volatile Solids in Solid and Semisolid Samples
	1725	Total, fixed, and volatile residue		
SM 3112 B 19th ED			20057403	Mercury by Cold Vapor Atomic Absorption Spectrometry
	1095	Mercury		
SM 4500-Cl G-2000 online			20081612	Chlorine (Residual) by DPD Colorimetric Determination
	1945	Residual free chlorine		
	1940	Total residual chlorine		
SM 4500-Cl G-93 online			20081601	Chlorine by DPD Colorimetric Method
	1945	Residual free chlorine		
	1940	Total residual chlorine		
SM 4500-ClO2 D 20th ED			20088806	Chlorine Dioxide by DPD Method
	1590	Chlorine dioxide, res. disinfectant		
SM 4500-CN^- E-97 online			20096406	Cyanide by Colorimetric Method
	1635	Cyanide		
SM 4500-CN^- G-97 online			20097205	Cyanide by Cyanides Amenable to Chlorination after Distillation
	1510	Amenable cyanide		
SM 4500-CN^- I-97 online			20098004	Cyanide by Weak Acid Dissociable Cyanide
	2074	Weak Acid Dissociable Cyanide		
SM 4500-F^- C-97 online			20102403	Fluoride by Ion-Selective Electrode Method
	1730	Fluoride		
SM 4500-H+ B-2000 online			20105219	pH Value by Electrometric Method .
	1900	pH		

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SM 4500-NH3 G-97 online			20111404	Ammonia by Automated Phenate Method
	1515	Ammonia as N		
SM 4500-NH3 H-97 online			20112203	Ammonia by Flow Injection Analysis
	1515	Ammonia as N		
SM 4500-NO_2^- B-2000 online			20113104	Nitrite by Colorimetric Determination
	1835	Nitrite		
	1840	Nitrite as N		
SM 4500-P E-1999			20124214	Phosphorous by Ascorbic Acid Method
	1870	Orthophosphate as P		
	1910	Phosphorus, total		
SM 4500-P E-97 online			20124203	Phosphorus by Ascorbic Acid Method
	1870	Orthophosphate as P		
	1910	Phosphorus, total		
SM 5310 B-2000			20137819	Total Organic Carbon (TOC) by Combustion Infra-red Method
	1710	Dissolved organic carbon (DOC)		
	2040	Total organic carbon		
SM 5310 B-96 online			20137808	TOC by High-Temperature Combustion Method
	1710	Dissolved organic carbon (DOC)		
	2040	Total organic carbon		
SM 5540 C-93 online			20145000	Surfactants by Anionic Surfactants as MBAS
	2025	Surfactants - MBAS		
SM 5910 B 20th ED			20146003	UV absorbing organic constituents
	2060	UV 254		
SM 5910 B-2011 2011			20146412	UV-Absorbing Organic Constituents - Ultraviolet Absorption Method
	2060	UV 254		
SM 6251 B-94 online			20149206	Haloacetic acid (HAAs) by Micro Liquid-Liquid Extraction Gas Chromatographic Method
	9312	Bromoacetic acid		
	9315	Bromochloroacetic acid		
	9336	Chloroacetic acid		
	9357	Dibromoacetic acid		
	9360	Dichloroacetic acid		
	9414	Total haloacetic acids		
	9642	Trichloroacetic acid		
SM 9215 B (PCA)-94 online			20181606	Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria
	2555	Heterotrophic plate count		

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Drinking Water	SM 9221 B (LTB) + E (EC) + C MPN-94 online			20189008	Multiple Tube Fermentation Quantitative (LTB/EC MUG): Total Coliform and Fecal coliform
		2525	Escherichia coli		
		2530	Fecal coliforms		
		2500	Total coliforms		
	SM 9223 B (Colilert Quanti-Tray)-2004 22nd Ed			20211614	Enzyme Substrate Coliform Test (Colilert Quanti-Tray)
		2525	Escherichia coli		
		2500	Total coliforms		
	SM 9223 B (Colilert®-18)-97 online			20214602	Chromogenic/Fluorogenic Qualitative (Colilert®-18)-97: Total Coliform and E. coli
		2525	Escherichia coli		
		2500	Total coliforms		
	SM 9230 B (NaCl) 20th ED			20216200	Multiple Tube Fermentation Quantitative: Enterococci
		2520	Enterococci		
	SM 9230 B (PSE) 20th ED			20217203	Multiple Tube Fermentation Quantitative: Fecal Streptococci
		2540	Fecal streptococci		
	SM 9230 D Enterolert SM 9230 D Enterolert			20219709	Fluorogenic Quantitative (Enterolert): Enterococci
		2520	Enterococci		
Non-Potable Water					
	CA Title 22 WET CA Title 22 WET			90017235	CA Waste Extraction Test (WET)
		8031	Extraction/Preparation		
	EPA 1010			10116606	Pensky-Martens Closed-Cup Method for Determining Ignitability
		1780	Ignitability		
	EPA 1311			10118806	Toxicity Characteristic Leaching Procedure
		1466	Toxicity Characteristic Leaching Procedure (TCLP)		
	EPA 1312			10119003	Synthetic Precipitation Leaching Procedure
		1460	Synthetic Precipitation Leaching Procedure (SPLP)		
	EPA 160.4			10010409	Total Volatile Solids, ignition @ 550 C.
		1947	Residue - Fixed		
		1970	Residue-volatile		
		2056	Volatile Dissolved Solids		
	EPA 160.4			10256801	Total Volatile Solids, ignition @ 550 C.
		1970	Residue-volatile		
		4075	Vol. residue, density, water & solids content of coatings		

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Non-Potable Water

EPA 1664B EPA 1664B			10261617	N-Hexane Extractable Material (Oil and Grease) by Extraction and Gravimetry
	1803	n-Hexane Extractable Material (O&G)		
	1860	Oil & Grease		
EPA 1664B (SGT-HEM) EPA 1664B (SGT-HEM)			10260628	Silica Gel Treated n-Hexane Extractable Material (Oil & Grease)
	1803	n-Hexane Extractable Material (O&G)		
	1860	Oil & Grease		
EPA 200.2 2.8			10013204	Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements - Revision 2.8
	1424	Metals Sample Prep		
EPA 200.7 4.4			10013806	ICP - metals
	1000	Aluminum		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1760	Hardness (calc.)		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1990	Silica as SiO2		
	1145	Silicon		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 200.8 5.5			10014809	Metals by ICP-MS
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		

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EPA 200.8 5.5				
	1020	Beryllium		
	1030	Cadmium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1075	Lead		
	1090	Manganese		
	1095	Mercury		
	1100	Molybdenum		
	1105	Nickel		
	1140	Selenium		
	1150	Silver		
	1165	Thallium		
	1175	Tin		
	1185	Vanadium		
	1190	Zinc		
EPA 218.6			10027802	Dissolved Hexavalent Chromium by Ion Chromatography
	1045	Chromium VI		
EPA 218.7 1			10268414	Determination of Hexavalent Chromium in Drinking Water by Ion Chromatography with Post-column Derivatization and UV-VIS Spectroscopic Determination
	1045	Chromium VI		
EPA 300.0 2.1			10053200	Methods for the Determination of Inorganic Substances in Environmental Samples
	1540	Bromide		
	1575	Chloride		
	1730	Fluoride		
	1810	Nitrate as N		
	1820	Nitrate plus Nitrite as N		
	1820	Nitrate plus Nitrite as N		
	1840	Nitrite as N		
	1870	Orthophosphate as P		
	2000	Sulfate		
EPA 300.1 1.0			10275602	Determination of Inorganic Anions in Drinking Water by Ion Chromatography
	1535	Bromate		
	1540	Bromide		
	1570	Chlorate		
	1595	Chlorite		
EPA 314.0			10055400	Perchlorate in Drinking Water by Ion Chromatography
	1895	Perchlorate		

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Non-Potable Water

EPA 331.0 1.0			10059708	Determination of Perchlorate in Drinking Water by Liquid Chromatography Electrospray Mass Spectrometry (LC/ESI/MS)
	1895	Perchlorate		
EPA 332.0 1.0			10059742	Determination of Perchlorate in Drinking Water by Ion Chromatography and Electrospray Mass Spectrometery
	1895	Perchlorate		
EPA 3500C			10137403	Organic Extraction and sample preparation
	8031	Extraction/Preparation		
EPA 351.2			10065006	Total Kjeldahl Nitrogen - Block Digest, Phenate
	1795	Total Kjeldahl Nitrogen (TKN)		
EPA 3510C			10138202	Separatory Funnel Liquid-liquid extraction
	1444	Seperatory Funnel Liquid-Liquid Extraction		
EPA 3511			10279808	Organic Compounds in Water by Microextraction
	7538	Organic Compounds in Water by Microextraction		
EPA 3520C			10139001	Continuous Liquid-liquid extraction
	1410	Continuous Liquid-Liquid Extraction		
EPA 3600C			10144000	Cleanup
	8031	Extraction/Preparation		
EPA 3620C			10146006	Florisil Cleanup
	1414	Florisil Clean-up		
EPA 3660B			10148400	Sulfur cleanup
	1456	Sulfur Clean-up		
EPA 3665A			10148808	Sulfuric Acid / permanganate Cleanup
	1458	Sulfuric Acid / Permanganate Clean-Up		
EPA 418.1			10079002	Petroleum Hydrocarbons - Spec. Infrared.
	2050	Total Petroleum Hydrocarbons (TPH)		
EPA 420.4			10080203	Phenolics, Total Recoverable by Semi-Automated Colorimetry
	1905	Total phenolics		
EPA 531.2 1			10091302	Carbamate Pesticides by Post-column Derivitization HPLC/Fluorescence
	7710	3-Hydroxycarbofuran		
	7010	Aldicarb (Temik)		
	7015	Aldicarb sulfone		
	7020	Aldicarb sulfoxide		
	7195	Carbaryl (Sevin)		

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EPA 531.2 1	7205	Carbofuran (Furaden)	
	7800	Methiocarb (Mesurol)	
	7805	Methomyl (Lannate)	
	7940	Oxamyl	
	8080	Propoxur (Baygon)	
EPA 533			10091619 Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Istope Dilution Anion Exchange Soid Phase Extraction and Liquid Chromotography/Tandem Mass Spectrometry
	9490	11-chloreicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	
	6951	4,8-dioxa-3H-perfluorononanoic acid (ADONA)	
	6946	4:2 Fluorotelomersulfonic acid (4:2 FTS)	
	6947	6:2 Fluorotelomersulfonic acid	
	6948	8:2 Fluorotelomersulfonic acid (8:2 FTS)	
	6952	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)	
	6956	Nonfluoro-3,6-dioxaheptanoic acid (NFDHA)	
	6957	Perfluoro(2-ethoxyethane) sulfonic acid (PFEESA)	
	6965	Perfluoro-3-methoxypropanoic acid (PFMPA)	
	6966	Perfluoro-4-methoxybutanoic acid (PFMBA)	
	6918	Perfluorobutane sulfonic acid (PFBS)	
	6915	Perfluorobutanoic acid (PFBA)	
	6905	Perfluorodecanoic acid (PFDA)	
	6903	Perfluorododecanoic acid (PFDoA)	
	9470	Perfluoroheptane sulfonic acid (PFHpS)	
	6908	Perfluoroheptanoic acid (PFHpA)	
	6927	Perfluorohexane sulfonic acid (PFHxS)	
	6913	Perfluorohexanoic acid (PFHxA)	
	6906	Perfluorononanoic acid (PFNA)	
	6931	Perfluorooctane sulfonic acid (PFOS)	
	6912	Perfluorooctanoic acid (PFOA)	
	6934	Perfluoropentane sulfonic acid (PFPeS)	
	6914	Perfluoropentanoic acid (PFPeA)	
	6904	Perfluoroundecanoic acid (PFUnA)	

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Non-Potable Water	EPA 537.1 1.0			10091642	Per- and Polyfluorinated Alkyl Substances in Drinking Water by LC/MS/MS
		9490	11-chloreicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)		
		6951	4,8-dioxa-3H-perfluorononanoic acid (ADONA)		
		6952	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)		
		9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
		9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
		4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
		4847	N-Methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)		
		6911	Perfluorobutane Sulfonate (PFBS)		
		6918	Perfluorobutane sulfonic acid (PFBS)		
		6905	Perfluorodecanoic acid (PFDA)		
		6903	Perfluorododecanoic acid (PFDoA)		
		6908	Perfluoroheptanoic acid (PFHpA)		
		6910	Perfluorohexane sulfonate (PFHxS)		
		6927	Perfluorohexane sulfonic acid (PFHxS)		
		6913	Perfluorohexanoic acid (PFHxA)		
		6906	Perfluorononanoic acid (PFNA)		
		6909	Perfluorooctane sulfonate (PFOS)		
		6931	Perfluorooctane sulfonic acid (PFOS)		
		6912	Perfluorooctanoic acid (PFOA)		
		6902	Perfluorotetradecanoic acid (PFTA)		
		9563	Perfluorotridecanoic acid (PFTrDA)		
		6904	Perfluoroundecanoic acid (PFUnA)		
	EPA 544 1.0			10091697	Determination of Microsystins and Nodularin in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)
		7517	Microcystin-LA (MC-LA)		
		7519	Microcystin-LF (MC-LF)		
		7523	Microcystin-LR (MC-LR)		
		7524	Microcystin-LY (MC-LY)		
		7526	Microcystin-RR (MC-RR)		
		7528	Microcystin-YR (MC-YR)		
		7529	Nodularin-R (NOD)		

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EPA 545			10991711	Cylindrospermopsin and Anatoxin-a in Drinking Water by Liquid Chromatography Electrospray Ionization Tandem Mass SpectrometryLC/ESI-MS/MS
	7038	Anatoxin-a		
	7039	Cylindrospermopsin		
EPA 546			10019724	Determination of Total Microcystins and Nodularins in Drinking Water and Ambient Water by Adda Enzyme-Linked Immunosorbent Assay
	7523	Microcystin-LR (MC-LR)		
	7529	Nodularin-R (NOD)		
	8049	Total Microcystin		
EPA 6010B			10155609	ICP - AES
	1000	Aluminum		
	1005	Antimony		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1760	Hardness (calc.)		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1910	Phosphorus, total		
	1125	Potassium		
	1990	Silica as SiO2		
	1145	Silicon		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 6020			10156000	Inductively Coupled Plasma-Mass Spectrometry
	1000	Aluminum		

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Non-Potable Water	EPA 6020	1005	Antimony		
		1010	Arsenic		
		1015	Barium		
		1020	Beryllium		
		1030	Cadmium		
		1040	Chromium		
		1050	Cobalt		
		1055	Copper		
		1075	Lead		
		1090	Manganese		
		1095	Mercury		
		1100	Molybdenum		
		1105	Nickel		
		1140	Selenium		
		1150	Silver		
		1165	Thallium		
		1175	Tin		
		1185	Vanadium		
		1190	Zinc		
	EPA 6020A 1			10156419	Inductively Coupled Plasma -Mass Spectrometry
		1095	Mercury		
	EPA 608.3 GC-ECD			10296614	Organochlorine Pesticides and PCBs by GC/ECD
		7355	4,4'-DDD		
		7360	4,4'-DDE		
		7365	4,4'-DDT		
		7025	Aldrin		
		7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
		8880	Aroclor-1016 (PCB-1016)		
		8885	Aroclor-1221 (PCB-1221)		
		8890	Aroclor-1232 (PCB-1232)		
		8895	Aroclor-1242 (PCB-1242)		
		8900	Aroclor-1248 (PCB-1248)		
		8905	Aroclor-1254 (PCB-1254)		
		8910	Aroclor-1260 (PCB-1260)		
		7115	beta-BHC (beta-Hexachlorocyclohexane)		
		7250	Chlordane (tech.)		
		7105	delta-BHC		
		7470	Dieldrin		
		7510	Endosulfan I		
		7515	Endosulfan II		
		7520	Endosulfan sulfate		

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Non-Potable Water	EPA 608.3 GC-ECD	7540	Endrin	
		7530	Endrin aldehyde	
		7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	
		7685	Heptachlor	
		7690	Heptachlor epoxide	
		7810	Methoxychlor	
		8250	Toxaphene (Chlorinated camphene)	
	EPA 624.1			10298121 Purgeables by GC/MS
		5160	1,1,1-Trichloroethane	
		5110	1,1,2,2-Tetrachloroethane	
		5165	1,1,2-Trichloroethane	
		4630	1,1-Dichloroethane	
		4640	1,1-Dichloroethylene	
		4610	1,2-Dichlorobenzene	
		4635	1,2-Dichloroethane (Ethylene dichloride)	
		4655	1,2-Dichloropropane	
		4615	1,3-Dichlorobenzene	
		4675	1,3-Dichloropropene	
		4620	1,4-Dichlorobenzene	
		4500	2-Chloroethyl vinyl ether	
		4320	Acetonitrile	
		4325	Acrolein (Propenal)	
		4375	Benzene	
		4395	Bromodichloromethane	
		4397	Bromoethane (Ethyl Bromide)	
		4400	Bromoform	
		4455	Carbon tetrachloride	
		4475	Chlorobenzene	
		4485	Chloroethane (Ethyl chloride)	
		4505	Chloroform	
		4680	cis-1,3-Dichloropropene	
		4625	Dichlorodifluoromethane (Freon-12)	
		4765	Ethylbenzene	
		5000	Methyl tert-butyl ether (MTBE)	
		4975	Methylene chloride (Dichloromethane)	
		5115	Tetrachloroethylene (Perchloroethylene)	
		5140	Toluene	
		4700	trans-1,2-Dichloroethylene	
		4685	trans-1,3-Dichloropropylene	
		5170	Trichloroethene (Trichloroethylene)	
		5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	
		5235	Vinyl chloride	

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EPA 624.1	5260	Xylene (total)		
EPA 625.1			10300024	Base/Neutrals and Acids by GC/MS
	5155	1,2,4-Trichlorobenzene		
	4610	1,2-Dichlorobenzene		
	6220	1,2-Diphenylhydrazine		
	4615	1,3-Dichlorobenzene		
	4620	1,4-Dichlorobenzene		
	5790	1-Chloronaphthalene		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	6835	2,4,5-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)		
	6490	2-Nitrophenol		
	5945	3,3'-Dichlorobenzidine		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		
	5825	4-Chlorophenyl phenylether		
	6500	4-Nitrophenol		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	5555	Anthracene		
	5595	Benzidine		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5590	Benzo(g,h,i)perylene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	5760	bis(2-Chloroethoxy)methane		

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Non-Potable Water	EPA 625.1	5765	bis(2-Chloroethyl) ether		
		5670	Butyl benzyl phthalate		
		5855	Chrysene		
		7105	delta-BHC		
		6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)		
		5895	Dibenz(a,h) anthracene		
		7470	Dieldrin		
		6070	Diethyl phthalate		
		6135	Dimethyl phthalate		
		5925	Di-n-butyl phthalate		
		6200	Di-n-octyl phthalate		
		7510	Endosulfan I		
		7515	Endosulfan II		
		7520	Endosulfan sulfate		
		7540	Endrin		
		6265	Fluoranthene		
		6270	Fluorene		
		7685	Heptachlor		
		7690	Heptachlor epoxide		
		6275	Hexachlorobenzene		
		4835	Hexachlorobutadiene		
		6285	Hexachlorocyclopentadiene		
		4840	Hexachloroethane		
		6315	Indeno(1,2,3-cd) pyrene		
		6320	Isophorone		
		7810	Methoxychlor		
		5005	Naphthalene		
		5015	Nitrobenzene		
		6545	n-Nitrosodi-n-propylamine		
		6535	n-Nitrosodiphenylamine		
		6550	n-Nitrosomethylethylamine		
		6605	Pentachlorophenol		
		6610	Phenacetin		
		6615	Phenanthrene		
		6625	Phenol		
		6665	Pyrene		
	EPA 6860			10304800	Perchlorate in Water, Soils and Solid Wastes Using Ion Chromatography/Electrospray Ionization/Mass Spectrometry
		1895	Perchlorate		

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EPA 7199			10163005	Determination of Hexavalent Chromium in Drinking Water, Groundwater and Industrial Wastewater Effluents by Ion Chromatography
	1045	Chromium VI		
EPA 7470A			10165807	Mercury in Liquid Waste by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 7471A			10166208	Mercury in Solid Waste by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 8011			10173009	1,2-Dibromoethane and 1,2-Dibromo-3-chloropropane by Microextraction and GC/ECD
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
	4580	Dibromochloropropane		
EPA 8015B			10173601	Non-halogenated organics using GC/FID
	9369	Diesel range organics (DRO)		
	9408	Gasoline range organics (GRO)		
	9506	Residual Range Organics (RRO)		
EPA 8081A			10178606	Organochlorine Pesticides by GC/ECD
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		
	7530	Endrin aldehyde		
	7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	7810	Methoxychlor		
	8250	Toxaphene (Chlorinated camphene)		

