SAN DIEGO RIVER WATERSHED
QUALITY ASSURANCE PROJECT PLAN

Submitted to:
California Regional Water Quality Control Board, San Diego Region
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Prepared by:

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On behalf of:
County of San Diego
City of San Diego
City of Santee
City of El Cajon
City of La Mesa

November 2015
AMEC Project No. 5025144046

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1.0 TITLE AND APPROVAL SHEETS

San Diego River Watershed
Quality Assurance Project Plan
Bacteria TMDL Monitoring Program

QAPP Revision Number: 4.0

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APPROVAL SIGNATURES

PROJECT ORGANIZATION:

Title:	Name:	Signature:	Date:
County of San Diego Contract Manager	Joanna Wisniewska		
Consultant QA Officer	TBD		
Consultant Project Manager	TBD		
Consultant Sampling Project Manager	TBD		
Wet Weather Laboratory Manager	TBD		
City of San Diego EM&TS Division Laboratory Manager	Laila Othman		

REGIONAL BOARD (San Diego RWQCB):

Title:	Name:	Signature:	Date:
San Diego RWQCB Project Manager	Christina Arias		
San Diego RWQCB QC Officer	Dat Quach		

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ACRONYMS AND ABBREVIATIONS

Abbreviation/Acronym	Meaning
%	percent
AB411	California State Assembly Bill 411
Bacteria TMDL	A *Resolution Amending The Water Quality Control Plan For The San Diego Basin (9) To Incorporate Revised Total Maximum Daily Loads For Indicator Bacteria Project I-Twenty Beaches And Creeks In The San Diego Region (Including Tecolote Creek),* Resolution No. R9-2010-0001
Basin Plan	State Water Resources Control Board's San Diego Region Basin Plan
BPA	Basin Plan Amendment
Caltrans	California Department Of Transportation
CEDEN	California Environmental Data Exchange Network
CFU	Colony Forming Unit
COC	Chain-of-Custody
DEH	San Diego County Department of Environmental Health
DHS	California Department Of Health Services
E. coli	*Escherichia coli*
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
EM&TS	Environmental Monitoring and Technical Services
EPA	USEPA Method
FIB	Fecal Indicator Bacteria
HA	Hydrologic Area
ID	Identification
JPEG	Joint Photographic Experts Group
LA	Load Allocation
MDL	Method Detection Limit
mL	milliliter
MM/DD/YY	Month/Day/Year
MPN	Most Probable Number
MQO	measurement quality objective
MS4	Municipal Separate Storm Sewer System
MS4 Permit	*National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges From the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds Within the San Diego Region,* Order No. R9-2013-0001
NA	not applicable
NOAA	National Oceanographic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
*.pdf	Portable Document Format

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Abbreviation/Acronym	Meaning
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
SCCWRP	Southern California Coastal Water Research Project
SDIA	San Diego International Airport
SDRWQCB	San Diego Regional Water Quality Control Boards
SM	Standard Method
SOP	Standard Operating Procedure
State Board	State Water Resources Control Board
SWAMP	Surface Water Ambient Monitoring Program
TBD	to be determined
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WLA	Waste Load Allocation
WQO	Water Quality Objective

2.0 DISTRIBUTION LIST

Title:	Name (Affiliation):	Tel. No.:	QAPP No.:
San Diego RWQCB Project Manager	Christina Arias (SDRWQCB)	(858) 627-3931	4.0
San Diego RWQCB QC Officer	Dat Quach (SDRWQCB)	(858) 467-2978	4.0
Contract Manager	Joanna Wisniewska (County of San Diego)	(858) 694-2312	4.0
Project QA Officer	TBD	TBD	4.0
Project Manager	TBD	TBD	4.0
Sampling Project Manager	TBD	TBD	4.0
Wet Weather Laboratory Manager	TBD	TBD	4.0
City of San Diego Laboratory Manager	Laila Othman (City of San Diego)	(619) 758-2312	4.0

Laboratory Managers will receive an electronic copy of the QAPP.