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EPA 8082A			10179201	Polychlorinated Biphenyls (PCBs) by GC/ECD
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	9105	Decachlorobiphenyl (BZ-209)		
EPA 8151A			10183207	Chlorinated Herbicides by GC/ECD
	8655	2,4,5-T		
	8545	2,4-D		
	8560	2,4-DB		
	8600	3,5-Dichlorobenzoic acid		
	8530	Bentazon		
	8550	Dacthal (DCPA)		
	8555	Dalapon		
	8595	Dicamba		
	8605	Dichloroprop (Dichlorprop)		
	8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)		
	6605	Pentachlorophenol		
	8645	Picloram		
	8650	Silvex (2,4,5-TP)		
EPA 8260B			10184802	Volatile Organic Compounds by purge and trap GC/MS
	5105	1,1,1,2-Tetrachloroethane		
	5160	1,1,1-Trichloroethane		
	5110	1,1,2,2-Tetrachloroethane		
	5165	1,1,2-Trichloroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	4670	1,1-Dichloropropene		
	5150	1,2,3-Trichlorobenzene		
	5180	1,2,3-Trichloropropane		
	5155	1,2,4-Trichlorobenzene		
	5210	1,2,4-Trimethylbenzene		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
	4610	1,2-Dichlorobenzene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4655	1,2-Dichloropropane		

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Non-Potable Water	EPA 8260B	5215	1,3,5-Trimethylbenzene
		4615	1,3-Dichlorobenzene
		4660	1,3-Dichloropropane
		4620	1,4-Dichlorobenzene
		4665	2,2-Dichloropropane
		4410	2-Butanone (Methyl ethyl ketone, MEK)
		4500	2-Chloroethyl vinyl ether
		4535	2-Chlorotoluene
		4860	2-Hexanone (MBK)
		4540	4-Chlorotoluene
		4910	4-Isopropyltoluene (p-Cymene)
		4995	4-Methyl-2-pentanone (MIBK)
		4315	Acetone
		4375	Benzene
		4385	Bromobenzene
		4390	Bromochloromethane
		4395	Bromodichloromethane
		4400	Bromoform
		4450	Carbon disulfide
		4455	Carbon tetrachloride
		4475	Chlorobenzene
		4575	Chlorodibromomethane
		4485	Chloroethane (Ethyl chloride)
		4505	Chloroform
		4705	cis & trans-1,2-Dichloroethene
		4645	cis-1,2-Dichloroethylene
		4680	cis-1,3-Dichloropropene
		4595	Dibromomethane (Methylene bromide)
		4625	Dichlorodifluoromethane (Freon-12)
		9375	Di-isopropylether (DIPE)
		4765	Ethylbenzene
		4770	Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)
		4835	Hexachlorobutadiene
		4900	Isopropylbenzene (Cumene)
		5240	m+p-xylene
		4950	Methyl bromide (Bromomethane)
		4960	Methyl chloride (Chloromethane)
		5000	Methyl tert-butyl ether (MTBE)
		4975	Methylene chloride (Dichloromethane)
		5005	Naphthalene
		4435	n-Butylbenzene
		5090	n-Propylbenzene
		5250	o-Xylene

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EPA 8260B				
	4440	sec-Butylbenzene		
	5100	Styrene		
	4370	T-amylmethylether (TAME)		
	4420	tert-Butyl alcohol		
	4445	tert-Butylbenzene		
	5115	Tetrachloroethylene (Perchloroethylene)		
	5140	Toluene		
	4700	trans-1,2-Dichloroethylene		
	4685	trans-1,3-Dichloropropylene		
	5170	Trichloroethene (Trichloroethylene)		
	5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
	5235	Vinyl chloride		
	5260	Xylene (total)		
EPA 8270C			10185805	Semivolatile Organic compounds by GC/MS
	5155	1,2,4-Trichlorobenzene		
	4610	1,2-Dichlorobenzene		
	4615	1,3-Dichlorobenzene		
	4620	1,4-Dichlorobenzene		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6005	2,6-Dichlorophenol		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)		
	6385	2-Methylnaphthalene		
	6400	2-Methylphenol (o-Cresol)		
	6490	2-Nitrophenol		
	6412	3 & 4 Methylphenol		
	5945	3,3'-Dichlorobenzidine		
	6465	3-Nitroaniline		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		

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Non-Potable Water	EPA 8270C	5825	4-Chlorophenyl phenylether
		6470	4-Nitroaniline
		6500	4-Nitrophenol
		5500	Acenaphthene
		5505	Acenaphthylene
		7025	Aldrin
		7110	alpha-BHC (alpha-Hexachlorocyclohexane)
		5545	Aniline
		5555	Anthracene
		7075	Azinphos-methyl (Guthion)
		5595	Benzidine
		5575	Benzo(a)anthracene
		5580	Benzo(a)pyrene
		5590	Benzo(g,h,i)perylene
		5600	Benzo(k)fluoranthene
		5585	Benzo[b]fluoranthene
		5630	Benzyl alcohol
		7115	beta-BHC (beta-Hexachlorocyclohexane)
		5760	bis(2-Chloroethoxy)methane
		5765	bis(2-Chloroethyl) ether
		5670	Butyl benzyl phthalate
		7300	Chlorpyrifos
		5855	Chrysene
		7105	delta-BHC
		7390	Demeton
		7395	Demeton-o
		7385	Demeton-s
		6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
		7410	Diazinon
		5895	Dibenz(a,h) anthracene
		5905	Dibenzofuran
		8610	Dichlorovos (DDVP, Dichlorvos)
		7470	Dieldrin
		6070	Diethyl phthalate
		7475	Dimethoate
		6135	Dimethyl phthalate
		5925	Di-n-butyl phthalate
		6200	Di-n-octyl phthalate
		8625	Disulfoton
		7510	Endosulfan I
		7515	Endosulfan II

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EPA 8270C	7520	Endosulfan sulfate		
	7540	Endrin		
	7565	Ethion		
	7570	Ethoprop		
	6265	Fluoranthene		
	6270	Fluorene		
	7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	6285	Hexachlorocyclopentadiene		
	4840	Hexachloroethane		
	6315	Indeno(1,2,3-cd) pyrene		
	6320	Isophorone		
	7740	Kepone		
	7770	Malathion		
	7810	Methoxychlor		
	7825	Methyl parathion (Parathion, methyl)		
	7870	Mirex		
	5005	Naphthalene		
	5015	Nitrobenzene		
	6530	n-Nitrosodimethylamine		
	6545	n-Nitrosodi-n-propylamine		
	6535	n-Nitrosodiphenylamine		
	7955	Parathion, ethyl		
	6605	Pentachlorophenol		
	6615	Phenanthrene		
	6625	Phenol		
	7985	Phorate		
	6665	Pyrene		
	5095	Pyridine		
	8110	Ronnel		
EPA 8270C SIM			10242407	Semivolatile Organic compounds by GC/MS Selective Ion Monitoring
	4735	1,4-Dioxane (1,4- Diethyleneoxide)		
	6530	n-Nitrosodimethylamine		
EPA 9012A			10193405	Total and Amenable Cyanide (automated colorimetric with off-line distillation)
	1510	Amenable cyanide		
	1635	Cyanide		
	1645	Total cyanide		

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EPA 9040B			10197203	pH Electrometric Measurement
	1900	pH		
EPA 9040C			10244403	pH Electrometric Measurement
	1900	pH		
EPA 9045C			10198400	Soil and Waste pH
	1900	pH		
EPA 9214			10206403	Potentiometric Determination of Fluoride in Aqueous Samples with Ion-Selective Electrode
	1730	Fluoride		
ESB SOP T758 3.0			60039136	Babcock Laboratories - PFAS by LC/MS/MS
	9490	11-chloreicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)		
	9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)		
	9340	2H,2H,3H,3H-Perfluorodecanoic acid (7:3 FTCA)		
	9338	2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA)		
	9353	4,4,5,5,6,6-Heptafluorohexanoic acid (3:3 FTCA)		
	6951	4,8-dioxa-3H-perfluorononanoic acid (ADONA)		
	6952	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)		
	6911	Perfluorobutane Sulfonate (PFBS)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6923	Perfluorododecane sulfonic acid (PFDoS)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6910	Perfluorohexane sulfonate (PFHxS)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6906	Perfluorononanoic acid (PFNA)		

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ESB SOP T758 3.0	6909	Perfluorooctane sulfonate (PFOS)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6902	Perfluorotetradecanoic acid (PFTA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
	6899	Potassium perfluoro-4-ethylcyclohexanesulfonate (PFecHS)		
	6898	Sodium perfluoro-1-propanesulfonate (PFPrS)		
OIA 1677 OIA 1677	1523	Available Cyanide	60031405	Available Cyanide by FIA, Ligand Exchange and Amperometry
ORDEQ DEQ18-LAB-0050-MTH 1.0	7039	Cylindrospermopsin	90019800	Oregon DEQ - Determination of Cyanotoxins in Raw and Finished Water by ELISA Method
SM 2120 B-2011	1605	Color	20039310	Color
SM 2120 B-93 online	1605	Color	20039207	Color by Visual Comparison Method
SM 2130 B-2011	2055	Turbidity	20048220	Turbidity by Nephelometric Method
SM 2130 B-94 online	2055	Turbidity	20042802	Turbidity by Nephelometric Method
SM 2150 B 22nd Ed	1855	Odor	20043612	Odor - Threshold Odor Test
SM 2320 B 22nd Ed	1505	Alkalinity as CaCO3	20045414	Alkalinity by Titration
SM 2320 B-2011 online	1505	Alkalinity as CaCO3	20045618	Alkalinity as CaCO3
SM 2340 B-97 1997	1550	Calcium hardness as CaCO3	20046600	Hardness by calculation
	1750	Hardness		
SM 2510 B 22nd Ed	1610	Conductivity	20048413	Conductivity by Probe
SM 2510 B-2011	1610	Conductivity	20048617	Conductivity by Probe
SM 2540 B-2011 2011	1950	Residue-total	20049416	Total Solids Dried at 103 - 105C

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SM 2540 B-97 1997			20049405	Total Solids Dried at 103 - 105C
	1950	Residue-total		
SM 2540 C 22nd Ed			20050424	Total Dissolved Solids Dried at 180 deg C
	1955	Residue-filterable (TDS)		
SM 2540 C-2011 online			20050413	Residue-filterable (TDS)
	1955	Residue-filterable (TDS)		
SM 2540 D-2011			20051212	Total Suspended Solids Dried at 103 - 105 C
	1960	Residue-nonfilterable (TSS)		
SM 2540 E-1997			20051585	Fixed & Volatile Solids Ignited at 550 C
	1725	Total, fixed, and volatile residue		
SM 2540 E-2011 2011			20051596	Fixed & Volatile Solids Ignited at 550 C
	1947	Residue - Fixed		
	1725	Total, fixed, and volatile residue		
SM 2540 F-2011			20052215	Settleable Solids
	1965	Residue-settleable		
SM 2540 F-97 online			20052204	Settleable Solids
	1965	Residue-settleable		
SM 2540 G-1997 online			20005269	Total, Fixed, and Volatile Solids in Solid and Semisolid Samples
	1725	Total, fixed, and volatile residue		
SM 3112 B 19th ED			20057403	Mercury by Cold Vapor Atomic Absorption Spectrometry
	1095	Mercury		
SM 4500-Cl G-2011 22nd ED			20081623	Chlorine (Residual) by DPD Colorimetric Method
	1945	Residual free chlorine		
	1940	Total residual chlorine		
SM 4500-Cl G-93 online			20081601	Chlorine by DPD Colorimetric Method
	1945	Residual free chlorine		
	1940	Total residual chlorine		
SM 4500-CN E-2011 2011			20096428	Cyanide by Colormetric Method
	1635	Cyanide		
SM 4500-CN⁻ E-97 online			20096406	Cyanide by Colorimetric Method
	1635	Cyanide		
SM 4500-CN⁻ G 22nd ED			20097012	Cyanide - Cyanides Amenable to Chlorination after Distillation
	1510	Amenable cyanide		
SM 4500-CN⁻ G-97 online			20097205	Cyanide by Cyanides Amenable to Chlorination after Distillation
	1510	Amenable cyanide		

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SM 4500-CN⁻ I-97 online			20098004	Cyanide by Weak Acid Dissociable Cyanide
	2074	Weak Acid Dissociable Cyanide		
SM 4500-F⁻ C-2011 online			20102414	Fluoride by Ion Selective Electrode
	1730	Fluoride		
SM 4500-F⁻ C-97 online			20102403	Fluoride by Ion-Selective Electrode Method
	1730	Fluoride		
SM 4500-H+ B-2000 online			20105219	pH Value by Electrometric Method .
	1900	pH		
SM 4500-H+ B-2011			20105220	pH - Electrometric Measurement
	1900	pH		
SM 4500-NH3 G-2011			20111415	Nitrogen (Ammonia) - Automated Phenate Method
	1515	Ammonia as N		
SM 4500-NH3 G-97 online			20111404	Ammonia by Automated Phenate Method
	1515	Ammonia as N		
SM 4500-NH3 H-97 online			20112203	Ammonia by Flow Injection Analysis
	1515	Ammonia as N		
SM 4500-NO2 B-2011 online			20113115	Nitrite as N
	1840	Nitrite as N		
SM 4500-NO2⁻ B-2000 online			20113104	Nitrite by Colorimetric Determination
	1835	Nitrite		
	1840	Nitrite as N		
SM 4500-O G-2011 22nd ED			20121668	Dissolved Oxygen by Membrane Electrode
	1880	Oxygen, dissolved		
SM 4500-P B4-2011 online			20123415	Phosphorus Digestion with Sulfuric Acid - Nitric Acid
	1910	Phosphorus, total		
SM 4500-P E-2011			20124225	Phosphorus by Ascorbic Acid Method
	1870	Orthophosphate as P		
SM 4500-P E-97 online			20124203	Phosphorus by Ascorbic Acid Method
	1870	Orthophosphate as P		
	1910	Phosphorus, total		
SM 4500-S2⁻ D-2011 online			20125864	Sulfide by Methylene Blue Method
	2005	Sulfide		
SM 4500-S2⁻ D-97 online			20125808	Sulfide by Methylene Blue Method
	2005	Sulfide		

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SM 5210 B-2001 online			20135255	Biochemical Oxygen Demand (BOD), 5-Day
	1530	Biochemical oxygen demand		
	1555	Carbonaceous BOD, CBOD		
SM 5210 B-2011 online			20135266	Biochemical Oxygen Demand (5 days @ 20 C).
	1530	Biochemical oxygen demand		
	1555	Carbonaceous BOD, CBOD		
SM 5220 B-2011			20135391	Chemical Oxygen Demand (COD) - Open Reflux Method
	1565	Chemical oxygen demand		
SM 5220 D-97 online			20136805	COD by Closed Reflux, Colorimetric Method
	1565	Chemical oxygen demand		
SM 5310 B-2011 2011			20137820	TOC by High-Temperature Combustion Method
	1710	Dissolved organic carbon (DOC)		
	2040	Total organic carbon		
SM 5310 B-96 online			20137808	TOC by High-Temperature Combustion Method
	1710	Dissolved organic carbon (DOC)		
	2040	Total organic carbon		
SM 5540 C-2011			20145066	Surfactants as MBAS
	2025	Surfactants - MBAS		
SM 5540 C-93 online			20145000	Surfactants by Anionic Surfactants as MBAS
	2025	Surfactants - MBAS		
SM 5910 B 20th ED			20146003	UV absorbing organic constituents
	2060	UV 254		
SM 9215 B (PCA)-94 online			20181606	Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria
	2555	Heterotrophic plate count		
SM 9221 B (LTB) + C MPN-94 online			20187206	Multiple Tube Fermentation Quantitative (LTB): Total Coliform
	2500	Total coliforms		
SM 9221 B (LTB) + E (EC) + C MPN-94 online			20189008	Multiple Tube Fermentation Quantitative (LTB/EC MUG): Total Coliform and Fecal coliform
	2525	Escherichia coli		
	2530	Fecal coliforms		
	2500	Total coliforms		
SM 9221 B (LTB) + F (EC MUG) + C MPN-94 online			20190801	Multiple Tube Fermentation Quantitative (LTB/EC MUG): E. Coli
	2525	Escherichia coli		

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Non-Potable Water	SM 9223 B (Colilert Quanti-Tray)-2004 22nd Ed	2525	Escherichia coli	20211614	Enzyme Substrate Coliform Test (Colilert Quanti-Tray)
		2500	Total coliforms		
	SM 9230 B (NaCl) 20th ED	2520	Enterococci	20216200	Multiple Tube Fermentation Quantitative: Enterococci
	SM 9230 B (NaCl) 21st ED	2520	Enterococci	20216404	Multiple Tube Fermentation Quantitative: Enterococci
	SM 9230 B (PSE) 20th ED	2540	Fecal streptococci	20217203	Multiple Tube Fermentation Quantitative: Fecal Streptococci
	SM 9230 D 23rd Ed	2520	Enterococci	20219685	Fluorogenic Quantitative (Enterolert): Enterococci
Solids					
	ASTM D7511-09 ASTM D7511-09	1645	Total cyanide	30032985	Total Cyanide by Segmented Flow Injection: In-line UV Digestion & Ampermetric Detection
	CA Title 22 WET	1407	California Waste Extraction Test	90017235	CA Waste Extraction Test (WET)
	EPA 1010	1780	Ignitability	10116606	Pensky-Martens Closed-Cup Method for Determining Ignitability
	EPA 1311	1466	Toxicity Characteristic Leaching Procedure (TCLP)	10118806	Toxicity Characteristic Leaching Procedure
	EPA 1312	1460	Synthetic Precipitation Leaching Procedure (SPLP)	10119003	Synthetic Precipitation Leaching Procedure
	EPA 200.2 2.8	1424	Metals Sample Prep	10013204	Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements - Revision 2.8
	EPA 300.0 2.1	1575	Chloride	10053200	Methods for the Determination of Inorganic Substances in Environmental Samples
		1730	Fluoride		
		1810	Nitrate as N		
		1820	Nitrate plus Nitrite as N		
		1820	Nitrate plus Nitrite as N		
		1840	Nitrite as N		
		2000	Sulfate		

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Solids

EPA 3050B			10135601	Acid Digestion of Sediments, Sludges, and soils
	1400	Acid Digestion of Solids		
EPA 3051A			10136002	Microwave Assisted Acid Digestion of Sediments, Sludges, Soils, and Oils
	1426	Microwave Digestion of Solids		
EPA 3052			10136206	Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices
	1433	Microwave Digestion of Solids (HNO3 + HCL)		
EPA 331.0 1.0			10059708	Determination of Perchlorate in Drinking Water by Liquid Chromatography Electrospray Mass Spectrometry (LC/ESI/MS)
	1895	Perchlorate		
EPA 332.0 1.0			10059742	Determination of Perchlorate in Drinking Water by Ion Chromatography and Electrospray Mass Spectrometery
	1895	Perchlorate		
EPA 3500C			10137403	Organic Extraction and sample preparation
	8031	Extraction/Preparation		
EPA 3546			10141205	Microwave Extraction
	1428	Microwave Extraction		
EPA 3550C			10142004	Ultrasonic Extraction
	1468	Ultrasonic Extraction		
EPA 3580A			10143007	Waste Dilution
	1470	Waste Dilution		
EPA 3600C			10144000	Cleanup
	8031	Extraction/Preparation		
EPA 3620C			10146006	Florisil Cleanup
	1414	Florisil Clean-up		
EPA 3660B			10148400	Sulfur cleanup
	1456	Sulfur Clean-up		
EPA 3665A			10148808	Sulfuric Acid / permanganate Cleanup
	1458	Sulfuric Acid / Permanganate Clean-Up		
EPA 418.1			10079002	Petroleum Hydrocarbons - Spec. Infrared.
	2050	Total Petroleum Hydrocarbons (TPH)		
EPA 6010B			10155609	ICP - AES
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		

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Solids	EPA 6010B	1020	Beryllium	
		1023	Bismuth	
		1025	Boron	
		1030	Cadmium	
		1035	Calcium	
		1550	Calcium hardness as CaCO3	
		1040	Chromium	
		1050	Cobalt	
		1055	Copper	
		1057	Gallium	
		1060	Gold	
		1760	Hardness (calc.)	
		1063	Indium	
		1075	Lead	
		1080	Lithium	
		1085	Magnesium	
		1100	Molybdenum	
		1105	Nickel	
		1990	Silica as SiO2	
		1145	Silicon	
		1150	Silver	
		2017	Sulfur	
		1165	Thallium	
		1175	Tin	
		1180	Titanium	
		1755	Total hardness as CaCO3	
		1183	Tungsten	
		1184	Uranium (mass)	
		1185	Vanadium	
		1190	Zinc	
		1192	Zirconium	
	EPA 6020			10156000 Inductively Coupled Plasma-Mass Spectrometry
		1005	Antimony	
		1010	Arsenic	
		1015	Barium	
		1020	Beryllium	
		1030	Cadmium	
		1040	Chromium	
		1050	Cobalt	
		1055	Copper	
		1075	Lead	
		1100	Molybdenum	
		1105	Nickel	

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EPA 6020			10156419	Inductively Coupled Plasma -Mass Spectrometry
	1140	Selenium		
	1150	Silver		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 6020A 1			10156419	Inductively Coupled Plasma -Mass Spectrometry
	1095	Mercury		
EPA 6860			10304800	Perchlorate in Water, Soils and Solid Wastes Using Ion Chromatography/Electrospray Ionization/Mass Spectrometry
	1895	Perchlorate		
EPA 7471A			10166208	Mercury in Solid Waste by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 8015B			10173601	Non-halogenated organics using GC/FID
	9369	Diesel range organics (DRO)		
	9408	Gasoline range organics (GRO)		
	9506	Residual Range Organics (RRO)		
EPA 8081A			10178606	Organochlorine Pesticides by GC/ECD
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		
	7530	Endrin aldehyde		
	7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	7810	Methoxychlor		
	8250	Toxaphene (Chlorinated camphene)		

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Environmental Laboratory Accreditation Program

ORELAP Fields of Accreditation

ORELAP ID: 4035

Babcock Laboratories, Inc.

EPA CODE: CA00102

6100 Quail Valley Court

Certificate: 4035 - 007

Riverside, CA 92507

Issue Date: 12/19/2020 Expiration Date: 12/18/2021

As of 12/19/2020 this list supersedes all previous lists for this certificate number.

Solids

EPA 8082			10179007	Polychlorinated Biphenyls (PCBs) by GC/ECD
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	9105	Decachlorobiphenyl (BZ-209)		
EPA 8082A			10179201	Polychlorinated Biphenyls (PCBs) by GC/ECD
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	9105	Decachlorobiphenyl (BZ-209)		
EPA 8151A			10183207	Chlorinated Herbicides by GC/ECD
	8655	2,4,5-T		
	8545	2,4-D		
	8560	2,4-DB		
	8555	Dalapon		
	8595	Dicamba		
	8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)		
	6605	Pentachlorophenol		
	8650	Silvex (2,4,5-TP)		
EPA 8260B			10184802	Volatile Organic Compounds by purge and trap GC/MS
	5105	1,1,1,2-Tetrachloroethane		
	5160	1,1,1-Trichloroethane		
	5110	1,1,2,2-Tetrachloroethane		
	5165	1,1,2-Trichloroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	4670	1,1-Dichloropropene		
	5150	1,2,3-Trichlorobenzene		
	5180	1,2,3-Trichloropropane		
	5155	1,2,4-Trichlorobenzene		
	5210	1,2,4-Trimethylbenzene		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		

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Solids	EPA 8260B	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
		4610	1,2-Dichlorobenzene
		4635	1,2-Dichloroethane (Ethylene dichloride)
		4655	1,2-Dichloropropane
		5215	1,3,5-Trimethylbenzene
		4615	1,3-Dichlorobenzene
		4660	1,3-Dichloropropane
		4620	1,4-Dichlorobenzene
		4665	2,2-Dichloropropane
		4410	2-Butanone (Methyl ethyl ketone, MEK)
		4500	2-Chloroethyl vinyl ether
		4535	2-Chlorotoluene
		4860	2-Hexanone (MBK)
		4540	4-Chlorotoluene
		4910	4-Isopropyltoluene (p-Cymene)
		4995	4-Methyl-2-pentanone (MIBK)
		4315	Acetone
		4375	Benzene
		4385	Bromobenzene
		4390	Bromochloromethane
		4395	Bromodichloromethane
		4400	Bromoform
		4450	Carbon disulfide
		4455	Carbon tetrachloride
		4475	Chlorobenzene
		4575	Chlorodibromomethane
		4485	Chloroethane (Ethyl chloride)
		4505	Chloroform
		4705	cis & trans-1,2-Dichloroethene
		4645	cis-1,2-Dichloroethylene
		4680	cis-1,3-Dichloropropene
		4595	Dibromomethane (Methylene bromide)
		4625	Dichlorodifluoromethane (Freon-12)
		9375	Di-isopropylether (DIPE)
		4765	Ethylbenzene
		4770	Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)
		4835	Hexachlorobutadiene
		4900	Isopropylbenzene (Cumene)
		5240	m+p-xylene
		4950	Methyl bromide (Bromomethane)
		4960	Methyl chloride (Chloromethane)
		5000	Methyl tert-butyl ether (MTBE)

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Solids	EPA 8260B	4975	Methylene chloride (Dichloromethane)	
		4435	n-Butylbenzene	
		5090	n-Propylbenzene	
		5250	o-Xylene	
		4440	sec-Butylbenzene	
		5100	Styrene	
		4370	T-amylmethylether (TAME)	
		4420	tert-Butyl alcohol	
		4445	tert-Butylbenzene	
		5115	Tetrachloroethylene (Perchloroethylene)	
		5140	Toluene	
		4700	trans-1,2-Dichloroethylene	
		4685	trans-1,3-Dichloropropylene	
		5170	Trichloroethene (Trichloroethylene)	
		5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	
		5235	Vinyl chloride	
		5260	Xylene (total)	
	EPA 8270C			10185805 Semivolatile Organic compounds by GC/MS
		5155	1,2,4-Trichlorobenzene	
		4610	1,2-Dichlorobenzene	
		4615	1,3-Dichlorobenzene	
		4620	1,4-Dichlorobenzene	
		4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether	
		6835	2,4,5-Trichlorophenol	
		6840	2,4,6-Trichlorophenol	
		6000	2,4-Dichlorophenol	
		6130	2,4-Dimethylphenol	
		6175	2,4-Dinitrophenol	
		6185	2,4-Dinitrotoluene (2,4-DNT)	
		6190	2,6-Dinitrotoluene (2,6-DNT)	
		5795	2-Chloronaphthalene	
		5800	2-Chlorophenol	
		6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	
		6385	2-Methylnaphthalene	
		6400	2-Methylphenol (o-Cresol)	
		6460	2-Nitroaniline	
		6490	2-Nitrophenol	
		6412	3 & 4 Methylphenol	
		5945	3,3'-Dichlorobenzidine	
		6465	3-Nitroaniline	
		7355	4,4'-DDD	

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Solids EPA 8270C

7360	4,4'-DDE
7365	4,4'-DDT
5660	4-Bromophenyl phenyl ether (BDE-3)
5700	4-Chloro-3-methylphenol
5825	4-Chlorophenyl phenylether
6470	4-Nitroaniline
6500	4-Nitrophenol
5500	Acenaphthene
5505	Acenaphthylene
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
5545	Aniline
5555	Anthracene
7075	Azinphos-methyl (Guthion)
5595	Benzidine
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5630	Benzyl alcohol
7115	beta-BHC (beta-Hexachlorocyclohexane)
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5670	Butyl benzyl phthalate
7300	Chlorpyrifos
5855	Chrysene
7105	delta-BHC
7390	Demeton
7395	Demeton-o
7385	Demeton-s
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7410	Diazinon
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
8610	Dichlorovos (DDVP, Dichlorvos)
7470	Dieldrin
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate

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Solids	EPA 8270C	6200	Di-n-octyl phthalate		
		8625	Disulfoton		
		7510	Endosulfan I		
		7515	Endosulfan II		
		7520	Endosulfan sulfate		
		7540	Endrin		
		7565	Ethion		
		7570	Ethoprop		
		6265	Fluoranthene		
		6270	Fluorene		
		7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)		
		7685	Heptachlor		
		7690	Heptachlor epoxide		
		6275	Hexachlorobenzene		
		4835	Hexachlorobutadiene		
		6285	Hexachlorocyclopentadiene		
		4840	Hexachloroethane		
		6315	Indeno(1,2,3-cd) pyrene		
		6320	Isophorone		
		7740	Kepone		
		7770	Malathion		
		7810	Methoxychlor		
		7825	Methyl parathion (Parathion, methyl)		
		7870	Mirex		
		5005	Naphthalene		
		5015	Nitrobenzene		
		6530	n-Nitrosodimethylamine		
		6545	n-Nitrosodi-n-propylamine		
		6535	n-Nitrosodiphenylamine		
		7955	Parathion, ethyl		
		6605	Pentachlorophenol		
		6615	Phenanthrene		
		6625	Phenol		
		7985	Phorate		
		6665	Pyrene		
		5095	Pyridine		
		8110	Ronnel		
	EPA 9012A			10193405	Total and Amenable Cyanide (automated colorimetric with off-line distillation)
		1635	Cyanide		
		1645	Total cyanide		

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Solids

EPA 9045C			10198400	Soil and Waste pH
	1900	pH		
EPA 9056			10199005	Determination of Inorganic Anions by Ion Chromatography
	1575	Chloride		
	1730	Fluoride		
	1805	Nitrate		
	1835	Nitrite		
	2000	Sulfate		
EPA 9214			10206403	Potentiometric Determination of Fluoride in Aqueous Samples with Ion-Selective Electrode
	1730	Fluoride		
ESB SOP T758 3.0			60039136	Babcock Laboratories - PFAS by LC/MS/MS
	9490	11-chloreicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)		
	9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)		
	9340	2H,2H,3H,3H-Perfluorodecanoic acid (7:3 FTCA)		
	9338	2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA)		
	9353	4,4,5,5,6,6-Heptafluorohexanoic acid (3:3 FTCA)		
	6951	4,8-dioxa-3H-perfluorononanoic acid (ADONA)		
	6952	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)		
	6911	Perfluorobutane Sulfonate (PFBS)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6923	Perfluorododecane sulfonic acid (PFDoS)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6910	Perfluorohexane sulfonate (PFHxS)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		

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Solids	ESB SOP T758 3.0	6906	Perfluorononanoic acid (PFNA)		
		6909	Perfluorooctane sulfonate (PFOS)		
		6931	Perfluorooctane sulfonic acid (PFOS)		
		6912	Perfluorooctanoic acid (PFOA)		
		6902	Perfluorotetradecanoic acid (PFTA)		
		9563	Perfluorotridecanoic acid (PFTrDA)		
		6904	Perfluoroundecanoic acid (PFUnA)		
		6899	Potassium perfluoro-4-ethylcyclohexanesulfonate (PFecHS)		
		6898	Sodium perfluoro-1-propanesulfonate (PFPrS)		
	SM 2540 G-1997 SM 2540 G-1997	1725	Total, fixed, and volatile residue	20005269	Total, Fixed, and Volatile Solids in Solid and Semisolid Samples

CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Babcock Laboratories, Inc.
6100 Quail Valley Ct.
Riverside, CA 92507

Fulfills the requirements of

ISO/IEC 17025:2017

and the

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V5.3)

In the field of

TESTING

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 04 December 2021
Certificate Number: ADE-2825

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017 AND U.S. DEPARTMENT OF DEFENSE (DOD) QUALITY SYSTEMS MANUAL FOR ENVIRONMENTAL LABORATORIES (DOD QSM V5.3)

Babcock Laboratories, Inc.
6100 Quail Valley Ct.
Riverside, CA 92507
Stacey Fry
951-653-3351x 238

TESTING

Valid to: **December 4, 2021** Certificate Number: **ADE-2825**

Environmental

Non Potable Water		
Technology	**Specification, Standard, Method, or Test Technique**	**Analyte**
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Hexafluoropropylene oxide dimer acid (HFPO-DA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-ethyl perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorododecanoic Acid (PFDoDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoroheptanoic Acid (PFHpA)

Non Potable Water		
Technology	**Specification, Standard, Method, or Test Technique**	**Analyte**
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorononanoic Acic (PFNA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorooctanesulfonic Acid (PFOS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorotetradecanoic Acid (PFTeDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic Acid
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	9-chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	4,8-dioxa-3H-perfluorononanoic Acid (ADONA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoropentanoic acid (PFPeA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoropentanesulfonic acid (PFPeS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorononanesulfonic acid (PFNS)

Non Potable Water		
Technology	**Specification, Standard, Method, or Test Technique**	**Analyte**
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorodecanesulfonic acid (PFDS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	4:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	6:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	10:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorooctadecanoic Acid (PFOcDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctane sulfamidoethanol (EtFOSE)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctane sulfamidoethanol (MeFOSE)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctane sulfonamide (MeFOSA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctane Sulfonamide (EtFOSA)

Non Potable Water		
Technology	**Specification, Standard, Method, or Test Technique**	**Analyte**
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorohexadecanoic Acid (PFHxDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorooctane Sulfonamide (PFOSA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)
Preparation	**Specification, Standard, Method, or Test Technique**	**Type**
Extraction	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Solid Phase Extraction (SPE)

Solid and Chemical Materials		
Technology	**Specification, Standard, Method, or Test Technique**	**Analyte**
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Hexafluoropropylene oxide dimer acid (HFPO-DA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-ethyl perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorododecanoic Acid (PFDoDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorononanoic Acic (PFNA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorooctanesulfonic Acid (PFOS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorotetradecanoic Acid (PFTeDA)

Solid and Chemical Materials		
Technology	**Specification, Standard, Method, or Test Technique**	**Analyte**
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic Acid
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	9-chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	4,8-dioxa-3H-perfluorononanoic Acid (ADONA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoropentanoic acid (PFPeA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoropentanesulfonic acid (PFPeS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorononanesulfonic acid (PFNS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorodecanesulfonic acid (PFDS)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	4:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	6:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	10:2 Fluorotelomer Sulfonate

Solid and Chemical Materials		
Technology	**Specification, Standard, Method, or Test Technique**	**Analyte**
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorooctadecanoic Acid (PFOcDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctane sulfamidoethanol (EtFOSE)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctane sulfamidoethanol (MeFOSE)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctane sulfonamide (MeFOSA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctane Sulfonamide (EtFOSA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorohexadecanoic Acid (PFHxDA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Perfluorooctane Sulfonamide (PFOSA)
LC/MS/MS	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)
Preparation	**Specification, Standard, Method, or Test Technique**	**Type**
Extraction	PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15	Solid Phase Extraction (SPE)

Drinking Water		
Technology	**Specification, Standard, Method, or Test Technique**	**Analyte**
LC/MS/MS	EPA Method 537.1	Hexafluoropropylene oxide dimer acid (HFPO-DA)
LC/MS/MS	EPA Method 537.1	N-ethyl perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)
LC/MS/MS	EPA Method 537.1	N-methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)
LC/MS/MS	EPA Method 537.1	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	EPA Method 537.1	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	EPA Method 537.1	Perfluorododecanoic Acid (PFDoDA)
LC/MS/MS	EPA Method 537.1	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	EPA Method 537.1	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	EPA Method 537.1	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	EPA Method 537.1	Perfluorononanoic Acic (PFNA)
LC/MS/MS	EPA Method 537.1	Perfluorooctanesulfonic Acid (PFOS)
LC/MS/MS	EPA Method 537.1	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	EPA Method 537.1	Perfluorotetradecanoic Acid (PFTeDA)
LC/MS/MS	EPA Method 537.1	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	EPA Method 537.1	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	EPA Method 537.1	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic Acid
LC/MS/MS	EPA Method 537.1	9-chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid
LC/MS/MS	EPA Method 537.1	4,8-dioxa-3H-perfluorononanoic Acid (ADONA)

Note:
1. This scope is formatted as part of a single document including Certificate of Accreditation No. ADE-2825.

Vice President

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

BABCOCK LABORATORIES, INC.
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BIOLOGICAL

Valid To: January 31, 2022 Certificate Number: 3232.01

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the laboratory's compliance with the A2LA Food Testing Program Requirements, containing the 2018 "*AOAC International Guidelines for Laboratories Performing Microbiological and Chemical Analyses of Food, Dietary Supplements, and Pharmaceuticals"*), accreditation is granted to this laboratory to perform the following tests on bottled beverage:

Test	**Test Method**
Aerobic Plate Count (Petrifilm)	AOAC 990.12
Rapid Yeast & Mold (Petrifilm)	AOAC 2014.05
Total Coliform / *Escherichia coli* (Petrifilm)	AOAC 991.14

Accredited Laboratory

A2LA has accredited

BABCOCK LABORATORIES, INC.

Riverside, CA

for technical competence in the field of

Biological Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of A2LA *R204 – Specific Requirements – Food and Pharmaceutical Testing Laboratory Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 20th day of December 2019.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3232.01
Valid to January 31, 2022

For the tests to which this accreditation applies, please refer to the laboratory's Biological Scope of Accreditation.

Appendix F

OPEN

Appendix G

Example Sampling SOPs
Refer to Babcock Server for current versions

Appendix H

Chemistry

H.1 Method Validation

Reference methods are validated by determining the MDL/DL and RL/LOQ, and precision and bias using the procedures outlined below.

a) Method Detection Limit/Detection Limit (MDL/DL)

The Method Detection Limit/Detection Limit (MDL/DL) is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results. The laboratory primarily uses the term Minimum Detection Limit (MDL) in its day to day operations and internal documentation.

MDLs are not required for any component for which spiking solutions or quality control samples are not available, or for analyses where the study is inapplicable such as pH, color, odor, temperature, alkalinity (titration) and dissolved oxygen. For such analyses the MDL is set equal to the RL which is determined/verified by statistical evaluation of method blank data, titration glassware limitations, or other appropriate instrument or method limitations.

The laboratory will select methods with MDLs that are expected to meet the intended data use. For analytical results that will not be reported below the RL/LOQ, an initial MDL determination is required but ongoing verification is not.

MDLs are determined in samples that represent the quality system matrices to be evaluated. All sample processing, preservation, preparation steps and all determinative steps are used to validate the method for all targeted analytes. The representative quality system matrix will be free from the target analytes of interest or interfering analytes that impact the MDL.

When the method or applicable regulation specifies a specific MDL procedure, the specified method procedure will be followed. For methods which still include reference to the older MDL procedures which do not incorporate blanks, due to the robustness of this new MDL/DL procedure, the laboratory may use the most recent MDL procedures. For methods in which advances in method capabilities and instrument sensitivity, and where the use of blanks has a direct effect on the MDL, the MDL procedure per current Quality and Regulatory Standards as outlined in this document may be followed. Laboratory SOPs will reference the use of method defined procedures if applicable. The laboratory will document the process used to derive the MDL and will retain all the supporting data.

When providing compliance data under 40-CFR Part 136 or equivalent delegated state programs, the laboratory follows 40 CFR Part 136, Appendix B.

b) Determination of Initial MDL/DL

Method Detection Limit Study-A MDL study is required when validating a method on an instrument for the first time, per method or regulation and when there is a significant change in the test method or instrument type. The initial MDL is used for methods being analyzed for the first time or if there is not enough on-going in house data to perform the annual Ongoing Verification.

Unless following a mandated test method or analytical procedure, the laboratory uses the following procedure and guidelines to determine the initial MDL/DL for each applicable method.

- The MDL study must be performed to represent current instrument conditions.
- Samples analyzed to complete the study must be prepared and analyzed following all method procedures, including preservation.
- To begin the study the initial MDL value may be estimated using one of the following options:
    a. Method prescribed level
    b. Current determined MDL (MDL as noted in Element LIMS)
    c. Concentration equivalent to 3 times the standard deviation of replicate spikes
    d. Concentration which corresponds to an instrument signal-to-noise ratio of 3 to 5.
    e. The mean concentration plus 3 times the standard deviation of a set of method blanks.
- Once an estimated MDL is established, the spiking level at which to run the MDL study must be determined:
    a. A concentration of 2 – 10 times the estimated MDL is typically used. The laboratory currently uses low level spikes at the RL.
    b. Please note that for some poor recovering analytes, spike concentrations may need to be raised to more than 10 times in order to obtain a recovery value. Please consult Technical Director, QA or manager for guidance.
    c. Instrument limitations and/or sensitivity of calibrations at certain concentrations may also play a part in determining an appropriate spiking level. Ex: Region of standard curve where there is a significant change in sensitivity
- A minimum of seven (7) low level spikes spiked at or below the reporting limit (RL), at a method prescribed level or following one of the above options and seven (7) routine method blanks are analyzed over multiple days. Both preparation and analysis of these samples shall include at least three batches on three separate days.
    - The study is performed in a quality system matrix free of target analytes or interferences which may impact results. The study may be performed in the specific sample matrix if it is determined necessary for MDL determination.

  - If the procedure for solid and sludge matrix is identical, except for initial volume, the study is performed using solid preparation volumes. Sludge MDLs are then calculated by applying a preparation factor to the solid MDL.
  - If more than one instrument is utilized, low level spikes and blanks must be analyzed on each instrument. At least two low level spikes and two blanks must be included for each instrument to obtain the 7 data points. A minimum of one spike/blank may be performed on an instrument for methods not ran on a regular basis.
    - For methods not analyzed on a regular basis, the same 7 low level spikes and blanks may be analyzed on each instrument, over multiple calendar days.
- Spiked results utilized in the initial MDL study must be at a value above zero and meet the qualitative identification criteria noted in the method, if applicable. Method identification criteria may include signal to noise requirements, recognizable spectra, presence of qualifier ions, etc.
- In order to address any possible issues associated with blanks in the study such as false positives:
  - If all method blank results are ND-Often identified when a peak is not present in chromatographic analysis, the blank result for the study ($MDL_{b)}$ does not apply and is not included in the MDL calculation.
  - When numerical results (both positive and negative results), including results below the current MDL are obtained for all 7 (or more) blanks the MDL_b is calculated based on the mean and standard deviation of those blanks. See MDL entry spreadsheet for calculation.
  - If blank results include both ND and numerical results, the MDL_b is set to the highest result.
  - If a negative result is derived for the MDL_b the result is set to zero (0).
- A collected data point may be excluded from the study if it is due to a gross failure (instrument malfunction, known error). Rational must be documented with study data for not including the data in the calculation.
- All data is reported from the primary reporting column or detector.
- Calculated MDL results must be less than the reporting limit (RL). If the MDL is not less the RL, the MDL study will be repeated or the RL may be raised above the MDL. Lab Technical Director will be consulted for guidance as needed. In cases where the sensitivity of the method is limited this may not be scientifically valid.
- Method MDLs may be set equal to or greater than the statistically derived MDL. If method blank data, ongoing MDL verifications or per analyst judgment indicate that the statistical MDL is too low and unrealistic to measure at current method capabilities, then the MDL may be raised to a value less the reporting limit, usually 1/3 but no more than half the RL is suggested. In some cases the MDL is set equal to the RL.
- MDLs are updated and entered into the LIMS system on an ongoing basis. The RL date is changed to reflect the MDL study date. (Date last samples were analyzed for study) If an MDL modification is needed based on results of an ongoing verification, control chart data, or yearly MDL

verification study, documentation is stored electronically with the original MDL study indicated by the Element RL date.