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3.0 PROJECT/TASK ORGANIZATION

3.1 Involved Parties and Roles

In 2011, the San Diego Regional Water Quality Control Board (SDRWQCB) issued Resolution No. R9-2010-0001, *A Resolution Amending the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Revised Total Maximum Daily Loads (TMDL) for Indicator Bacteria Project I-Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek)*, herein referred to as the Bacteria TMDL (SDRWQCB, 2011a). The Bacteria TMDL identifies the Responsible Parties for the San Diego River Watershed as the following: County of San Diego, City of El Cajon, City of San Diego, City of Santee, City of La Mesa, and the California Department of Transportation (Caltrans). The Bacteria TMDL excludes owners and operators of small Municipal Separate Storm Sewer Systems (MS4s) and controllable nonpoint sources from this list. The recently adopted *National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges From the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds Within the San Diego Region, Order No. R9-2013-0001*, herein referred to as the MS4 Permit, lists the Copermittees for the San Diego River Watershed as the following: County of San Diego, City of El Cajon, City of San Diego, City of Santee, and City of La Mesa. The County of San Diego has been designated as the lead Copermittee and will implement the Bacteria TMDL Monitoring Program.

The County of San Diego, consultants, and laboratory staff will have the following roles and responsibilities (Table 3-1):

- **SDRWQCB Project Manager:** Christina Arias is the SDRWQCB staff member assigned to the San Diego River Watershed. The SDRWQCB will receive the data generated from this study in the Annual Report.
- **SDRWQCB Quality Assurance (QA) Officer:** Dat Quach is the Project QA Officer for the SDRWQCB. He is responsible for review and approval of the Quality Assurance Project Plan (QAPP) and any QAPP amendments. He may request modifications to program activities.
- **Contract Manager:** Joanna Wisniewska is the Contract Manager for the County of San Diego. The Contract Manager will be responsible for establishing contracts with the selected consultants and/or laboratories to implement the San Diego River Bacteria TMDL Monitoring Program and act as the liaison between the Responsible Parties and consultants.
- **Project Manager:** The consultant Project Manager is to be determined (TBD). The consultant Project Manager will be responsible for overseeing the day-to-day activities of implementing the San Diego River Bacteria TMDL Monitoring Program.
- **Project QA Officer:** The consultant Project QA Officer is TBD. The consultant Project QA Officer will be responsible for overseeing the project QA activities independently from the Project Manager to ensure that project implementation is being conducted in accordance with this QAPP.

- **Sampling Project Manager:** The consultant Sampling Project Manager is TBD. The Sampling Project Manager will be responsible for coordinating field sampling efforts.
- **Wet Weather Laboratory QA Officer/Project Manager:** TBD
- **City of San Diego Laboratory QA Officer/Project Manager:** Laila Othman is the Laboratory Project Manager as well as the QA Officer. Laila Othman holds a position independent of data generation with the City of San Diego Public Utilities Department, Wastewater Operations, Environmental Monitoring & Technical Services, Marine-Microbiology Laboratory (herein referred to as the City of San Diego EM&TS Laboratory). Ms. Othman oversees the laboratory staff at the City's EM&TS laboratory that will be performing dry and/or wet weather sample analyses.

Table 3-1.
Personnel Responsibilities

Name	Organizational Affiliation	Role/Responsibility	Contact Information
Christina Arias	SDRWQCB	Project Manager	CArias@waterboards.ca.gov (858) 627-3931
Dat Quach	SDRWQCB	QA Officer	DQuach@waterboards.ca.gov (858) 467-2978
Joanna Wisniewska	County of San Diego	Contract Manager	Joanna.Wisniewska@sdcounty.ca.gov (858) 495-5317
TBD	Consultant	Project Manager	TBD
TBD	Consultant	Project QA Officer	TBD
TBD	Consultant	Sampling Project Manager	TBD
TBD	TBD	Laboratory Project Manager/QA Officer	TBD
Laila Othman	City of San Diego EM&TS Division Laboratory	Laboratory Project Manager/QA Officer	Lothman@sandiego.gov (619) 758-2312