- Instrument changes:
  - A column of a different phase constitutes a significant change.
    - A new MDL study is required unless the new column proves to be more sensitive than the original column.
    - Column sensitivity is measured by comparing the signal to noise ratio of an analyte in one RL standard analyzed on both columns. The RL standard with the higher S/N ratio demonstrates which column is more sensitive.
    - In addition to the RL standard, a blank is also prepared and analyzed. Result should be below the MDL. If not, a new MDL study may be required.
    - The MDL study is performed using both columns. The analyte MDL is set at the highest value between the two columns.
  - If an instrument is torn down and moved, a new MDL study may be required if instrument sensitivity was affected.
    - The RL standard after the move will be compared to the RL standard prior to the move.
    - Sensitivity is measured by comparing the signal to noise ratio of an analyte in one RL standard versus another. The RL standard with the higher S/N ratio demonstrates a system that is more sensitive.
    - In addition to the RL standard, a blank is also prepared and analyzed. Result should be below the MDL. If not, a new MDL study may be required.
    - If it is not as sensitive, a MDL study will be performed on the instrument once it is up and running in the new location.

*For additional DOD MDL/RL requirements see Appendix L Sec-"App H"

c) Limit of Quantitation(LOQ)/Reporting Limit(RL)

The Limit of Quantitation (LOQ)/Reporting Limit (RL) is an estimate of the minimum amount of a substance that can be reported with a specified degree of confidence. RLs are established based on analytical studies, regulation or client requirements. RLs are greater than the MDL (or equal) and consistent with client needs. The laboratory primarily uses the term Reporting Limit (RL) in its day to day operations and internal documentation.

RLs are determined in a quality system matrix, free of target analytes or interferences which may impact results. A RL is required for each matrix, technology, method and analyte. Exceptions include methods where spiking standards are not available or results cannot be quantitated such as pH, dissolved oxygen, color, odor, turbidity, temperature, etc.

d) Initial Determination of RL/LOQ

If a test method or regulation requires specific RLs or RL determination procedures, those will be followed. This initial RL procedure is used for methods being analyzed for the first time, requests for lower RLs, method development changes, etc. Unless following a mandated test method, regulation or client requirement, the laboratory uses the following procedure and guidelines to determine the initial RL for each applicable method.

- The RL study must be performed to represent current instrument conditions.
- Samples analyzed to complete the study must be prepared and analyzed following all method procedures, including preservation.
- A minimum of seven (7) low level spikes spiked at or below RL or proposed RL from at least three batches on three separate days.
    - Where applicable, the laboratory will use the same low level spikes analyzed for MDL determination and verification to perform RL determination and verification.
    - The RL must be at or above the lowest calibration standard. This does not apply to methods using a single point calibration.
    - If more than one instrument is utilized, low level spikes must be analyzed on each instrument. At least two low level spikes are prepared and analyzed on different days on each instrument.
    - If existing data is available and meets the requirements for the study, RL determination may be completed using this data as long as it is over 3 batches, represent current operations and was collected within the last 2 years.
- If the RL study meets the following requirements, the RL is verified at that level:
    - Spike results are at a value above zero and meet the qualitative identification criteria noted in the method, if applicable. Method identification criteria may include signal to noise requirements, recognizable spectra, presence of qualifier ions, etc.
    - Analyte recovery in the spiked samples is within the laboratory prescribed limits of 50-150%
    - The determined RL is greater than the MDL and equal or greater than the spiking concentration
- If the RL is less than or equal the established MDL, the RL may need to be raised. Lab Technical Director or QA will be consulted for guidance as needed.
- Where possible the initial verification of the RL is performed using the Initial MDL study. The RL is verified if the spike concentrations are less than or equal to the RL and recovery of each analyte is within the laboratory established acceptance criteria of 50%-150%. Historical data may be utilized to establish acceptance criteria for known troublesome analytes. The MDL spreadsheet used by the lab includes the RL verification following the requirements above.

- Raising the RL- Due to various analytical reasons the RL may need to be raised. Examples of when RL is raised:
    - Wet Chemistry:
        - If a sample is diluted for any reason the RL is raised to reflect the dilution.
    - Instrumentation:
        - If a sample is diluted due to a chromatographic interference that prevents peak integration, the RL is raised to reflect the dilution.
        - If a sample is diluted because it is over calibration range, the RL is raised to reflect the dilution.
        - If the above does not apply to all target analytes in one sample, report other analytes from the original injection with original reporting limits.
        - If a raw result is below the RL but rounds up to a reportable value then Element will report that result as a hit for that analyte.

*For additional DOD RL requirements see Appendix L Sec-"App H"

e) Ongoing MDL and RL Verification and Annual MDL Recalculation

Ongoing Verification of the MDL/Data Collection

For ongoing MDL verification the laboratory utilizes MRL (RL) checks and method blanks which are analyzed on an ongoing basis at varying frequencies depending on the analysis and/or frequency of analysis. A minimum of 1 verification spike (MRL check) and 1 blank are required on each instrument for each matrix, method and analyte during each quarter in which samples are being analyzed and reported below the RL. EPA requires a minimum of 2 spiked samples per quarter. See Appendix L for more details.

MRL check samples and method blanks are assessed by the laboratory at the time of analysis and prior to release of data. Results must meet the same requirements as initial MDL determination. Spiked results must be at a value above zero and meet the qualitative identification criteria noted in the method, if applicable. (See b) above) Results that do not meet this criteria will not be reported or included in MDL recalculation. The cause of the failure should be investigated and appropriate corrective action taken as needed. MRL check failure will affect batch acceptance, unless the failure is due to a known issue with MRL check (spiking error, miss-injection, etc.) that only compromised the MRL check but not the rest of the batch. See SOP T-255 Technical Corrective Action for guidance on unacceptable MRL checks.

If MRL checks do not meet criteria on a continuous basis the laboratory will assess whether the spiking level needs to be raised and the initial MDL re-determined. Following EPA guidance, if more than 5% of MRL checks do not produce results above zero and meet all method identification criteria, the spiking level should be assessed and if required, corrective action should be taken and the MDL may need to be re-determined.

Ongoing Verification of the RL

For ongoing RL verification the laboratory utilizes MRL (RL) checks which are analyzed on an ongoing basis at varying frequencies depending on the analysis and/or frequency of analysis. A minimum of 1 verification spike at the initial RL (MRL check) is required on each instrument for each matrix, method and analyte during each quarter in which samples are being analyzed.

MRL check samples are evaluated by the laboratory at the time of analysis and prior to release of data. Results of the MRL check must be at a value above the MDL, meet the qualitative identification criteria noted in the method or SOP, if applicable (See b) above) and fall within the laboratory established acceptance criteria. Criteria of 50-150% recovery is followed for most analyses. For difficult or poor responding analytes, historical limits based on control charting may be used to determine the acceptance criteria.

If these requirements are not met the RL verification is not acceptable and corrective action is required. The cause of the failure should be investigated and appropriate corrective action taken. Corrective actions must be documented and include technically valid reason for the actions taken. Corrective actions taken must be performed by one of the following options:

- Correct instrument or method performance then repeat verification test-reanalyze MRL check sample
- Evaluate the laboratory established control limits to ensure they represent current performance.
- Raise the spiking level and repeat the verification at the new spiking level within 30 days of the initial failure. Please see technical manager or QA for guidance for this option since RL value may be affected.
- The manager, technical manager or QA deems the unacceptable result as a gross error or anomaly not representative of the actual analytical batch and the validity of client sample results were not affected.

If none of the above options address a failing RL verification for a batch, the batch will be re-analyzed or the samples reported with appropriate qualifier(s). Manager, technical managers or QA should be consulted for guidance if this situation arises and before reported results.

Annual MDL Assessment and Recalculation

At least once per calendar year all results obtained from the ongoing verification samples (blanks and MRL checks) for MDL and RL are tabulated and reviewed. All data collected within the last two years, that is representative of current operations shall be used. Results associated with documented incidents of gross failure such as instrument malfunction, compromised sample containers, mislabeled samples, etc. may be excluded. The rationale for the exclusion of any data point is documented and maintained with the MDL annual assessment study. Data collection should begin after the initial MDL study is completed. Data results used to determine the initial MDL must be included in the annual recalculation if

they were collected within the last 24 months. A minimum of 7 blanks and 7 low level spikes (MRL checks) are required to perform the annual assessment.

Blanks and MRL check samples analyzed and verified throughout the year by the laboratory are included in analytical batches and easily identified. Blanks and verification samples which did not pass criteria or those included on a batch that was rejected are not included in the annual verification. Laboratory bench sheets/batches and corresponding analytical data document the preparation and analytical methods used, dates of preparation and analysis, batch numbers, instrument/equipment, matrix, technology, analyte, concentration of spike amount and the results obtained for each verification sample.

The tabulated data is reviewed for each analyte in a test method, if applicable. All blanks and MRL data points obtained under current operations are used to recalculate the MDL. If more than one instrument is used data is included from all instruments. The following is documented with the recalculation: percent recovery, number of results (n), the mean and standard deviation of the percent recovery, and the spike concentration of the spiked samples including units. As a result of this study, the MDL_s and MDL_b are recalculated for each analyte using the same calculation used to determine the initial MDL.

The recalculated MDL is compared to the existing MDL. If the recalculated MDL obtained is within 0.5 to 2.0 times the existing MDL and less than 3% of the method blank results for each analyte have a result above the existing MDL, the existing MDL is verified. The laboratory has the option of changing the MDL to the newly calculated value or keep the existing MDL. Whether the MDL is changed is based on method, analyte performance, recovery, analyst input, etc. The date of the MDL will remain the date of the original MDL study unless the MDL is changed to a new value. If the recalculated MDL does not meet the criteria noted above, the MDL is changed to the new value. In this instance the MDL date would be set to the date the last verification sample included in the study was analyzed.

f) Precision and Bias

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms.

Bias is the systematic error that contributes to the difference between the mean of a significant number of test results and the accepted reference value.

Precision and bias using non-reference, modified reference or laboratory-developed methods are established using the IDOC procedure outlined below and compared to the criteria established by the client (when requested), the method, or the laboratory.

Precision and bias are determined by processing samples through all phases of the method (sample preparation, cleanup, analysis, etc.) for each analyte of interest and are evaluated across the analytical calibration range of the method. This study is performed for all quality system matrices for which the test is to be used.

d) Selectivity

Selectivity is the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances (EPA-QAD).

The laboratory evaluates selectivity through procedures defined in the test method SOPs for example: mass spectral tuning, second column confirmation, ICP inter-element interference checks, chromatography retention time windows, sample blanks, spectrochemical absorption or fluorescence profiles, co-precipitation evaluations, and electrode response factors.

*For DOD specific confirmation column requirements see Appendix L Sec-"App H"

H.2 Demonstration of Capability

Demonstration of Capability (DOC): A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.

Before reporting any data with a given method, a satisfactory DOC is performed. Thereafter, each analyst demonstrates continuing proficiency through the procedures outlined in Ongoing Demonstration of Capability.

a) Initial Demonstration of Capability (IDOC)

An IDOC is performed:

- Before independent preparation and/or analysis of any method

- If the laboratory or analysts has not performed the method in a twelve-month period and
- Each time there is a change in instrument type, personnel or method.
    - A column of a different phase constitutes a significant change. A new demonstration study is required.
    - A change in detector or method revision/modification will require a new demonstration study.
    - A second instrument of the same type does not require a new study.

The IDOC(s) for each analyst is documented electronically on the Babcock Server. The document identifies the analyst(s) involved in preparation and/or analysis; matrix; analyte(s), class of analyte(s), or measured parameter(s); the method(s) performed; the laboratory-specific SOP used for analysis (including revision number); the date(s) of analysis; and a summary of the results used to calculate the mean recovery and standard deviations.

All raw data, preparation records, and calculations for each IDOC are retained and are available for review.

When the method specifies a procedure to be followed as documented in each test method SOP, only those procedures will be used. If no procedures are specified the study is completed as follows:

The study is completed by the analysis of at least four replicates of a QC sample diluted in a clean quality system matrix at a concentration specified in the analytical SOP, prepared and analyzed according to the method either concurrently or over a period of days. This is accomplished for most analyses by analysis of four replicates of a QC sample made at a concentration between 10 times the MDL and the midpoint of the calibration curve or one to four times the RL. Replicate results must be within QC acceptance criteria. If analytes do not lend themselves to spiking, QC or PT samples are used.

An analyst may exclude a data point from the study as long as it is proven to be a statistical outlier. This is determined using the Grubbs Test. A 95% confidence level is used to determine if a data point may be rejected. The analyst must document this proof with the raw data.

For chromatography, newer studies require data from both columns if applicable. Older studies may include data tabulated from the primary column only.

Results are compared to acceptance ranges specified in the SOP. If limits for specific analytes are not found in the determinative method, acceptance criteria may be taken from limits provided by historical review of QC data recoveries or use Performance Testing Studies criteria as guidance. The analyst must successfully complete the study prior to analysis of client samples. All work performed during the training period, prior to a successful IDoC, must be co-initialed by the trainer. Please see SOP G-200 Employee Training Procedure for details on co-initialing.

When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst shall repeat the test for all parameters that failed to meet criteria. Repeated failure, however, confirms a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest. When an analyte not currently found on the laboratory's list of accredited analytes is added to an existing accredited method, an initial demonstration shall be performed for that analyte.

b) Ongoing Demonstration of Capability

After the demonstration of capability is completed, on-going proficiency is maintained and demonstrated at least annually. Each analyst is expected to consistently meet the QC requirements of the method, the laboratory SOP, client requirements and/or the TNI Standard. Ongoing DOCS are documented electronically on the Babcock server and all records related to the demonstration are retained.

The laboratory uses the following procedure to demonstrate ongoing DOC:

On an annual basis, each analyst must complete a Demonstration of Continuing Proficiency for every certified analytical procedure performed that year unless they have performed an IDoC that year.
The demonstration may consist of one of the following:

- Valid LCS data from four consecutive LCS samples-These can be ran at the same time or selected from Element Control Charts
    - LCS percent recovery must meet laboratory prescribed acceptance criteria for precision and accuracy.
    - LCS data is tabulated either manually, by use of control chart data, or using the Element.
    - Precision data is readily retrievable by calculation, using results tabulated from the above mentioned documents. Relative standard deviation between the four replicates must be less than or equal to 20% for Inorganic analyses or 40% for Organic analyses (allowing for one marginal exceedance if applicable).
- Results from a successful Proficiency Testing Study.

Note: Successful analysis of a blind performance sample on a similar method using the same technology (e.g., GC/MS volatiles by purge and trap for Methods 524.2, 624 or 5030/8260) would only require documentation for one of the tests.

- Successful analysis of a blind performance sample
- Perform another initial IDOC
- If one of the above is not practical, the analysis of authentic samples that have been analyzed by another trained analyst with statistically indistinguishable results.

H.3 Calibration

Section 23.2.2 includes information on calibration of support equipment. This Section covers calibration of analytical equipment.

Initial instrument calibration and continuing instrument calibration verification are an important part of ensuring data of known and documented quality. If more stringent calibration requirements are included in a mandated method or by regulation, those calibration requirements override any requirements outlined here or in laboratory SOPs. Generally, procedures and criteria regarding instrument calibrations are provided in technical test method SOPs.

H.3.1 Initial Instrument Calibration

Initial calibrations are performed daily, as needed or when continuing calibration checks are out of the control limits as specified by the method or SOP.

- Records:

  Initial instrument calibration including calculations, integrations, acceptance criteria, and associated statistics are referenced in the test method SOP.

  All reported analytes and surrogates (if applicable) are included in the initial calibration.

  Sufficient raw data records are collected to allow reconstruction of the initial instrument calibration. These include, at a minimum, calibration date, test method, instrument, analysis date, analyte names, analysts signature or initials, concentration and response, calibration curve or response factor, or unique equation or coefficient used to reduce instrument responses to concentration. Calibration date and expiration date (when recalibration is due) is documented for equipment requiring calibration, where practicable (see Section 23.1).

- Number of Standards and Concentrations:

  If the reference or mandated method does not specify the number of calibration standards to use, the minimum number is three, not including blanks or a zero standard, except where a single point calibration is stipulated in the method.

  For 500 and 600 series methods a three point calibration is recommended for linear curves. For nonlinear curves, more than three points is recommended.

  For 8000 series methods, a five point calibration is required for a linear (first order) model, six point calibration for a quadratic (second order) model, and seven point for a polynomial (third order) model.

  The analyst has the option to use linear or nonlinear integration and to force, include, or ignore the origin, depending on method requirements.

  For instrumentation where single point calibration is recommended by manufacturer's instructions, such as with some ICP and ICP/MS technologies (with a zero and single point calibration), the following apply:

a) For single point plus zero blank calibrations, the zero point and the single point standard are analyzed prior to the analysis of samples, and the linear range of the instrument established by analyzing a series of standards, one of which is at the lowest quantitation level.

b) Zero blank and single point calibration standards are analyzed with each analytical batch for methods where they are specified.

c) A standard corresponding to the limit of quantitation is analyzed with each analytical batch and must meet established acceptance criteria when using single point plus zero blank calibrations.

d) The linearity of single point plus zero blank calibrations is verified at a frequency established by the method or the manufacturer.

For curves that are generated manually such as spectrophotometry, analysts should take three readings for each calibration level. The average of the three readings is plotted on the calibration curve.

The lowest calibration standard is the lowest concentration for which quantitative results can be reported without qualification. The lowest calibration standard is at or below the Reporting Limit (RL) and is greater than the Limit of Detection. Results that are less than the RL are considered to have increased uncertainty, and are either reported with a qualifier code or explained in the case narrative.

Other calibration standards include those that are at or below the regulatory limit, if known. Standards are made at levels that typically bracket expected concentrations but do not exceed instrument linearity.

The highest calibration standard is the highest concentration for which quantitative results can be reported. When sample responses exceed the calibration range, the sample should be diluted to bring results within the calibration range. Data reported exceeding the highest calibration standard without dilutions is considered to have increased uncertainty and are reported with a qualifier code or reanalyzed and explained in the case narrative if applicable.

- Evaluation, Verification and Corrective Action

  All initial instrument calibrations are verified with a standard obtained from a second source traceable to a national standard when commercially available. If a second source is not available, a standard prepared from a different lot may be used. Verification is performed for every analyte of interest, except for multi-component analytes such as Aroclors or Total Petroleum Hydrocarbons, where a representative chemical related substance or mixture is used.

  Criteria for the acceptance of an initial instrument calibration is established (e.g., correlation coefficient, relative percent difference (RPD), relative standard deviation (RSD) or relative error (%RE) and defined in technical test method SOPs. The criteria used are appropriate to the calibration technique and method criteria.

If the method does not specify acceptance criteria, a linear curve must have a correlation coefficient (r) as specified below and a nonlinear curve must have a coefficient of determination (r^2) as specified below.

	Linear	Nonlinear
Inorganic methods	$r \geq 0.995$	$r^2 \geq 0.99$
500,600 methods	$r \geq 0.99$	$r^2 \geq 0.98$
8000 methods	$r \geq 0.99$	$r^2 \geq 0.99$

The laboratory has manual integration procedures that are adhered to when evaluating calibration data.

Any samples that are analyzed after an unacceptable initial calibration are re-analyzed or the data are reported with qualifiers, appropriate to the scope of the unacceptable condition (see Section 12 – "Control of Nonconforming Environmental Testing").

Quantitation is always determined from the initial calibration unless the test method or applicable regulations require quantitation from the continuing instrument calibration verification.

Corrective actions are performed when the initial calibration results are outside acceptance criteria. High or low calibration points may be dropped from the curve if needed, see below. If the low or high calibration point is dropped from the curve, the working curve is adjusted and any reported sample results outside the curve range are qualified. Calibration points are not dropped from the middle of the curve unless the cause is determined and documented**. If the cause cannot be determined, the calibration curve is re-prepared.

The analyst may decide to exclude a calibration point if it appears to be invalid, under the following conditions:

- The curve will still contain the minimum number of points required without the excluded point.
- If the lowest point is dropped from the curve, the reporting limit is adjusted up to the level of the lowest calibration standard remaining. The level of this low calibrator is the reporting limit at which results are reported.
- No sample result is reported above the high calibrator unless qualified.
- The analyst documents reasoning for eliminating a calibrator.
- Manager or QA approval is noted on the calibration or data
- **If a point is eliminated in the middle/interior of the curve, the analyst must verify that portion of the curve with a QC sample. No interior points are removed from a calibration without documented reasoning and documented approval by QA, Lab Director or manager on a case by case basis. Points should never be removed to compensate for lack of instrument maintenance or repair**.

The analyst may replace the a calibrator with a standard injected later in the run (e.g. extra CCV) as long as the new calibration can be validated with method prescribed ICVs and CCVs.

In addition, the analyst may replace a calibration standard with another calibration standard if the standard was analyzed at the same level and within twenty-four hours of the original standard.

The run may be reprocessed based on a later calibration as long as the reprocessed run contains method required QC that is acceptable under the new calibration. This may not apply to calibration standards that require preparation alongside samples in a specific batch.

- Internal Standard Calibration

  Internal standard calibration is completed per method requirements. In such cases internal standard is added to all client and QC samples in the batch.

  Internal standard methods normally have protocol for evaluating the internal standard recovery in QC and Sample data. Two variations on this evaluation process are most common. Compare the mean value of the internal standard from the calibration standard and/or compare the daily calibration verification internal standard to the internal standards in the QC and Sample data.

  Internal standard response is calculated by chromatography software.

  Internal standard performance is monitored and evaluated based on method specified criteria. If internal standards do not satisfy requirements, corrective action must be taken.

H.3.2 Continuing Instrument Calibration

- Records

  The calculations and associated statistics for continuing instrument calibration are included or referenced in the technical test method SOPs.

  Sufficient raw data records are retained to allow reconstruction of the continuing instrument calibration verification. Continuing instrument calibration verification records connect the continuing verification date to the initial instrument calibration.

  The laboratory has manual integration procedures that are adhered to when evaluating calibration data.

- Frequency

  Calibration is verified for each compound, element, or other discrete chemical species. For multi-component analytes, such as aroclors, chlordane, toxaphene,

or total petroleum hydrocarbons, a representative chemically related substance or mixture is used.

Calibration verifications are performed:

- at the beginning and end of each analytical batch and at the frequency defined in the method, except for instances when an internal standard is used. For methods which use an internal standard, one calibration verification is performed at the beginning of the analytical batch and at the frequency defined by the method. Some methods have more frequent CCV requirements (see specific SOPs). Many inorganic methods require the CCV to be analyzed after every 10 samples.
- whenever it is expected that the analytical system may be out of calibration or might not meet verification acceptance criteria.
- when the time period for calibration or the most recent calibration verification has expired.
- for all analytical systems that have a calibration verification requirement. Requirements can be found in the technical test method SOPs.
- A calibration check standard at the reporting limit may be analyzed at the end of an automated run. This standard is used to validate ND results should the LCS, ICV, or CCV be biased low, by demonstrating that the instrument signal at the RL is greater than the method blank signal.

- Evaluation, Verification and Corrective Actions

  The validity of the initial calibration is verified prior to sample analysis by use of a continuing instrument calibration verification (CCV) standard. Acceptance criteria are stipulated in individual methods.

  Corrective action is initiated for CCV results that are outside of acceptance criteria (see Section 12 – "Control of Nonconforming Environmental Testing").

  *For additional DOD calibration requirements see Appendix L Sec-"App H"

H.3.3 Unacceptable Continuing Instrument Calibration Verifications

If routine corrective action for continuing instrument calibration verification fails to produce acceptable calibration verification within acceptance criteria, then a new calibration is performed or acceptable performance is demonstrated after corrective action with consecutive calibration verifications.

For any samples analyzed on a system with an unacceptable calibration, some results may be useable if qualified and under the following conditions:

a) If the cause for the failed calibration verification is known and shown to only impact the calibration verification sample (such as autosampler mis-injection), analysis may proceed if a second calibration verification sample is analyzed immediately and is within acceptance criteria.

b) If the acceptance criteria are exceeded high (high bias) and the associated samples are below detection, then those sample results that are non-detects may be reported as non-detects.

c) If the acceptance criteria are exceeded low (low bias) and there are samples that exceed the maximum regulatory limit, then those exceeding the regulatory limit may be reported.

Appendix I

Microbiology

Contents

1.0 METHOD VALIDATION

1.1 When methods specify a procedure to be followed, only those procedures will be used. If no procedures are specified, the laboratory uses its own procedure which is documented on the Babcock Server.

1.2 The following parameters will be assessed for the non-reference method:

1.2.1 Accuracy – At least one known reference material will be analyzed to prove that the results are comparable to the reference method. If no reference method exists, the results are compared to the expected recovery of the material as stated by the manufacturer.

1.2.2 Precision – At least 10 replicate analyses are performed by the new and reference method. The results from the two methods should not be statistically different. If no reference method is available, the results should be within the acceptable range for the reference material as stated by the manufacturer.

1.2.3 Selectivity (Sensitivity) – At least 10 samples of mixed cultures that include the target organism(s), and at varying concentrations, are analyzed. The number of false negatives and false positives is calculated. The laboratory director will determine if the results are acceptable.

1.3 The laboratory will confirm the validation by participating in a proficiency test program with acceptable results.

1.4 All records of the validation will be retained for at least 5 years past the date of last use of the method.

1.5 Clients will be notified of the use of non-reference methods. Samples will only be analyzed by that method after written consent has been received from the client.

2.0 DEMONSTRATION OF CAPABILITY (DOC)

2.1 Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.

2.2 Before reporting any data with a given method, a satisfactory Initial DOC (IDOC) is performed. Thereafter, each analyst will demonstrate continuing proficiency through the procedures outlined in Ongoing Demonstration of Capability.

2.3 Initial Demonstration of Capability (IDOC)

2.3.1 Prior to analysis of samples or when a significant change is made to the method, an IDOC is performed by the laboratory for each analysis.

2.3.2 This IDOC is accomplished by successful analysis of a PT sample.

2.3.3 Where applicable, the new method may be compared to a reference method already approved for use in the laboratory.

2.3.4 All documentation is maintained on the Babcock Server as long as the method is in use and for at least 5 years past the date of last use.

2.3.5 After the IDOC is completed, final written authorization to run the method is given by management.

2.4 Analyst IDOC

2.4.1 Prior to analysis of samples, when a significant change is made to the method or if the analyst has not performed the method within a twelve-month period, an IDOC is performed by the analyst for each analysis.

2.4.2 This IDOC is accomplished by successful analysis of a PT sample or by the analysis of four consecutive known samples that meet the criteria specified in the SOP for that analysis. Daily media QC for the qualitative methods can be used as an IDOC as long as all of the information in section 2.4.4 can be provided.

2.4.3 Each known sample may be at a different level but the true value must be established by one of the following:

2.4.3.1 Ranges supplied by the manufacturer or determined by laboratory generated control charts.

2.4.3.2 Logarithmic precision criterion of the true value, where the true value is established by an analyst who has already demonstrated capability.

2.4.4 The IDOC(s) for each analyst is documented on the Babcock Server. The document identifies the analyst(s) involved in preparation and/or analysis; matrix; analyte(s), class of analyte(s), or measured parameter(s); the method(s) performed; the laboratory-specific SOP used for analysis (including revision number); the date(s) of analysis; and a summary of the results used to calculate the mean recovery and standard deviations.

2.4.5 All documentation is maintained on the Babcock Server as long as the analyst is performing the analysis and for at least 5 years past the date that the analyst stops performing the analysis.

2.4.6 After training and IDOC are completed, final written authorization to run the analysis is given by management.

2.5 Ongoing Demonstration of Capability

2.5.1 Each analyst is expected to consistently meet the QC requirements of the method, the laboratory SOP, client requirements and/or the TNI standard.

2.5.2 Ongoing DOCs are completed annually by each analyst for each analysis, unless an IDOC was performed that year.

2.5.3 This is accomplished in one of the following ways, as specified in the method SOPs:

2.5.3.1 Results from a successful analysis of a PT sample.

2.5.3.2 Results of two sample duplicate results that are statistically indistinguishable from another trained analyst.

2.5.3.3 Results of four consecutive known samples that are within the range determined by the manufacturer or laboratory generated control charts. This can include daily media QC for qualitative methods.

2.5.4 All documentation is maintained on the Babcock Server as long as the analyst is performing the analysis and for at least 5 years past the date that the analyst stops performing the analysis.

3.0 CALIBRATION

3.1 See Section 23.5.2 for information on calibration of support equipment.

3.2 Calibration Checks

3.2.1 Analytical balances are checked each day used with a NIST certified 500.0 g and 1.0 g weight. Microbiology lab balances are also checked monthly with 3 weights: 500.0 g, 100.0 g and 1.0 g.

3.2.2 Before daily use and whenever a volume change is made, volumetric media dispensers are checked with a graduated cylinder. The volume is adjusted, if needed.

3.2.3 Disposable pipettes are checked for accuracy per lot. Calibration error must be <2.5%.

3.2.4 HACH® Pocket Colorimeter™ II, Chlorine is checked weekly.

3.2.5 All results are documented.

3.2.6 All method specified calculations, data reduction, and statistical interpretations are followed. See specific method SOPs for details.

3.3 pH Meter

3.3.1 Instructions for calibrating the pH meter can be found in SOP T-204.

3.3.2 Microbiology Lab Equipment and Reagents

3.3.2.1 Meter: Symphony pH Benchtop Meter (Model SB70P) or equivalent.

3.3.2.2 Electrodes: Thermo Scientific Gel-Filled Triode (Model 9107BNMD), Sensorex Spear-Tip Electrode (Model S175CD) or equivalents.

3.3.2.3 Electrode Storage: The gel-filled electrode is stored in a solution prepared by dissolving 1 g KCl into 200 mL of pH 7 buffer. The solution is changed weekly. The spear-tip electrode is stored in a pH 4 buffer solution.

3.3.2.4 Standards: pH 4, 7 and 10 buffers, purchased premixed from a certified vendor. Buffers are stored at room temperature and manufacturer expiration dates are observed. Once opened, standards are held up to one year as long as that does not exceed the manufacturer's expiration date. Each standard is assigned an Element ID.

3.3.3 Calibration Procedure (performed prior to each day of use)

3.3.3.1 Pour pH 4, 7 and 10 buffer solutions into test tubes.

3.3.3.2 Rinse the electrode with DI water and blot dry.

3.3.3.3 Put the electrode into the pH 7 buffer solution with a slight bouncing action to ensure that no air is trapped under the electrode. Press the "calibrate" button. The bottom of the display will read "CAL.1". Wait until "pH" stops flashing on the right side of the display and the arrow starts flashing on the left side of the display. Check that the reading is 7.0 ± 0.1.

3.3.3.4 With the electrode still in the pH 7 buffer, press calibrate again. The bottom of the display will change to "CAL.2".

3.3.3.5 Rinse the electrode with DI water, dry and put it in the pH 10 buffer solution. Wait until "pH" stops flashing on the right side of the display and the arrow starts flashing on the left side of the display. Check that the reading is 10.0 ± 0.1.

3.3.3.6 Press measure. Record the slope that appears on the screen. The slope is displayed as a percentage and should be between 95-105%.

3.3.3.7 Rinse the electrode with DI water, dry and put it in calibration check pH 4 buffer. Check that the reading is 4.0 ± 0.1.

3.3.3.8 The instrument is now calibrated and the electrode may be rinsed, dried and placed in the first sample of media.

3.4 Conductivity Meter

3.4.1 Equipment and Reagents

3.4.1.1 ECTester11+ conductivity meter or equivalent

3.4.1.2 1413 µmho calibration solution prepared by dissolving 0.7456 g of pre-dried KCl in 1 L of nanopure water.

3.4.1.3 1413 µmho calibration check solution prepared from a second source.

3.4.2 Calibration Procedure (performed monthly)

3.4.2.1 Open the battery compartment.

3.4.2.2 Turn on the conductivity meter (it should be in measuring mode).

3.4.2.3 Rinse the electrode cup with the calibration solution, then fill the cup with the solution.

3.4.2.4 Press the INC or DEC button in the battery compartment to enter calibration mode.

3.4.2.5 When the reading stabilizes, press the HOLD/ENT key to confirm the calibration.

3.4.2.6 Rinse the cup well with deionized water.

3.4.2.7 Verify the calibration by reading a second source. Rinse then fill the cup with the second source and record the results. The acceptable range of 1272-1554 µmho/cm must be observed. If the reading is out of control, get fresh KCl standard and repeat. If the reading is still out of control, recalibrate the meter.

4.0 AUTOCLAVES

4.1 General Usage Information

4.1.1 The autoclaves are used for sterilizing media, glassware, waste, etc.

4.1.2 Water is added to the appropriate level, the autoclave is loaded and the door is closed.

4.1.3 If liquids are loaded, the exhaust system is set to slow to prevent the liquid from boiling over. If instruments, glassware, etc.are being sanitized, the exhaust may be set to either slow or fast.

4.1.4 The autoclave dial is turned to the appropriate setting.

4.1.5 The autoclave can be re-opened when the timer reaches zero, the temperature is ≤100°C and the pressure gauge reads zero.

4.1.6 Appropriate PPE, including laboratory approved safety glasses or goggles, must be worn when opening the autoclave in case of shattering glass or spattering liquids.

4.1.7 The door handle must be released quickly after the door is opened. Use caution if wearing autoclave gloves when opening the door as steam coming out of the autoclave may get trapped inside the glove and cause severe burns.

4.1.8 Autoclave gloves must be worn at all times when items are being removed from the autoclave.

4.2 Quality Control and Documentation

4.2.1 New autoclaves are initially evaluated prior to use by establishing functional properties and performance, such as heat distribution, timing, temperature and sterilization efficiency.

4.2.2 Initial and annual uniformity and stability checks are conducted by measuring the temperature at the front and back of the autoclave to ensure that the required temperature (121°C) is reached in all areas.

4.2.3 Autoclave tape is used with each batch to ensure that proper sterilization temperature was reached.

4.2.4 *A maximum registering thermometer is not used to confirm autoclave temperature since each autoclave is fitted with a continuous temperature recorder* which includes maximum temperature reached and sterilization time.

4.2.5 Each autoclave graph is dated and each run is identified with the contents of that run. These graphs are kept in their own binder or stored on a laboratory computer. Autoclave log records include: date, analyst initials, contents, maximum temperature reached, pressure, sterilization time, time in and time out.

4.2.6 Annual maintenance is performed by an ISO 17025 certified vendor which includes a pressure check and calibration of the temperature device. Records of all maintenance are kept in the appropriate maintenance log in Element. See G-201 Support Equipment, for instructions on how to enter maintenance information into the element maintenance logs. All paperwork associated with any repairs and/or maintenance will be scanned and saved in the appropriate equipment folder.

4.2.7 The mechanical timing device is checked quarterly against an ISO certified timer. The actual time elapsed is documented. The corrected setting for each autoclave dial is clearly marked on the autoclave.

4.2.8 Sterilization efficiency is checked monthly (See Section 5.0).

5.0 BIOLOGICAL INDICATOR OF STERILIZATION EFFICIENCY

5.1 On a monthly basis the autoclaves and the dry oven are tested for sterilization efficiency by the use of *Geobacillus stearothermophilus*. A spore strip is used to test the dry oven. All results are recorded and maintained in a laboratory binder.

5.2 Autoclave testing

5.2.1 An ampoule is placed in a container of water in the coolest part of the autoclave load, near the door, and autoclaved for 30 minutes at 121ºC.

5.2.2 All autoclaves are tested. Ampoules are carefully labeled to match the corresponding autoclave. After the autoclave cycle is completed, the ampoule is removed, and allowed to incubate at 60ºC ± 2ºC for 48 ± 3 hours, checking after 24 hours. An additional ampoule which has not been autoclaved is used as a positive control. The positive control is incubated along with the autoclaved ampoule.

5.2.3 If the sterilization process is adequate, the ampoules will remain their original color of purple after incubation. If the sterilization process is inadequate, the ampoules will turn yellow-orange and turbid after incubation. The positive control will be yellow after incubation.

5.2.4 If, after 24 hours, the ampoules are yellow, retest the autoclave immediately and DO NOT USE the failing autoclave except for waste until QC is passed.

5.3 Dry Oven Testing (Riverside Microbiology lab only)

5.3.1 A spore strip is placed into an empty jar and placed in the dry oven at the end of the day.

5.3.2 During the night, the dry oven will reach a minimum temperature of 340ºF for a minimum of two hours. This is the typical sterilization time for glassware in the oven.

5.3.3 In the morning, when the dry oven cycle is completed, the strip is aseptically removed from the empty jar and placed into a jar of sterile Tryptic Soy Broth. A second strip which has not been in the dry oven is aseptically placed in a jar of sterilized Tryptic Soy Broth as a positive control.

5.3.4 The jars are allowed to incubate at 60ºC ± 2ºC for 48 ± 3 hours.

5.3.5 If the sterilization process is adequate, the broth will remain non-turbid after incubation. If the sterilization process is inadequate, the broth will become turbid after incubation. The positive control will become turbid after incubation.

6.0 INCUBATORS, WATER BATHS, DRY OVENS AND REFRIGERATORS

6.1 Incubators

6.1.1 Each incubator contains a thermometer. Temperature readings are done twice a day, once in the morning and once in the afternoon at least 4 hours apart. Larger incubators contain two thermometers to monitor both top and bottom temperatures.

6.2 Water Baths

6.2.1 Microbiology lab fecal water baths must be kept at 44.5°C ± 0.2°C. Temperature readings are done once in the morning and once in the afternoon at least 4 hours apart.

6.3 Dry Ovens (Riverside Microbiology lab only)

6.3.1 The Microbiology lab dry oven is used to sterilize glassware; pipettes, tweezers, and transfer loops overnight. It is kept on a timer, which turns the oven on at 7 pm and shuts itself off eight hours later. A minimum

temperature of 340°F is required for a minimum 2 hour period. A continuous temperature chart recorder is used to record temperature time and date. A dry heat chemical indicator tape is also used every night. The following records are kept:

6.3.1.1 Date
6.3.1.2 Cycle Time: indicated by chart
6.3.1.3 Temperature; indicated by chart and heat tape
6.3.1.4 Analyst initials

6.4 Refrigerators

6.4.1 Each refrigerator contains a thermometer. Temperatures should be 2°C-8°C. Temperature readings are taken once a day.
6.4.2 All temperature adjustment is recorded.

6.5 Thermometers

6.5.1 Bacteriological thermometers are of the appropriate quality needed to meet the specifications in the test method.
6.5.2 Incubator thermometers are graduated by 0.5°C or 0.1°C. Fecal water bath thermometers are graduated by 0.1°C.
6.5.3 Thermometers must be calibrated annually against a NIST certified thermometer. The thermometer is calibrated annually by an ISO 17025 accredited vendor. Documentation of NIST certification is maintained for each thermometer. If thermometer calibration indicates a bias ≥0.1°C, this correction factor must be taken into account during lab thermometer calibration.

6.6 Quality Control and Documentation

6.6.1 A temperature log is maintained for each incubator, water bath, dry oven and refrigerator.
6.6.2 Each incubator, water bath, dry oven and refrigerator is cleaned on a quarterly basis (See Tables 1) for the Microbiology lab, and monthly for the food lab
6.6.3 Initial and annual uniformity and stability checks are conducted on each piece of equipment.

6.6.3.1 Incubators: The temperature is measured on each shelf (front and back for larger incubators) to ensure that all areas in the incubator are within the required temperature range.
6.6.3.2 Water Baths: The temperature is measured at the front and back of the water bath to ensure that the temperature is the same at both ends. Fecal water baths must be within 44.5°C ± 0.2°C at each end. Other water baths must be within the range specified in the method SOP.
6.6.3.3 Dry Ovens: The temperature is measured on each shelf to ensure that all areas are reaching the minimum required or method specified temperature range.

6.6.4 All documentation is maintained in laboratory folders.

7.0 INCUBATOR DESIGNATIONS

7.1 See Tables 2 and 3.

8.0 GLASSWARE

8.1 Glassware is made of borosilicate or other non-corrosive material, free of chips and cracks, and has readable measurement marks. The laboratory uses detergent designed for laboratory use.

8.2 Inserts

8.2.1 Inserts are sterilized inside culture tubes after the addition of media.
8.2.2 Used inserts are soaked in a solution of Alconox and dilute bleach.
8.2.3 After soaking for a minimum of 2 hours, the inserts are placed in a sink and rinsed under tap water for 20 minutes, followed by three rinses with DI water.
8.2.4 Rinsed inserts are placed in drying racks to be reused in new media tubes.

8.3 Pipettes

8.3.1 Pipettes are placed in disinfectant immediately after use, and rinsed three times with DI water before being sterilized overnight in the dry oven (Riverside). *When necessary, pipettes are sterilized by autoclaving for 30 minutes*. All pipettes utilized in El Centro are sterilized by autoclave.
8.3.2 Since pipettes are used to prepare the Colilert blank (See Appendix J), sterility is demonstrated.

8.4 Glass Jars

8.4.1 Jars and lids are sterilized after the addition of media.
8.4.2 Used jars are rinsed three times with DI water.
8.4.3 Caps are soaked in a solution of Alconox and dilute bleach, then rinsed thoroughly with DI water.