3.2 Quality Assurance Officer Role

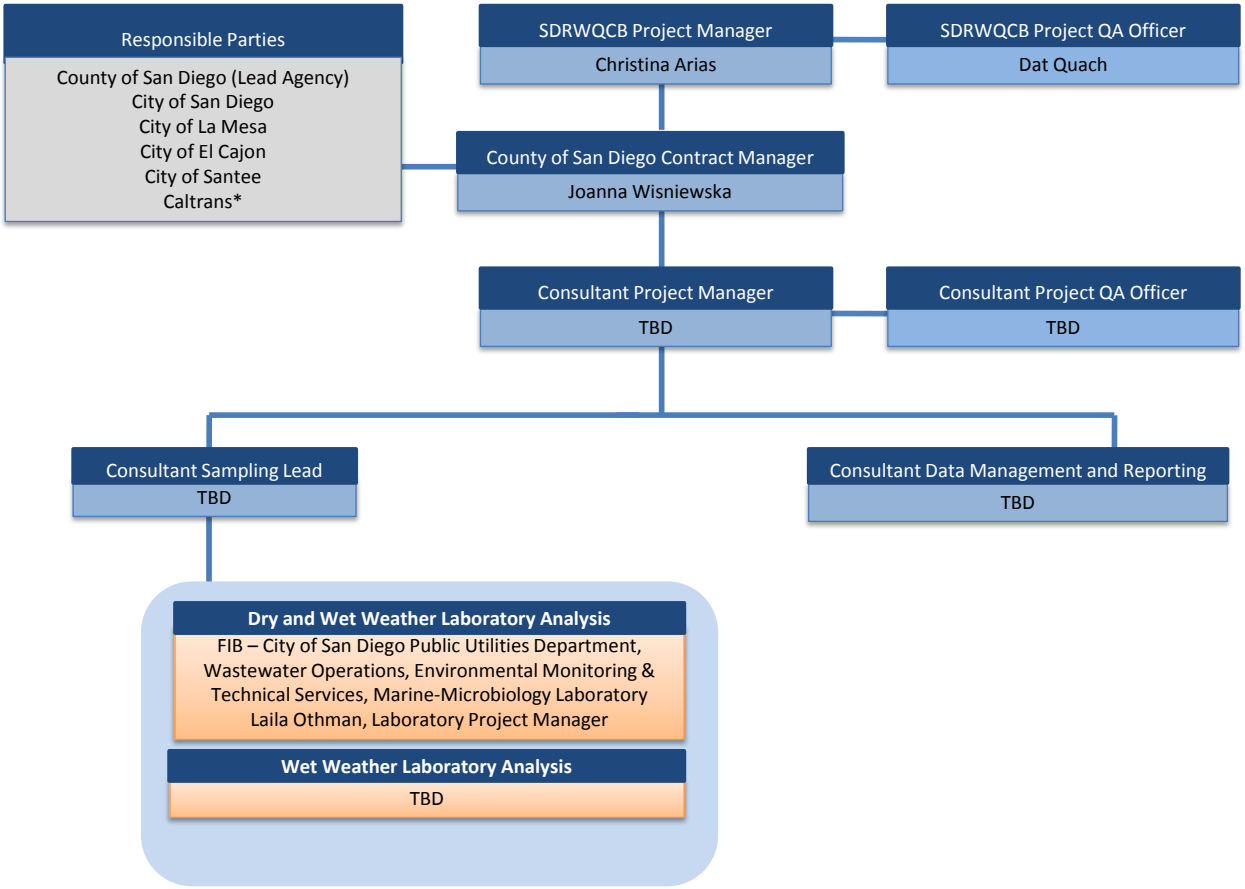
The Project QA Officer position is independent of data generation. The QA officer will ensure that the QA and Quality Control (QC) procedures set in place in this document are properly applied throughout the sampling activities and analysis. The Project QA Officer will coordinate with the project managers and QA officers of participating laboratories to ensure that all QA and QC procedures within this QAPP are understood and followed by participating labs.

3.3 Persons Responsible for QAPP Update and Maintenance

The consultant Project Manager and consultant Project QA Officer are responsible for maintaining this QAPP. Changes and updates to this QAPP may be made by the consultant Project Manager and consultant Project QA Officer. The consultant Project Manager will be responsible for making the changes and ensuring that these updates are provided electronically to each of the participating agencies as listed in Table 3-1. Previous versions of the QAPP should be removed to avoid any confusion regarding the most current version of the QAPP.

3.4 Organizational Chart and Responsibilities

Figure 3-1 presents the organization chart for the San Diego River Bacteria TMDL Monitoring Program.