8.5 Media Beakers

8.5.1 Beakers are inspected for chips and cracks. Damaged beakers are not used for media preparation.
8.5.2 Beakers are cleaned with Alconox and rinsed with tap water three times or until all media and detergent has been removed, followed by three rinses with DI water.
8.5.3 One drop of 0.04% bromothymol blue is added to one random beaker (place beaker in the sink and add drop to the inside bottom of the beaker to check for acid residue.
8.5.4 If the results are not "blue-green" all beakers are rinsed with tap water three times and deionized water three times and re-checked for acidity.
8.5.5 Once the results are acceptable, the dye is rinsed out of the beaker and the results are recorded in a laboratory folder.

9.0 MICROBIOLOGY SAMPLE CONTAINERS

9.1 Sample containers are sterile 120 mL plastic bottles, obtained from a vendor, containing a predetermined amount of $Na_2S_2O_3$ for chlorine removal. Sterilized bottles are kept in a cool dry area until needed. Any bottles returned empty from the client with the shrink-wrap broken are considered contaminated and discarded. See Table 5 for a summary of bottle QC requirements and acceptance criteria.

9.2 Cracked Bottle

9.2.1 If a cracked bottle is logged in and submitted to the lab, the bottle may not lead until the lid is loosened.
9.2.2 Quickly pour the remaining sample into another sterile sample container and proceed with the analysis.
9.2.3 Add a notation to the lab sheet stating the bottle was cracked and transferred to a new sterilized container.
9.2.4 Email the client's PM and cc the manager by the end of the day. Let them know the bottle was cracked and if there was enough sample to proceed with the analysis. The manager will fill out an NCR. Keep the lab sheet with the day's paper work.
9.2.5 If there is enough sample to run the analysis and the results are all negative and HPC <200, no further action are needed.
9.2.6 If the sample if positive, has confirmed tubes, or the HPC>200, a qualifier will be added stating the sample bottle was cracked and results are questionable.
9.2.7 PMs will cancel the sample upon client's request.

9.3 Identification Labels

9.3.1 Identification labels are added which include lines for recording:

9.3.1.1 Sample location.
9.3.1.2 Date and Time.
9.3.1.3 Names of the sampler and customer.
9.3.1.4 Type of sample (i.e. routine, resample, and special).
9.3.1.5 Stamped on the identification label is the vessel's expiration date.

9.4 Volume Check

9.4.1 A volume check is performed on each lot of sterile sample containers. The bottle is filled to the 100 mL mark and then transferred to a 100 mL graduated cylinder for verification. The 100 mL mark must be accurate to within ± 2%.

9.5 Sterility Check (Vessel Check)

9.5.1 A sterility check is performed on each lot of sterile sample containers.
9.5.2 One hundred milliliters of sterile Tryptic Soy Broth (TSB), a non-selective broth, is added to one sterile sample container per lot and incubated for 24 hours at 35.0°C ± 0.5°C.

9.5.3 The containers are examined for cloudiness and the results are recorded in the Bacteriology QC log book.

9.5.4 If there is a positive result, cultures are transferred to EMB and Colilert to ensure that it is negative for Coliform prior to use of the containers.

9.6 Autofluorescence Check

9.6.1 Each new lot of sample containers is checked for autofluorescence.

9.6.1.1 One container filled is with nanopure water and placed in front of a 365 nm UV light to ensure that it does not fluoresce.

9.6.2 Each new lot of Colilert®-18hr, Colilert 24 hour and Colitag® is checked along with a sample container for autofluorescence at 365 nm UV light prior to use.

10.0 QUALITY CONTROL

10.1 Batch QC

10.1.1 QC is performed under the same conditions as those for routine sample analysis. All quality control measures and acceptance criteria are assessed and evaluated on an on-going basis to determine the validity of the data.

10.1.2 Method Blank (ISO 17025/AOAC Methods)

10.1.2.1 At least one blank is prepared for each batch of samples using un-inoculated media. Results must be below the RL.

10.1.3 Laboratory Control Samples (ISO 17025AOAC Methods)

10.1.3.1 For presence/absence tests, a positive control is spiked with the analyte of interest.

10.1.3.2 For quantitative tests, the LCS is run in duplicate in order to measure accuracy and precision. Quantitative CRMs are obtained from an ISO certified vendor.

10.1.4 Duplicates

10.1.4.1 Sample duplicates are performed at a frequency of 5% or once per batch (day) for each analysis performed that day, when possible. Duplicate sample bottles are logged into Element and designated with a letter that is unique to that container.

10.1.4.2 Acceptable duplicate RPD is determined either with control charts generated from historical LCS data or a precision criterion generated from historical sample data as described in Standard Methods 9020:VII.

10.1.4.3 The precision criterion is converted to RPD for the purposes of Element QC reporting.

$$\frac{\text{Precision Criterion}}{0.0044} = \text{RPD}$$

0.0044 = estimated antilog value

10.1.5 If a duplicate of a presence/absence sample indicates results in opposition to the original sample result, client notification will be based on the result that poses the greatest risk to public health. The final report will reflect this result, accompanied by a case narrative and the client will be called.

10.2 Inhibitory Residue

10.2.1 The laboratory detergent is tested annually to ensure that it does not leave inhibitory residue on the glassware (see Standard Methods 9020B 5a2 for details).

10.2.2 The Inhibitory Residue test is performed again if the type of detergent or washing procedure is changed.

10.3 Quanti-Trays

10.3.1 Quanti-Trays are monitored monthly for proper seal.

10.3.1.1 100 mL of tap water and 0.1 g of Bromocresol purple are added to a Quanti-Tray and the tray is sealed as normal.

10.3.1.2 Dye outside the wells is an indication of leakage.

10.4 Reagent Water

10.4.1 Reagent water quality is regularly monitored. The lab is exempt from the annual Bacteriological Water Quality Test (Water Suitability Test SOP) since we have documented that we have Standard Methods Type II reagent water. A summary of the required tests and acceptance limits can be found in Table 5. Results are kept for five years.

10.4.2 Conductivity

10.4.2.1 Nanopure water conductivity is checked daily after confirming a calibration check.

10.4.2.1.1 Rinse the measurement cup, and then fill with the calibration check solution. The reading must be within the acceptable range of 1272-1554 µmho/cm. If the reading is out of this range, repeat the test with a fresh portion of the solution. If the reading is still out of range, the instrument may need to be recalibrated.

10.4.2.1.2 After confirming that the calibration is valid, rinse the measurement cup well, then fill with Nanopure water. The

reading should be <1. Record all 0 results as <1. If the result is >1, rinse the reservoir thoroughly and start again. If the reading is still >1, the supervisor is notified.

10.4.3 Total Chlorine

10.4.3.1 Rinse a 10 mL cell and its cap with Nanopure water. Fill the cell with water to the 10 mL line. This is the blank.
10.4.3.2 Wipe the outside of the cell with a tissue to remove any excess liquid or fingerprints.
10.4.3.3 Place the blank in the cell holder with the diamond mark facing the keypad and fit the cap over the cell compartment.
10.4.3.4 Press the ZERO/SCROLL button (looks like a 0). Remove the blank from the cell holder.
10.4.3.5 Rinse a second 10 mL cell and its cap with Nanopure water and fill with Nanopure to the 10 mL line. Add DPD Total Chlorine Reagent Powder. Cap the cell and shake gently for 20 seconds.
10.4.3.6 Let the cell sit for 3-6 minutes.
10.4.3.7 Wipe the outside of the cell with a tissue and place in the cell holder with the diamond facing the keypad.
10.4.3.8 Press the READ/ENTER button (looks like a check mark). Record the results. Results should be ≤1. Record all 0 results as <1. If the reading is >1, rinse the cell and cap thoroughly and start again. If the reading is still >1, the manager is notified.

10.5 Chlorine Residual

10.5.1 All samples from known chlorinated samples, unknown sources where chlorine usage is suspected and all potable water samples are checked for the absence of chlorine residual.

10.5.1.1 Equipment and Reagents

10.5.1.1.1 Plastic cup
10.5.1.1.2 Sterile pipettes
10.5.1.1.3 HACH Free and Total Chlorine Test Strips, or equivalent

10.5.1.2 Procedure

10.5.1.2.1 A test strip is placed in a receptacle.
10.5.1.2.2 The test strip is saturated with sample and observed for a color change.
10.5.1.2.3 A color change indicates the presence of chlorine. Samples that test positive for chlorine are qualified with N-BCl.

10.6 Daily Quality Control

10.6.1 The microbiology labs perform daily QC in the morning before samples are analyzed on all media that will be used that day, including Colilert®-18hr, Colitag® and tubed media.

10.6.2 Colilert®-18hr and Colitag® QC is prepared by dissolving one unit of the indicator in 90 mL sterile Nanopure water. After the powder has dissolved, 10-20 mL are transferred into each or four sterile test tubes.
10.6.3 A blank and at least one positive and negative control is made for each type of media that will be used that day. See Table 6 and 7 for controls used and incubation conditions.
10.6.4 The media is placed into the appropriate incubator (See Table 2).
10.6.5 A 365 nm UV light is used to check for fluorescence.

10.7 Monthly Air Plates (Riverside Lab)

10.7.1.1 The air quality in the Microbiology fume hood is monitored as required by running an air plate, as described in SOP T-604
10.7.1.2 The air quality in the lab is monitored in the fume hood and on the counter while samples are being prepared using APC Petrifilms.
10.7.1.3 One mL of sterile water is dispensed in the center of the Petrifilm.
10.7.1.4 A ridged spreader is used to distribute the water over an area of 20 cm^2.
10.7.1.5 The Petrifilm is allowed to hydrate for at least 1 hour before being opened.
10.7.1.6 The top film is lifted and secured open with tape for 15 minutes.
10.7.1.7 The top film is lowered back onto the bottom of the Petrifilm and the plates are incubated as normal.

11.0 REFERENCE CULTURES

11.1 Reference cultures of organisms used in the Microbiology labs for daily QC are obtained from ATCC, (American Type Culture Collection), and purchased through an ISO 17025 accredited vendor. The reference cultures are stored at 2-8°C until manufacturer expiration date.

11.2 Reference cultures are rehydrated in Lauryl Sulfate broth (Azide Dextrose Broth for *E. faecalis*) at 35°C ± 0.5°C until dissolved. This stock is stored at 35°C ± 0.5°C. The working stocks are not sub-cultured to replace the reference stocks or to make more working stocks.

11.3 One mL of the suspension is streaked onto a working plate on Tryptic Soy Agar (Bile Esculin Azide Agar for *E. faecalis*) and kept at 35°C ± 0.5°C for up to a month. If a plate shows signs of contamination or is drying out, a new working plate is prepared.

11.4 Reference Culture Labeling and Documentation.

11.4.1 Stock Log includes: receipt date/initials, expiration date, name, lot number, manufacturer, certificate of analyses and ID number.
11.4.2 Stock Containers are labeled with: date received, date opened, initials, expiration date, name and ID number.
11.4.3 Working Log includes: name, date made, initials, expiration date, recipe and ID number.
11.4.4 Working Containers are labeled with: date made, analyst initials, expiration date, name of media and media ID number.

12.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

12.1 All positive QC is autoclaved prior to disposal.

12.2 Refer to "Babcock Labs Hazard Communication section of the Chemical Hygiene Plan".

13.0 HOUSEKEEPING

13.1 Walls, floors, ceilings, and work surfaces are non-absorbent, easy to clean and disinfect and properly sealed.

13.2 In general there is sufficient storage space.

13.3 Laboratories are clean and free from dust accumulation.

13.4 Plants, food and drink are prohibited in the laboratory work area.

13.5 Counter tops are cleaned with a disinfectant (Amphyl or bleach) after each set of samples and at the end of each day.

13.6 Cabinets containing stored media are cleaned yearly.

14.0 REFERENCES

14.1 Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WPCF, 22nd edition, 9020.

14.2 The NELAC Institute Standard, EL-V1-2009/2016

14.3 Official Methods of Analysis of AOAC International, 17th Edition.

14.4 IDEXX EZ-DPD Dispenser for Free Chlorine Package Insert

15.0 METHOD VARITATIONS

15.1 All *italicized items* are an indication of a variation from the method.

TABLE 1: EXAMPLE Microbiology Equipment Cleaning and Sanitization Sheet

Equipment	Date/Initials	Date/Initials	Date/Initials	Date/Initials
Incubator #5				
Incubator #6				
Incubator #7				
Incubator #9				
Incubator #10				
Incubator #11				
Incubator #12				
Agar Water Bath #9				
Agar Water Bath #8				
Agar Water Bath #10				
Fecal Water Bath #4				
Fecal water Bath #3				
Colilert Water Bath				
Bacti Fridge #1				
Dry oven				

Note: Items are checked off as they are cleaned. The date cleaned and analyst initials are documented in the maintenance log book.

TABLE 2: EXAMPLE Microbiology Lab Incubators

Incubator	Temperature	Analysis	Scheduled Days
~~#4~~ 335	25-28°C	Petrifilms	As needed
~~#5~~	41.5°C ± 1°C	Pathogens, Enterococcus Quanti-Trays	As needed
~~#6~~	35.0°C ± 0.5°C	Brilliant Green Bile	Daily
~~#7~~	35.0°C ± 0.5°C	Lauryl Sulfate Broth, Azide Broth	Daily
~~#9~~	35.0°C ± 0.5°C	P/A, Coliform Quanti-Trays	Mon,Wed,Fri
~~#10~~	35.0°C ± 0.5°C	HPC, Azide Agar, Incubated Petrifilms	Tues, Thurs, Sat
~~#11~~	35.0°C ± 0.5°C	HPC, Azide Agar, Incubated Petrifilms	Mon, Wed, Fri, Sun
~~#12~~	35.0°C ± 0.5°C	P/A, Coliform Quanti-Trays	Tues, Thurs, Sat, Sun

Note: Deviation from this plan must be noted on the back of the incubator's temperature log.

TABLE 3: EXAMPLE Petrifilm Lab Incubators

Incubator	Temperature	Analysis	Scheduled Days
#335	25-28°C	Petriflims	Daily
#144	60.0°C ± 2°C	*Geobacillus stearothermophilus*	As needed

TABLE 4: Bottle QC Acceptance Criteria

QC Parameter	Acceptance Criteria
Volume Check	100 mL ± 2%
Sterility Check	no turbidity of TSB after incubation at 35.0°C ± 0.5°C for 24 hr
Autofluorescence Check	no fluorescence of a nanopure filled bottle

TABLE 5: Reagent Water Testing

Test	Frequency	Acceptance Criteria
Conductivity (T2)*	Daily	<1.0 umho/cm
Residual Chlorine*	Daily	<0.1 mg/L
Heterotrophic Plate Count* (T2)	Monthly	<500 CFU/mL
Total Organic Carbon	Monthly	<1.0 mg/L
Ammonia Nitrogen	Monthly	<0.1 mg/L
Organic Nitrogen	Monthly	<0.1 mg/L
Heavy Metals (Cd, Cr, Cu, Ni, Pb, Zn)	Yearly	<0.05 mg/L each, <0.10 mg/L total
Silica	Yearly	<0.1 mg/L

T2 – Also a requirement for Type II reagent water.
* – Repeated if maintenance is performed on the water treatment system or after a period of disuse longer than one month.

TABLE 6: Daily QC Bacterial Controls

Media	*E. coli*	*E. aerogenes*	*P. aeruginosa*	*E. faecalis*
Colilert® 18hr	yellow, fluorescence	yellow, no fluorescence	colorless	N/A
Colitag®	yellow, fluorescence	yellow, no fluorescence	colorless	N/A
Lauryl Sulfate Broth	gas	gas	no gas	N/A

Azide Dextrose Broth	not turbid	N/A	N/A	turbid
Brain Heart Infusion Broth with 6.5% NaCl	not turbid	not turbid	N/A	turbid
EC Medium with MUG	gas, fluorescence	no gas	no gas	N/A
Brilliant Green Bile	gas	gas	no gas	N/A

TABLE 7: Daily QC Incubation Temperatures and Times

Media	**Code**	**Temperature**	**Total Incubation Time**
Colilert® 18hr (Pre-heated)*	N/A	35.0 ± 0.5°C	18-22 hr
Colitag®	N/A	35.0 ± 0.5°C	22-48 hr (not pre-heated)
Colitag® (Pre-heated)*	N/A	35.0 ± 0.5°C	16-48 hr
Lauryl Sulfate Broth	B1	35.0 ± 0.5°C	48 ± 3 hr
Azide Dextrose Broth	B2	45.0 ± 0.5°C	48 ± 3 hr
Brain Heart Infusion Broth with 6.5% NaCl	B4	45.5 ± 0.5°C	48 ± 3
EC Medium with/without MUG	E2	44.5 ± 0.2°C	24 ± 2 hr
Brilliant Green Bile	G2	35.0 ± 0.5°C	48 ± 3 hr

*Pre-heat in water bath designated for P/A drinking water samples only.

Appendix J

Media Preparations and Quality Control

Table of Contents

1.0 MEDIA PREPARATION AND STORAGE

1.1 Media is prepared from commercial dehydrated powders. Rehydrated media is sterilized in an autoclave within 2 hours of rehydration. Pressure cookers are not used for sterilization. Measures are taken to ensure that the type and quality of media used is appropriate for the test concerned.

1.2 Fermentation Tube Preparation

1.2.1 Directions on media labels are followed for proper rehydration except for Lauryl Sulfate Broth, and Azide Broth which are prepared at double strength.
1.2.2 If necessary, media may be heated gently, while stirring, until dissolved.
1.2.3 Media is dispensed into culture tubes by 12 mL aliquots so that the final volume after sterilization is 10 mL.
1.2.4 Prepared media is autoclaved for 12-15 minutes at 250°F (121°C) and 15 lb/in^2 pressure.
1.2.5 Culture Tubes: All culture tubes are disposable. Culture tubes are large enough that the media plus the sample will not fill the tube over two-thirds full. The Durham tube diameter is at least one-half the diameter of the culture tube. Tubes are sterilized after addition of media.
1.2.6 Caps: Loose fitting caps are used for short term media. Polyurethane foam plugs are used for long term storage. Prior to initial use, Polyurethane foam plugs are autoclaved at 121°C for 15-30 minutes and are completely dry prior to use.
1.2.7 See Table 1 for the combinations of tubes, caps and racks used for media in the microbiology lab.

1.3 Agar Preparation

1.3.1 The directions for proper rehydration on the label of the media are followed. Media is dissolved by heating in a boiling water bath. After about 1-2 hours, the media should be transparent. Approximately 200 mL of the solution is poured into each 250 mL agar flask.
1.3.2 The agar flasks are placed in a metal rack, loosely capped, and autoclaved for 12-15 minutes at 250°F and 15 lb/in^2 pressure along with autoclave tape.
1.3.3 The flasks are allowed to cool until the agar is solidified, then capped tightly.

1.4 Standard Methods Agar (SMA) Melting (daily)

1.4.1 The number of samples expected for the day is estimated to determine the number of agar flasks to be melted.
1.4.2 Agar flasks filled with sterile prepared solidified agar are placed in a boiling water bath until melted. A designated temperature test agar flask is melted with each set of agar flasks.
1.4.3 The melted agar is allowed to cool to 42-46°C in a warm water bath. The temperature is monitored by placing a thermometer in the designated test agar flask.
1.4.4 Agar is used within three hours of being melted.

1.4.5 Any agar that remains at the end of the day or melted agar that contains precipitate is discarded.

1.5 Storage

1.5.1 Dried stock may be stored until the manufacturer's expiration date. If there is not manufacturer expiration date then the media will expire two years after the date received. In the event that expired media must be used, the performance of the media is verified with quality control checks to ensure that acceptable recoveries are obtained.

1.5.1.1 Powdered media is stored at room temperature in the dark.
1.5.1.2 Open containers of dried media are stored in a cool, dry area or desiccator.

1.5.2 Prepared liquid media is stored in a cool area away from direct sunlight. See Table 2 for storage time and temperature. A previous study using foam plugs showed that evaporation of media does not exceed 1 mL until after 6 weeks have elapsed. The study is documented on the Babcock server.
1.5.3 Purchased prepared media is stored according to manufacturer's instructions.
1.5.4 Media is checked for gas, turbidity or other signs of contamination or degradation, as applicable, before use.
1.5.5 All media is dated and rotated to ensure oldest media is used first.

1.6 Documentation

1.6.1 Dehydrated media is labeled with: date received, date opened, initials of the person(s) who received and opened the media, expiration date and Element ID number.
1.6.2 A preparation sheet is maintained for each batch of prepared media which includes: preparation and expiration date, preparer's initials, amount of media prepared, Element ID number of dehydrated and prepared media and sterilization and QC information.
1.6.3 Prepared media is labeled with: date made, media code, Element ID number, preparer's initials, and expiration date.

2.0 QUALITY CONTROL

2.1 See Tables 3-6 for specific QC requirements and incubation conditions for each type of prepared media.

2.2 General QC

2.2.1 Prior to use, each batch of media is tested with sterility blank and at least one positive and/or negative control; this proves that the media allows for the growth of the target bacteria and the suppression of non-target bacteria. If QC checks fail, any affected media is dumped and new media is prepared.
2.2.2 One media pH tube is prepared for each autoclave run. Tubes are allowed to cool to room temperature before the pH is taken. If the pH is outside

the acceptance criteria, the media is warmed to approximately 25°C and retested. If the pH is still out of range, it is checked again the next day. If the pH is still out of range, any media autoclaved in that run is dumped and new media is prepared.

2.2.3 Purchased ready-to-use media is checked either per lot or with the first batch of samples for which it is used. Positive controls and blanks are used to ensure accurate and reproducible results, check the quality of the media and incubation temperature and to ensure that the media, pipettes, and glassware are sterile.

2.3 Fermentation/Broth Tubes and Pathogen Enrichment Media

2.3.1 When a batch of media is prepared, three to four tubes are designated as QC tubes. One tube is designated as a blank, one or two tubes are inoculated with a reference culture that should grow on the media and one or two tubes may be inoculated with a reference culture that should not grow on the media. Negative controls are not always included.

2.4 Agar

2.4.1 An agar tri-plate is poured from each autoclave run. One section is left as a blank, another section is inoculated with a positive control and the third section is inoculated with either a negative or another positive control.

2.5 Dilution Water

2.5.1 Each lot of purchased dilution bottles is tested before use.

2.5.1.1 The pH of one random bottle is taken at approximately 25°C. If the pH is outside the manufacture's criteria it is checked again the next day. If the pH is still out of range, the pH of each bottle is adjusted before use or new media is purchased.

2.5.1.2 Sterility is checked by adding 50 mL of purchased dilution water to a bottle containing 50 mL sterile, double-strength Tryptic Soy Broth. The bottle is checked for turbidity after incubation.

3.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

3.1 All positive QC is autoclaved prior to disposal.

3.2 Refer to "Babcock Hazard Communication section of the Chemical Hygiene Plan".

4.0 REFERENCES

4.1 Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WPCF, 22nd edition, 9020.

4.2 Official Methods of Analysis of AOAC International, 17th Edition.

5.0 METHOD VARIATIONS

5.1 All *italicized items* are an indication of a variation from the method.

TABLE 1: Tube/Cap/Rack Designations for Tubed Media

Media	Tube Size	Insert Size	Cap	Rack Type
Laurel Sulfate Broth	20 X 150 mm	Large (12 X 35 mm)	Loose, long or short	Wire or plastic
Azide Dextrose Broth	20 X 150 mm	None	Foam	Wire or plastic
Brilliant Green Bile	16 X 150 mm	Small (9 X 30 mm)	Loose, long	Green plastic or Wire
EC Medium	16 X 150 mm	Small (9 X 30 mm)	Loose, short	Orange plastic or Wire
EC Medium with MUG	16 X 150 mm	Small (9 X 30 mm)	Loose, Long	Black Plastic
Brain Heart Infusion Broth with 6.5% NaCl	16 X 150 mm	None	Foam	Black Plastic

TABLE 2: Media Storage

Container Type	Maximum Storage Time	Temperature
Tubes with loose caps	2 weeks	Room temperature
Tubes with foam plugs	6 weeks	Room temperature
Screw-cap bottles	3 months	Room temperature
Agar flasks	3 months	2-8°C
Petri dish (Azide Agar)	*Until desiccation starts to occur*	*Room Temperature*
Petri dish (SMA, Selective Agars)	1 month	2-8°C

TABLE 3: Prepared Media pH and QC Incubation Conditions

Media		**Code**	**pH**	**Temperature**	**Incubation Time**
Standard Methods Agar		A1	7.0 ± 0.2	35.0 ± 0.5°C	48 ± 3 hr
Bile Esculin Azide Agar		A2	7.1 ± 0.2	35.0 ± 0.5°C	24 ± 2 hr
Eosin Methylene Blue (EMB) Agar		A3	7.1 ± 0.2	35.0 ± 0.5°C	48 ± 3 hr
Tryptic Soy Agar		A5	7.0 ± 0.2	35.0 ± 0.5°C	48 ± 3 hr
Lauryl Sulfate Broth		B1	6.8 ± 0.2	35.0 ± 0.5°C	48 ± 3 hr
Azide Dextrose Broth		B2	7.2 ± 0.2	35.0 ± 0.5°C	48 ± 3 hr
Tryptic Soy Broth		B3	7.3 ± 0.2	35.0 ± 0.5°C	48 ± 3 hr
Brain Heart Infusion Broth with 6.5% NaCl		B4	7.4 ± 0.2	44.5 ± 0.2°C	48 ± 3 hr
Buffered Peptone Water	Micro lab	B6	7.0 ± 0.2	41.5 ± 1.0°C	48 ± 3 hr
	Food lab			37.0 ± 1.0°C	21 ± 1 hr
Demi-Frasier Broth	Micro lab	B7	7.2 ± 0.2	30.0 ± 1.0°C	48 ± 3 hr
	Food lab			35.0 ± 2.0°C	26 ± 2 hr
EC Medium		E1	6.9 ± 0.2	44.5 ± 0.2°C	24 ± 2 hr
EC Medium with MUG		E2	6.9 ± 0.2	44.5 ± 0.2°C	24 ± 2 hr
Brilliant Green Bile		G2	7.2 ± 0.2	35.0 ± 0.5°C	48 ± 3 hr
Sterile Nanopure Water (90mL)		N1	N/A	35.0 ± 0.5°C	24 ± 2 hr
Sterile Nanopure Water (100mL)		N2	N/A	35.0 ± 0.5°C	24 ± 2 hr
Purchased Dilution Water		N/A	See COA	35.0 ± 0.5°C	24 hr

TABLE 4: Bacterial Controls for Prepared Agars and Broths

Media	***E. coli***	***E. aerogenes***	***P. aeruginosa***	***E. faecalis***
Standard Methods Agar (SMA)	growth	growth	N/A	N/A
Bile Esculin Azide Agar	no black growth	N/A	N/A	black growth
Eosin Methylene Blue (EMB) Agar	growth, green sheen	N/A	opaque growth	no growth
Tryptic Soy Agar (TSA)	growth	growth	N/A	N/A
Lauryl Sulfate Broth	gas	gas	no gas	N/A
Azide Dextrose Broth	no turbidity	no turbidity	N/A	turbid
Tryptic Soy Broth	turbid	turbid	tubid	N/A
Brain Heart Infusion Broth with 6.5% NaCl	no turbidity	no turbidity	N/A	turbid
EC Medium	gas	no growth	no growth	N/A
EC Medium with MUG	gas, fluorescence	no growth	no growth	N/A
Brilliant Green Bile	gas	gas	no gas	N/A

TABLE 5: Dilution Water and Nanopure QC

Media	**QC Preparation**	**Appearance after Incubation**
Purchased Dilution Water	3 g TSB + 50 mL Nanopure + 50 mL dilution water	no turbidity
Sterile Nanopure Water (90 or 100 mL)	3 g TSB in 100 mL Nanopure	no turbidity

Appendix K-1

Sample Containers, Preservation Techniques, and Holding Times For Aqueous Matrices

Bacteriological Analyses

Determination	Method	Container/ Volume (mL)	Preservative	Holding Time[1]
Coliform, Total	SM9221BC,SM9223	P,G/Sterile/100	recom.<10°C[9]	8hrs nonDW aqueous/30hrsDW
Coliform, Fecal	SM9221BE,SM9223	P,G/Sterile/100	recom.<10°C[9]	8hrs nonDW aqueous/30hrsDW
Enterococcus	SM9230B,	P,G/Sterile/100	recom.<10°C[9]	8hrs nonDW aqueous/30hrsDW
	ASTM D650399 (Enterolert)	P,G/Sterile/100	recom.<10°C[9]	8hrs nonDW aqueous/30hrsDW
Heterotrophic Plate Ct.	SM9215B	P,G/Sterile/100	recom.<10°C[9]	8hrs nonDW aqueous/30hrsDW
Streptococcus, Fecal	SM9230B	P,G/Sterile/100	recom.<10°C[9]	8hrs nonDW aqueous/30hrsDW

Bacteriological Analyses-Food and Bottled Beverages

Determination	Method	Container/ Volume (mL)***	Preservative	Holding Time[1]
Yeast & Mold	AOAC 2014.05	P,G/Sterile/100	None	NA
APC	AOAC 990.12	P,G/Sterile/100	None	30hrsDW/NA
E. Coli	AOAC 991.14	P/G/Sterile/100	Sodium Thiosulfate	30hrsDW/NAother
Coliform, Total	AOAC 991.14	P/G/Sterile/100	Sodium Thiosulfate	30hrsDW/NA other

Inorganic Wet Chemistry Analyses

Determination	Method	Container/ Volume (mL)	Preservative	Holding Time[1]
Alkalinity*	SM2320B	P,G/500	≤6°C	14 days
Ammonia	SM4500NH3G,H	P,G/100	≤6°C H_2S0_4	28 days
Asbestos	100.2	P/1000	≤6°C	48 hours[10]
BOD*	SM5210B	P,G/1000	≤6°C	48 hours
Boron	EPA 200.7	P/500	$HN0_3$[7]	6 months
Bromate	EPA 300.1	P,G/100	EDA[13]	28 days
Bromide*	EPA 300.1	P,G/100	None	28 days
Cations(Ca,Mg,Na,K)	EPA200.7/6010B	P,G/500	$HN0_3$[7]	6 months
COD	SM5220D	P,G/100	≤6°C, H_2S0_4	28 days

Chlorine demand	SM2350B	P,G/1000	None	15 minutes
Chlorine dioxide*	SM4500ClO2D	P,G,/100	None	15 minutes
Chlorine, residual*	SM4500ClG	P,G/100	None	15 minutes
Chlorate	EPA 300.1	P,G/100	EDA[13]	28 days
Chlorite	EPA 300.1	P,G/100	≤6°C,EDA[13]	14 days
Chromium-Hexavalent	SM3500CrD	P,G/100	≤6°C, NH_4Buffer[11]	DW/WW 28 days
Chromium-Hex.(low level)	EPA 7199	P,G/100	≤6°C	24 hours
	EPA218.6/ 218.7	P,G/100	≤6°C, Na_2CO3, $NaHCO_3$ & $(NH4)_2SO4$[14] OR $(NH4)^2SO4$ & NH4OH	14 days
Color*	SM2120B	P/G/100	≤6°C	48 hours
Cyanide	SM4500CNC E G	P,G/250	≤6°C NaOH	14 days
Dissolved Oxygen	SM4500 O C	G/300	Fixed on site	8 hours
Flashpoint	EPA 1010	G/500	None	Not Specified
Fluoride*	SM4500F B C	P/100	None	28 days
	EPA 300.0	P,G/100	None	28 days
Hardness (Total)	EPA 200.7	P,G/500	$HN0_3$[7]	6 months
Metals ICP (incl. Cations)	EPA 200.7,6010B	P,G/500	$HN0_3$[7]	6 months
Metals ICPMS	EPA 200.8,6020	P,G/500	$HN0_3$[7]	6 months
Copper/Lead Rule	EPA 200.8	P,G/1000	None[12]	6 months
Mercury	EPA 7470A,200.8	P,G/500	$HN0_3$[7]	28 days
	SM3112B	P,G/500	$HN0_3$[7]	28 days
Nitrate*	EPA 300.0	P,G/100	≤6°C	48 hours
Nitrite*	SM4500NO_2B	P,G/100	≤6°C	48 hours
	EPA 300.0	P,G/100	≤6°C	48 hours
Nitrogen–Total Kjeldahl	EPA 351.2	P,G/500	≤6°C, H_2S0_4	28 days
Odor	SM2150B	G/250	≤6°C	24 hours
Oil & Grease	EPA 1664	G-A/500[8]	≤6°C, H_2S0_4	28 days
PCBSA*	EPA 300.0	P,G/100	None	28 days
Perchlorate	EPA 314	P,G/100[15]	≤6°C	28 days
Perchlorate (low level)	EPA332.0/6860	P,G/100 sterile or	≤6°C	28 days
		P,G/100[15]	≤6°C	28 days
pH*	SM4500H+B	P,G/100	None	15 minutes
Phenols	EPA 420.4	G-A/250	≤6°C[5], H_2S0_4	28 days
Phosphates – Ortho	SM4500P E	P,G/100	≤6°C	48 hours
Phosphorus, Total (as P)	SM4500P E	P,G/100	≤6°C, H_2S0_4	28 days
Silica, Reactive*	SM4500 SiO_2C	P/500	≤6°C	28 days
Silica Total	EPA 200.7	P/500	$HN0_3$[7]	6 months
Solids-Dissolved-TDS*	SM2540C	P,G/500	≤6°C	7 days
Solids-Suspended-TSS*	SM2540D	P,G/500	≤6°C	7 days
Solids-Total*	SM2540B	P,G/500	≤6°C	7 days
Solids-Settleable*	SM2540F	P,G/1000	≤6°C	48 hours
Solids-Volatile*	EPA 160.4	P,G/500	≤6°C	7 days
Specific Conductance-EC*	SM2510B	P,G/100	≤6°C	28 days
Sulfate*	EPA 300.0	P,G/100	≤6°C	28 days
Sulfide, dissolved	SM4500S D	P,G/100	≤6°C Floc in field	15 min/7 flocZnAc
Sulfide, total	SM4500S D	P,G/100	≤6°C NaOH,ZnAcetate	7 days
Surfactants (MBAS)*	SM5540C	P,G/500	≤6°C	48 hours
Turbidity*	SM2130B	P/G/100	≤6°C	48 hours
Uranium	EPA 200.8	P,G/500	$HN0_3$[7]	6 months
UV254	SM 5910B	G-TLC-A/250	≤6°C	48 hours

Volatile Acids	SM5560C	P,G/500	<6°C	7 days

Radiochemistry Analyses

Determination	Method	Container/ Volume (mL)	Preservative	Holding Time[1]
Gross Alpha	EPA 900.0,9310	P,G/1000	$HN0_3$[4]	6 months
Gross Beta	EPA 900.0,9310	P,G/1000	$HN0_3$[4]	6 months
Uranium	EPA 908.0	P,G/1000	$HN0_3$[4]	6 months
Radium 226	EPA 903.1	P,G/1000	$HN0_3$[4]	6 months
Radium 228	EPA 904.0,9320	P,G/2000	$HN0_3$[4]	6 months
Radon	EPA 913	G-TLC-A /2 x 250	≤6°C	4 days
Strontium 90	EPA 905.0	P,G/1000	$HN0_3$[4]	6 months
Tritium	EPA 906.0	G/1000	None	6 months

Additional Analyses

Determination	Method	Container/ Volume (mL)	Preservative	Holding Time[1]
Chemicals:				
Metals: Ge,Mn	EPA 200.8	P/125	$HN0_3$[7]	Recom. 28/28 days
Pesticides/Byproduct	EPA 525.5	G-A/2 x 1000	Ascorbic acid, EDTA, Potassium dihydrogen citrate	14/28 days
Semivolatiles	EPA 530	G-A/2 x 1000	Trizma, Ascorbic acid, EDTA, Diazolidinyl urea	14/14 days
Alcohols	EPA 541	G-TLC-A /2 x 60 vial	Sodium sulfate, sodium bisulfate	28/28 days
Cyanotoxins:				
Microcystins, Nodularin	EPA 544	G-A/2 x 550	Trizma, Ascorbic acid, EDTA, 2-Chloroacetamide	28/28 days
Anatoxin-a, Cylindrospermopsin	EPA 545	G-TLC-A /2 x 60 vial	Ascorbic acid, sodium bisulfate	28 days
Total Microcystins (ELISA)	EPA 546	G-TLC-A /2 x 40 vial	Sodium thiosulfate	14 days

Organic Analyses

Determination	Method	Container/ Volume (mL)	Preservative	Holding Time[1] Extraction/Analysis
Semivolatiles, N.P.Pest.	EPA525	G-TLC-A/1000	≤6°C [3], HCl	14/30 days
Base/Neutrals/Acid	EPA625.1	G-TLC-A/1000	≤6°C [3]	7/40 days
	EPA8270	G-TLC-A/1000	≤6°C [3]	7/40 days
Carbamates	EPA531.2	VOA-G-A/3 x 40 vials	≤6°C, $Na_2S_2O_3$, PDC	28 days
Chlorinated pests/PCB's	EPA505	G-TLC-A/2 X 40 vial	≤6°C, $Na_2S_2O_3$	7/1 days[6]
Chlorinated pesticides	EPA608,8081	G-TLC-A/1000	≤6°C [3]	7/40 days[6]
Polychlorinated Biphenyls	EPA 608.3	G-TLC-A/1000	≤6°C	7/40 days
	EPA 8082	G-TLC-A/1000	≤6°C	7/40 days
Chlorinated Herbicides	EPA515.3	G-TLC-A/1000	≤6°C [3]	14/14 days
	EPA8151	G-TLC-A/1000	≤6°C [3]	7/40 days
Diesel Range Organics	EPA8015B	VOA-G/4 x 40 vials, TB[2]	≤6°C, HCl or H_2SO_4	7 days
Dioxins	EPA1613B	G-A/1000	≤6°C [3]	30 days
Diquat	EPA 549.1	P/1000, A	≤6°C [3],H_2SO_4[16]	7/21 days[10]
EDB and DBCP	EPA 504, 8011	VOA-G-A/3x40vials,TB	≤6°C, $Na_2S_2O_3$	14 days
Endothall	EPA548.1	G-A/500	≤6°C [3]	7/14 days
Ethylene Glycol	GCFID/MS(8015-Mod)	G-TLC-A/1000	≤6°C	40 days
Gasoline Range Orgs.	EPA 8015B	VOA-G/4 x 40 vials	≤6°C, HCl	14 days
Glyphosate	EPA547	VOA-G/3 x 40 vials	≤6°C, $Na_2S_2O_3$	14 days[6]
Haloacetic Acids	SM6251B	VOA-G/2 x 40 vials,TB	≤6°C, NH_4Cl	14/21 days
Haloacetic Acids	EPA552.3	VOA-G/4 x 60 vials,TB	≤6°C, NH_4Cl	14/28 days
Organophos. Pests.	EPA8270C	G-TLC-A/1000	≤6°C [3]	7/40 days[6]
Perfluorinated Compounds	EPA 537	PP/ 250, TB	≤6°C, Trizma	14/28 days
Total Organic Carbon	SM5310B	G/4 x 40 vials	≤6°C, H_2S0_4	28 days
Total Organic Halogen	SM 5320B	G-TLC-A/250	≤6°C [3], H_2S0_4	28 days
TPH	EPA418.1	G-TLC-A/1000	≤6°C, H_2S0_4	28 days
Trihalomethanes	EPA 524.2	VOA-G-A/4 x 40 vials,TB[2]	≤6°C, $Na_2S_2O_3$ (or HCL + ascorbic acid)	14 days
Formation Potential	EPA524.2	VOA-G-A/4 x 40 vials,TB	≤6°C	10 days
Maximum Potential	EPA 524.2	VOA-G-A/4 x 40 vials,TB	≤6°C	7 days
Volatile Organics	EPA524.2,624,8260	VOA-G/4 x 40 vials,TB[2]	≤6°C, HCl[3]	14 days*

*holding times vary for acrolein, acrylonitrile, 2CEVE (3 or 7 days)

Notes:

G=Glass, P=Polyethylene (plastic), PP= Polypropylene G-A=Amber Glass, VOA=Vial with Teflon-lined septum – zero head space, G-TLC-A=Amber Glass with Teflon-lined cap, Recomm.=recommended, NA=Not Applicable, TB=Travel Blank, °C = degrees, floc = flocculate, EDA = Ethylenediamine
DW = drinking water, GW = groundwater, SW = storm water, WW = wastewater

SM refers to Standard Methods for the Examination of Water and Wastes, 22nd Edition unless otherwise noted.

* All of these analyses can be performed out of one 1/2 gallon plastic container.
*** Bottled Beverage samples for Bacteriological analyses are submitted in sealed product containers provided by client. Container size depends on product container.

1. Holding times per 40 CFR 141 for drinking waters, and CFR 136.3 for wastewaters. Preservative, as indicated, must be present for holding time to be valid.
2. Travel Blank (also preserved with HCl).
3. If Chlorine Residual is present, ascorbic acid (524.2) or sodium sulfite (525) or sodium thiosulfate (all other methods) is needed to neutralize free chlorine. Dechlorinator must be added prior to additional preservation.

Nonvolatile samples, suspected of containing chlorine, are screened for chlorine and additional dechlorinator is added as needed. Consult method.
4. Sample preserved at lab after Electrical Conductivity is checked.
5. Preserved sample is screened for chlorine as necessary and treated at lab. See SOP G-245 for more details.
6. See method exceptions.
7. Sample can be preserved at lab in its original container and must be held > 24 hrs. prior to analysis. (> 16 hrs. for UCMR)
8. Grab sample only.
9. With Sodium thiosulfate
10. Analysis is subbed out. Please allow extra time for short holding time analyses.
11. Wastewater samples should be filtered in the field (within 15 minutes) and preserved by the laboratory within 24 hours. Drinking water samples should be preserved in the field and filtered at the bench. Preservation includes addition of NH4 buffer to pH 9.0-9.5.
12. For client safety, sample is preserved at lab with nitric acid, in its original container, and held > 28 hrs. prior to analysis.
13. Sparge sample with an inert gas (helium, argon, nitrogen) prior to preservation if chlorine dioxide is present.
14. The NH4OH/(NH4)2SO4 preservative serves as buffer and dechlorinating agent. May be added to sample bottles prior to shipment. Apply the preservative at the rate of 1 mL per 100 mL of sample.
15. Sample must be submitted with headspace. Fill sample container no more than half full to ensure sample is aerobic.
16. Samples which are biologically active must be preserved by adding sulfuric acid to pH 2 to prevent adsorption of method analytes by the humectant material.