*Not subject to the MS4 Permit

Figure 3-1. Organizational Chart

4.0 PROBLEM DEFINITION/BACKGROUND

4.1 Problem Statement

The Bacteria TMDL has identified Phase I MS4s and Caltrans as point sources that have been assigned Waste Load Allocations (WLAs). The Basin Plan Amendment (BPA), which is Attachment A of the Bacteria TMDL, outlines an implementation plan that includes a compliance schedule and a description of minimum monitoring requirements to assess compliance with the TMDLs, WLAs, and Load Allocations (LAs) (SDRWQCB, 2011b). In addition, the MS4 Permit has outlined additional compliance monitoring and assessment requirements regarding Bacteria TMDL compliance monitoring in Attachment E.6 (SDRWQCB, 2013). The County of San Diego has developed this QAPP to meet the requirements of the Bacteria TMDL as incorporated into the MS4 Permit.

The Bacteria TMDL Monitoring Program is described in detail in the Monitoring Plan (Appendix A). The Bacteria TMDL Monitoring Program is designed to fulfill the requirements of the MS4 Permit and to assess the conditions of the receiving waters with the following objectives:

- Characterize levels of bacteria concentrations at compliance monitoring locations
- Track progress toward meeting the Bacteria TMDL numeric targets

The purpose of this QAPP is to outline the methodology and data requirements to meet the goals of the San Diego River Bacteria TMDL Monitoring Program and address specific monitoring requirements of the monitoring components scheduled to be implemented each year of compliance monitoring.

4.2 Decisions or Outcomes

The data generated by this project will be used to track water quality at the compliance monitoring locations during wet and dry weather conditions. Compliance monitoring is designed to meet the receiving water monitoring requirements of the MS4 Permit.

The general approach and specific design elements of the project are driven by the following monitoring questions:

- Are TMDL numeric targets being met at the compliance monitoring locations?
- Are bacteria levels improving at the compliance monitoring locations?

4.3 Water Quality or Regulatory Criteria

The TMDL defines the numeric targets and WLAs for the Responsible Parties. Data collected as part of the San Diego River Bacteria TMDL Monitoring Program will be used to evaluate progress toward and attainment of the TMDL numeric targets and WLAs. The receiving water limitations, exceedance targets, WLAs, and LAs for the San Diego River Watershed are provided in Tables 1-3 through 1-5 of the Monitoring Plan (Appendix A) per the Bacteria TMDL.

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5.0 PROJECT/TASK DESCRIPTION

5.1 Work Statement and Products

This QAPP pertains to the compliance monitoring and reporting components of the San Diego River Bacteria TMDL Monitoring Program.

5.2 Geographical Setting

The San Diego River Watershed is located in central San Diego County, California. It is the fourth largest of the nine major watersheds in San Diego County, extending over 52 miles inland and covering approximately 277,543 acres. The watershed is primarily undeveloped (44 percent [%]), followed by open space/parks and recreation, residential and transportation uses (23%, 19% and 6%, respectively) (SanGIS, 2009). The lower San Diego Hydrologic Area (HA 907.1) is the westernmost portion of the San Diego River Watershed (Geosyntec, 2012). It drains approximately 173 square miles and supports the following main land uses: residential (30%), open space/parks and recreation (25%), and undeveloped land (18%).

5.3 Compliance Monitoring

The Bacteria TMDL identifies the Pacific Shoreline at the mouth of the San Diego River, the lower 6 miles of the San Diego River, and the lower 1 mile of Forester Creek as the targeted segments for indicator bacteria. Table 9-1 and Figure 9-2 in Section 9.0 show the locations of the monitoring sites used to evaluate compliance. Compliance monitoring is designed to meet the receiving water monitoring requirements of the Bacteria TMDL and will include wet and dry weather sampling as follows:

- Wet weather monitoring will be conducted to characterize the bacteria concentrations during representative storm events. Responsible Parties are targeting at least one and up to three storm events for monitoring during the wet weather season (October 1– April 30).
- Dry weather monitoring will be conducted throughout the year to characterize non-storm conditions. At least five samples per month will be collected on a weekly basis between April 1 and October 31. Dry weather monitoring will be conducted at minimum monthly frequency between November 1 and March 31.