Basic Sampling Guidelines

A. Always utilize proper sampling containers and preservatives.
B. For organic analytes, all bottles should have Teflon lined lids, vials should have Teflon lined septa.
D. Aqueous samples for volatile analyses should not have head space between the sample matrix and septum, or bubbles within the sample.
E. Samples requiring organic analyses should never be handled with plastic implements, latex gloves, or stored in plastic containers. Glass is the only acceptable container (except EPA 549).
F. Always use trip blanks when samples require volatile analyses. Fill completely, eliminate all headspace.
G. Keep samples isolated from all possible sources of contamination (i.e., gasoline refueling operations, solvents, paints, lacquers, and adhesives).
H. Always complete a Chain-of-Custody form.
I. Use blue ice packs in coolers when possible. Unless not appropriate for particular containers/analysis.
J. Deliver samples directly to the laboratory as soon as possible.

Appendix K-2

Sample Containers, Preservation Techniques, and Holding Times For Non-Aqueous Matrices

Bacteriological Analyses

Determination	Method	Container/ Volume	Preservative	Holding Time[1]
Coliform, Total	SM9221B,SM9223	G,P Sterile 8 oz	recom.<10°C	24hrs
Coliform, Fecal	SM9221E,SM9223	G,P Sterile 8 oz	recom.<10°C	24hrs
Enterococcus	SM9230B	G,P Sterile 8 oz	recom.<10°C	24hrs
	ASTM D650399/ Enterolert	G,P Sterile 8 oz	recom.<10°C	24hrs
Heterotrophic Plate Ct.	SM9215B	G,P Sterile 8 oz	recom.<10°C	24hrs
Streptococcus, Fecal	SM9230B	G,P Sterile 8 oz	recom.<10°C	24hrs

Bacteriological Analyses-Food and Bottled Beverages

Determination	Method	Container/ Volume***	Preservative	Holding Time[1]
Yeast & Mold	AOAC 2014.05	G,P/Sterile/25grams	None	NA
APC	AOAC 990.12	G,P/Sterile/25grams	None	NA
E. Coli	AOAC 991.14	G,P /Sterile/25grams	None	NA
Coliform, Total	AOAC 991.14	G,P /Sterile/25grams	None	NA

Inorganic Wet Chemistry Analyses

Determination	Method	Container/ Volume	Preservative	Holding Time[1]
Alkalinity	SM2320B	G, P 8 oz	≤6°C	14 days
Ammonia	SM4500NH3G,H	G,P 8 oz	≤6°C	28 days
Asbestos	EPA 100.2	G,P 8 oz	≤6°C	48 hours[2]
BOD	SM5210B	G, 8 oz	≤6°C	48 hours
Boron	EPA 6010B	G, 8 oz	None	6 months
Bromate	EPA 300.1	G, 8 oz	None	28 days
Bromide	EPA 300.1	G, 8 oz	None	28 days
Cations(Ca,Mg,Na,K)	EPA 6010B	G, 8 oz	None	6 months
COD	SM5220D	G, 8 oz	≤6°C	28 days
Chloride	EPA 300.0	G, 8 oz	None	28 days
Chlorate	EPA 300.1	G, 8 oz	None	28 days
Chlorite	EPA 300.1	G, 8 oz	≤6°C	14 days
Chromium-Hex	EPA 7199/7196	G, 8 oz	≤6°C	28/1 days

Cyanide	EPA9012	G, 8 oz	None	14 days
Oxygen-Consumption Rate	SM 2710B	G, 8 oz	None	14 days
Flashpoint	EPA 1010	G, 8 oz	None	Not Specified
Fluoride	EPA 9214	P/8oz	≤6°C	28 days
	EPA 300.0	G,P 8 oz	None	28 days
Hardness (Total)	EPA 6010B	G, 8 oz	None	6 months
Metals ICP (incl. Cations)	EPA 6010B	G, 8 oz	None	6 months
Metals ICPMS	EPA 6020	G, 8 oz	None	6 months
Mercury	EPA 7471	P,G/8 oz	≤6°C	28 days
	EPA 6020A	P,G/8 oz	≤6°C	28 days
Nitrate	EPA 300.0	P,G/8 oz	≤6°C	48 hours
Nitrite	SM4500NO_2B	P,G/8 oz	≤6°C	48 hours
	EPA 300.0	P,G/8 oz	≤6°C	48 hours
Nitrogen–Total Kjeldahl	EPA 351.2	P,G/8 oz	≤6°C	28 days
Oil & Grease	EPA 9071B	P,G/8 oz	≤6°C	28 days
PCBSA	EPA 300.0	P,G/8 oz	None	28 days
Perchlorate	EPA 314	P,G/8 oz	≤6°C	28 days
Perchlorate (low level)	EPA 6860	P,G/8 oz	≤6°C	28 days
pH	EPA 9045C	P,G/8 oz	None	15 minutes
Phenols	EPA 9065	P,G/8 oz	≤6°C	28 days
Phosphates – Ortho	SM4500P E	P,G/8 oz	≤6°C	48 hours
Phosphorus, Total (as P)	SM4500PE(Mod)	P,G/8 oz	≤6°C	28 days
Silica Total	EPA 6010B	P,G/8 oz	None	6 months
Solids-Dissolved-TDS	SM2540C	P,G/8 oz	≤6°C	7 days
Solids-Suspended-TSS	SM2540D	P,G/8 oz	≤6°C	7 days
Solids-Total	SM2540G	P,G/8 oz	≤6°C	7 days
Solids-Volatile	SM 2540G	P,G/8 oz	≤6°C	7 days
Specific Conductance-EC	SM 2510B	P,G/8 oz	≤6°C	28 days
Sulfate	EPA 300.0	P,G/8 oz	≤6°C	28 days
Surfactants (MBAS)	SM5540C	P,G/8 oz	≤6°C	48 hours
Volatile Acids	SM5560C	P,G/8 oz	<6°C	7 days

Organic Analyses Determination	**Method**	**Container/ Volume (mL)**	**Preservative**	**Holding Time[1] Extraction/Analysis**
Semivolatiles				
Base/Neutrals/Acid,	EPA 8270	G-TLC-A/8 oz	≤6°C	14/40
Chlorinated pesticides	EPA608,8081	G-TLC-A/8 oz	≤6°C	14/40 days
Polychlorinated Biphenyls	EPA 608	G-TLC-A/8 oz	≤6°C	14/40 days
	EPA 8082	G-TLC-A/8 oz	≤6°C	14/40 days
Chlorinated Herbicides	EPA 8151	G-TLC-A/8 oz	≤6°C	14/40 days
Diesel Range Organics	EPA 8015B	G-TLC-A/8 oz	≤6°C	14 days
Dioxins	EPA 1613B	G-A/8 oz	≤6°C	30 days
Ethylene Glycol	GCFID/MS(8015-Mod)	G-TLC-A/8 oz	≤6°C	40 days
Gasoline Range Orgs.	EPA 8015B	G-TLC-A/8 oz	≤6°C	14 days
Organophos. Pests.	EPA 8270	G-TLC-A/8 oz	≤6°C	14/40 days
Total Organic Carbon	EPA 9060	P,G/8 oz	≤6°C	28 days
TPH	EPA 418.1	G-TLC-A/8 oz	≤6°C	28 days
Volatile Organics	EPA 624,8260	G-TLC-A/8 oz	≤6°C	14 days

Notes:

G=Glass, P=Polyethylene (plastic), G-A=Amber Glass, VOA=Vial with Teflon-lined septum, G-TLC-A=Amber Glass with Teflon-lined cap, NA=Not Applicable, °C = degrees

SM refers to Standard Methods for the Examination of Water and Wastes, 22nd Edition unless otherwise noted. All other methods referenced are EPA Method Numbers or AOAC Method Numbers.

1. Holding times per analytical methods and SW-846. Preservative, as indicated, must be present for holding time to be valid.
2. Analysis is subbed out. Please allow extra time for short holding time analyses.

Basic Sampling Guidelines

A. Always utilize proper sampling containers and preservatives.
B. For organic analytes, all bottles should have Teflon lined lids, vials should have Teflon lined septa.
C. Soil samples are typically collected in brass or steel tubes and wide mouth jars (500ml) with Teflon-lined caps. Sludges should be collected in wide mouth jars, not brass or steel tubes.
D. Samples requiring organic analyses should never be handled with plastic implements, latex gloves, or stored in plastic containers. Glass is an acceptable container.
E. Keep samples isolated from all possible sources of contamination (i.e., gasoline refueling operations, solvents, paints, lacquers, and adhesives).
F. Always complete a Chain-of-Custody form.
G. Use blue ice packs in coolers when possible.
H. Deliver samples directly to the laboratory as soon as possible.

Appendix L

Department of Defense (DOD) Requirements

This appendix outlines DOD specific Quality Systems requirements to be followed for all DOD analytical work. These requirements are additional to those included in this Quality Manual. Requirements are noted below and include the section reference from the Quality Manual for additional information if applicable.

Section 5: Management

5.5.2 Standard Operating Procedures (SOPs)

Standard operating procedures for DOD work such as technical methods, analytical procedures, sample receipt and sample storage are reviewed on an annual basis. Reviews and any needed SOP updates are performed by qualified staff per the Babcock SOP review and modification procedures. (SOP G-100 SOP Review and Modification)

All DOD technical SOPs, in addition to the information noted in Sec 5.5.2 of this Quality Manual, are written to include the following additional requirements:

- Equipment and Instrumentation maintenance (or reference to)
- Computer hardware and software utilized
- Trouble-shooting procedures and tips

Section 7: Review of Requests, Tenders and Contracts

Requests or client contracts regarding DOD projects will be completed in accordance with the DOD QSM requirements. Any request to waive a QSM requirement must be submitted in writing from the DoD Chemist, technical director, quality assurance manager or designee. The request must include the technical justification noted in addition to the specific client or project information.

Documentation noting the waiver approval is maintained by the laboratory and readily available upon request.

Section 8: Subcontracting of Environmental Tests

The laboratory will ensure that any subcontracted labs utilized for DOD work meet the requirements of the DOD QSM. Subcontract lab documents verifying this requirement are kept on file.

Subcontracted labs performing DOD analytical services must be accredited in accordance with the project.

Any subcontracted lab utilized for DOD work projects will be approved by the DOD client prior to their use. Babcock lab maintains a record of this approval.

Section 10: Service to the Client

The laboratory will notify DOD clients prior to any anticipated changes in the LIMS system that could affect client electronic data negatively. Prior to changes in LIMS, the client will be contacted by the laboratory and notified of the upcoming update. Communication will be either verbal or in writing and documented. Clients will be notified at least 24 hours before the LIMS update is completed.

Section 12: Control of Non-Conforming Environmental Testing Work

The laboratory will submit documentation regarding corrective actions and action plans, if applicable, to the DOD customer within thirty (30) business days of the discovery of the nonconformance.

Any nonconformance identified as a violation to the lab's Ethics and Data Integrity policies and procedures will be addressed by the lab. The lab will report the issue to the AB-Accrediting Body (Ex: ANAB) within fifteen (15) business days of discovery. Failure to notify the AB within 15 days will result in immediate suspension of the lab's DOD ELAP accreditation. Once reported to the AB, the laboratory will submit the associated corrective action and supporting documentation or proposed corrective action to the AB within thirty (30) business days of the discovery of the issue. It is then the responsibility of the AB to notify the Environmental Data Quality Workgroup (EDQW) of the infraction as they are deemed serious and require attention.

Section 14: Corrective Action

Approved corrective actions performed in response to findings from assessments by ABs (Ex: ANAB) must be implemented. The laboratory's DOD accreditation may be withdrawn if deliberate failure of the laboratory to implement these corrective actions as documented. This may result in the suspension of any DOD project work performed by the laboratory until implementation in completed and approval from the AB is received.

Section 22: Test Methods and Method Validation

Sec 22.3

DoD/DOE allows method modifications as described in the November 20, 2007 USEPA Memorandum on method flexibility.

Section 26: Handling Samples and Test Items

In addition to the lab's disposal procedures outlined in Section 26.8 of this Quality Manual and the Babcock Safety and Health Program, DOD project samples are also subjected to the following procedures:

- DOD samples are not disposed of before set project specific timelines unless approval to dispose is provided by the client.
- For samples where the entire volume is used during analysis, sample disposal is documented as such.
- All conditions of disposal and all records and correspondence concerning the final disposition of the physical sample are recorded and retained.
- Records of disposal should include the date of disposal, manner of disposal and person who performed the disposal.
- DOD samples requiring Legal Evidentiary Custody will also be:
  - Stored in a secure space that can be locked from the outside
  - Distributed to the appropriate analyst(s) by the sample custodian or designee, if possible.
  - After sample analyses are completed, any unused volume of sample is returned to the sample custodian. Sample labels such as lab work order label and sample labels remain on the sample container.
    - The sample is retained in custody until either the sample custodian or authorized designee releases the sample for disposal.
  - If any samples, subsamples, etc. must be transported to another party, all legal custody procedures will be followed.

Section 27: Quality Assurance for Environmental Testing

27.1

For DOD project work, in-house control limits are generated using a minimum of 30 data points. Control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery.

In-house control limits are monitored for DOD test methods are monitored at least quarterly.

- The QA Officer or designee reviews control charts at a specified frequency for out-of-control conditions and initiate appropriate corrective actions.
- In-house statistically LCS control limits are established for the purpose of trend analysis and may use in-house control limits as a component in estimating measurement uncertainty.
- In the absence of client specified LCS reporting criteria, the LCS control limits outlined in the QSM Appendix C tables are used when reporting data for DoD/DOE projects. Labs develop processes or procedures to incorporate these limits.

27.2

LCS/BS:

For any DOD specific test method, the LCS will include all reported analytes. Due to interferences between some analytes, multiple LCS samples may be made to prevent issues with analyte interferences. A reported analyte will not be excluded from the LCS due to interference issues with fellow analytes.

Random marginal exceedances are not allowed for those analytes determined by a project to be target analytes without project specific approval.

DoD considers the same analyte exceeding the LCS control limit two (2) out of three (3) consecutive LCS to be indicative of non-random behavior, which requires corrective action and reanalysis of the LCS.

For analytes that are not listed in the QSM Appendix C control limits tables, the lab uses in-house control limits for batch control and data reporting.

For DoD ELAP accreditation, a lab develops in-house control limits for all analytes on their scope of accreditation.

MS/MSD:

If adequate sample material is not available, then the lack of MS/MSDs (or MD) is noted in the case narrative, and a LCS Duplicate (LCSD) shall be used to determine precision.

27.4 Data Review

Additional data review of at least 10% of all DOD data packages will be performed by the quality manager or designee. Reviews will be completed on a quarterly basis. Data packages are reviewed for accuracy, compliance and technical completeness. During the review, if any quality issues are noted, corrective action will be taken per procedures outlined in section 14 of this Quality Manual if applicable. The client will be notified of the issue upon discovery per section 12 of this Quality Manual.

Section 28: Reporting the Results

Qualifiers: The following DOD specific qualifiers will be used at a minimum by the laboratory unless project-specific qualifiers are requested.

- U – Analyte was not detected and is reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
- J – The reported result is an estimated value (e.g., matrix interference was observed or the analyte was detected at a concentration outside the calibration range).
- B – Blank contamination. The recorded result is associated with a contaminated blank.
- N – Non-target analyte. The analyte is a tentatively identified compound using mass spectrometry or any non-customer requested compounds that are tentatively identified.
- Q – One or more quality control criteria failed (e.g., LCS recovery, surrogate spike recovery, or CCV recovery).

Additional qualifiers may be utilized on DOD project samples if approved for use under DOD requirements.

Test Reports: In addition to the information listed in section 28.1 of this Quality Manual, DOD project test reports will include start and stop dates and times of the batch preparation if applicable. For example- Start time for extraction it is the moment that extraction solvent touches the sample; for "Analysis" it is the moment that the extract is introduced into the instrument.

Appendix A: Ethics and Data Integrity Manual Section 4-Ethics, Data Integrity and Fraud

In addition to the "Examples of Fraud (Unethical Practices)" included in section 4, the following specific practices are also prohibited:

- Using external analysts, equip., and/or labs to perform analyses when not allowed by contract
- Resetting the internal clock on an instrument to make it appear that a sample was analyzed within holding time when in fact it was not
- Unjustified dilution of samples
- Manipulating GC/MS tuning data to produce an ion abundance result that appears to meet specific QC criteria
- Changing the instrument conditions for sample analysis from the conditions used for standard analysis (e.g., changing EM voltage)
- Unwarranted manipulation of computer software (e.g., forcing calibration or QC data to meet criteria, removing computer operational codes such as the "M" flag, inappropriately subtracting background, or improperly manipulating the chromatographic or spectrophotometric baseline)
- Turning off, or otherwise disabling, electronic instrument audit/tracking functions
- Representing spiked samples as being digested or extracted when this has not been done
- Substituting previously generated runs for a non-compliant calibration or QC run to make it appear that an acceptable run was performed
- Failing to prepare or analyze method blanks and the lab control sample (LCS) in the same manner that samples were prepared or analyzed
- Tampering with QC samples and results, including over spiking and adding surrogates after sample extraction
- Performing multiple calibrations or QC runs (including CCVs, LCSs, spikes, duplicates, and blanks) until one meets criteria, rather than taking needed corrective action, and not documenting or retaining data for the other unacceptable data
- Deleting or failing to record non-compliant QC data to conceal the fact that calibration or other QC analyses were non-compliant
- Improper calibrations
- Discarding points in the initial calibration to force the calibration to be acceptable
- Discarding points from an MDL study to force the calculated MDL to be higher or lower than the actual value
- Using an initial calibration that does not correspond to the actual run sequence to make continuing calibration data look acceptable when in fact is was not
- Concealing a known analytical or sample problem

- Failing to report the occurrence of a prohibited practice or known improper or unethical act to the appropriate lab or contract representative, or to an appropriate government official.

Appendix H-Chemistry

For DOD Test Methods:

MDL-RL:

If MDL/RL verifications are not performed on all combinations (all preparation or extraction techniques, clean-up procedures, etc.) the lab bases the LOD/LOQ verifications on the worst-case basis.

After each MDL determination, the lab establishes the LOD by spiking a quality system matrix at a concentration of at least 2 times but no greater than 4 times the MDL.

MDLs are established by the laboratory using methods which are accepted and approved by recognized entities for each analyte-matrix-method including surrogates.

Sensitivity is measured by comparing the signal to noise (S/N) ratio of an analyte in one RL standard versus another. The standard with the higher S/N ratio demonstrates a system that is more sensitive. For DOD test methods S/N ratio at the MDL should be at least three in addition to meeting method requirements.

For data systems that do not provide a measure of noise, the signal produced by the verification sample produces a result that is at least three standard deviations greater than the mean method blank concentration. This is initially estimated based on a minimum of four method blank analyses and later established with a minimum of 20 method blank results.

If an MDL verification study fails, then the labs repeats the study and verification or performs and pass two consecutive LOD verifications at a higher spike concentration and set the LOD at the higher concentration.

Regarding quarterly RL verifications for methods which are not analyzed on a regular basis, verifications may need to be performed by batch prior to sample analysis. LOD verifications may be done every batch if analysis batches are sparse (ie: <1 batch/month).

LOD verification is performed on a quarterly basis using any cleanup steps that are used in the procedure. LOD verifications are performed by spiking one QC sample at 2 to 4 times the MDL. The LOD is verified if the S/N ratio > 3 for the analyte and the ion ratios meet criteria. Refer to Technical SOP(s) for complete procedure.

Selectivity:

For DOD test methods that require secondary column confirmations, project-specific reporting requirements are followed when reporting data:

- When reporting data for methods that require analyte confirmation using a secondary column or detector, project-specific reporting requirements are followed.
- If project-specific requirements have not been specified, follow the reporting requirements in the method.
- If the method does not include reporting requirements, then report the results from the primary column or detector, unless there is a scientifically valid and documented reason for not doing so and is concurred with by the client.
- The client is notified of any results that are unconfirmed
- Analyte presence is indicated only if both original and confirmation signals are positive or if confirmation signal cannot be discerned from interference.

Calibration:

For DOD project work, initial instrument calibrations are verified with a second source standard at a concentration at or near the midpoint of the calibration range.

DOD calibrations will be evaluated by the analysis of a CCV standard at a concentration greater than the low calibrator but less than or equal to the midpoint of the calibration curve.

Continuing Calibration:

If a CCV fails, the lab can immediately analyze two additional consecutive CCVs. For DOD analyses "immediately" is defined as starting a consecutive pair within one hour; no samples can be run between the failed CCV and the two additional CCVs.

Flagging of data for a failed CCV is only appropriate when the affected samples cannot be reanalyzed. The lab notifies the client prior to reporting data associated with a failed CCV.