5.3.1 Reporting

The consultant will provide sampling summaries to the County of San Diego via email. Dry weather sampling summaries will be sent to the County Project Manager monthly; wet weather summaries will be provided within five weeks after each monitored storm event.

A Draft and Final Annual Report will be developed to summarize the number and dates of wet and dry monitoring events, analytical results, and event data (total rainfall, duration of event, antecedent dry days, etc.). Sample results will be reported, along with calculated exceedance frequencies for the year and how these results compare with Bacteria TMDL and MS4 Permit

compliance requirements. The Annual Report will also include a Data Quality Report outlining if and how the collected data meet the requirements of this QAPP.

5.3.2 Monitored Constituents and Measurement Techniques

Samples will be analyzed for fecal indicator bacteria (FIB). Beach samples will be analyzed for *Enterococcus*, fecal coliform, and total coliform and freshwater samples will be analyzed for fecal coliform, and *Enterococcus* per the MS4 Permit. Freshwater samples will also be analyzed for *Escherichia coli* (*E. coli*) in anticipation of potential future monitoring requirements. Table 5-1 provides a master list of analytical constituents as well as Surface Water Ambient Monitoring Program (SWAMP) requirements. The County of San Diego has selected two Environmental Laboratory Accreditation Program (ELAP)-certified laboratories to conduct FIB analysis: the City of San Diego EM&TS Laboratory and a wet weather laboratory (TBD). The methods to be employed for FIB analysis are given in Table 5-1.

The laboratories will conduct the appropriate dilutions to generate results, avoid data qualifiers such as greater than values, and achieve the desired reporting limits. It is required that the laboratories perform analysis of at least 100 milliliters (mL) of sample, undiluted, and for at least one dilution to achieve the Target Reporting Limit for *Enterococcus* and *E. coli*, and at least 50 mL of sample, undiluted, and for at least one dilution to achieve the Target Reporting Limit for total and fecal coliform. However, if these volumes produce plates that are outside of the countable range, the reporting limit may increase on the basis of the results from other dilutions.

Table 5-1.
Master List of Analytical Constituents

Constituents	Method	Target Reporting Limit[(a)]
E. coli[(b)]	SM 9223B*	1 MPN/100 mL
Enterococcus	EPA 1600*	1 CFU/100 mL
	SM 9230C	1 CFU/100 mL
	Enterolert	1 MPN/100 mL
Fecal coliform	SM 9222D*	2 CFU/100 mL
	SM 9221E	2 MPN/100 mL
Total coliform[(c)]	SM 9222B*	2 CFU/100 mL
	SM 9221B	2 MPN/100 mL

Notes:
(a) Reporting limits may increase depending on dilution required to generate valid results.
(b) Applies to freshwater samples only. Not a compliance constituent.
(c) Applies to beach samples only.
* Preferred method
CFU – Colony Forming Unit
EPA – United States Environmental Protection Agency (USEPA) Method
MPN – Most Probable Number
SM – Standard Method

5.4 Project Schedule

Compliance monitoring began on June 27, 2013. Table 5-2 provides the schedule for the annual activities for the San Diego River Bacteria TMDL Monitoring Program to be implemented, including work plans, monitoring, and reporting. Program deliverables are described in Section 3 of the Monitoring Plan (Appendix A).

Table 5-2.
Project Schedule

Activity	Date (MM/DD/YY)		Deliverable
	Anticipated Date of Initiation	Anticipated Date of Completion	
TMDL Monitoring			
QAPP/Monitoring Plan	Submitted herein	Submitted herein	QAPP/Monitoring Plan
Dry Weather Compliance Monitoring	06/27/13	TBD	Monthly email updates including a summary of sampling activities
Wet Weather Compliance Monitoring	October 1, annually	April 30, annually	Email updates including a summary of sampling activities within five weeks after each event
Reporting			
Draft Annual Report and EDD (includes Data Quality Report)	NA	November, annually	Draft Annual Report and EDD, electronic copies
Final Annual Report and EDD (includes Data Quality Report)	NA	December, annually	Final Annual Report and EDD, 6 hardcopies with CDs

Notes:
NA – Not applicable
EDD – Electronic Data Deliverable

5.5 Constraints

This program has the following procedural and logistical constraints:

- Laboratories will employ multiple dilutions in an effort to meet lower detection limits. However, method detection limits (MDLs) and reporting limits (RLs) may increase as a result of those dilutions.
- During dry weather, five samples are required per 30 days during the summer dry months to calculate a geometric mean as specified in the Bacteria TMDL and MS4 Permit. If creek flows are extremely low and ponding occurs at a site, the Sampling Lead will consult with the County prior to increasing sampling frequency to meet the requirements. It is also possible that rainfall may interrupt sampling activities in the fall or early spring; in that case, the team will schedule an additional sample date within the 30-day period to meet the requirements.
- Wet weather monitoring will occur within 24 hours after the end of the majority of precipitation. The consultant will use precipitation data as recorded for the San Diego

International Airport (SDIA) station by the National Oceanographic and Atmospheric Administration (NOAA) National Weather Service (NWS), as well as secondary gauges at Project Manager discretion, to initiate sample collection.

- During wet weather, the consultant may use a runner or laboratory courier to meet holding time requirements.
- Field teams will not be mobilized during or near certain holidays if the mobilization or laboratory analyses should continue through that holiday. This includes the following holidays:

  - Independence Day
  - Labor Day
  - Thanksgiving
  - Christmas Eve
  - Christmas
  - New Year's Eve
  - New Year's Day
  - Memorial Day

- During wet weather, access may be an issue because of flooded roads or unsafe monitoring conditions. The consultant will check traffic alerts and flood warnings prior to mobilizing the sampling team in an effort to avoid false mobilizations. If for any reason site access is restricted at monitoring locations, the County of San Diego will be notified immediately of postponed events.

6.0 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Data quality will be assessed using measurement quality objectives (MQOs) such as accuracy, precision, and completeness. The applicable MQOs are provided for each analysis type in Table 6-1. Measurement quality objectives for laboratory analyses and field collection are provided in Tables 6-2 and 6-3. Details regarding MQOs and how they are measured are provided below. Data quality will be assessed using the above criteria as described in Section 6.0. Section 13.0 provides QA/QC activities associated with both field sampling and laboratory analyses, including frequency.

Table 6-1.
Measurement Quality Objectives

Measurement or Analysis Type	Applicable Quality Indicators
Laboratory – Bacteria	Accuracy, Precision, Completeness
Field – Bacteria	Accuracy, Precision, Completeness

Accuracy is a measurement of the closeness of a test value to the true or reference value. Accuracy can be measured in the laboratory using positive and negative controls and with field blanks.

Accuracy is measured through comparison of laboratory quality control parameters with their measurement quality objectives, as presented in the SWAMP QAPP requirements for Indicator Bacteria in Fresh Water and as presented in Table 6-2 (State Board, 2015).

Table 6-2.
Accuracy Objectives

Quality Control Type	Accuracy Quality Control	Frequency	Measurement Quality Objective
Laboratory	Sterility Checks	Method dependent, but may include media, filters, dilution water, and/or glassware on a daily or per-batch basis	No growth
	Positive Control	Per new lot or batch of media	Positive response
	Negative Control	Per new lot or batch of media	Negative response
	Laboratory Blank	When samples are diluted, dilution water must be tested	No growth
Field	Field Blank	≥5% of sample count	No growth

Precision is a measurement of the repeatability of test measurements. Precision can be measured using laboratory replicates and field duplicates, although field duplicates are not a current SWAMP requirement.

Per the SWAMP requirements for Indicator Bacteria in Fresh Water published in 2013 and revised in 2015, laboratory precision will be measured using the following calculation:

$$R_{log} \leq 3.27 \times \bar{R}$$

To calculate the precision for bacterial analyses, the results from the preceding 15 positive samples of a specific type (matrix) are used to calculate a running mean. The results used to calculate the running mean must all correspond to the same quality control parameter (such as laboratory duplicates). The results of different quality control parameters such as laboratory and field duplicates must not both be used to calculate a single running mean.

Step 1:
Record the results from duplicate analyses (these results are here designated as D_1 and D_2).

Step 2:
Calculate the logarithm (here designated as L_1 and L_2) of each duplicate result.
Note: If either of the values D_1 or D_2 are less than 1, add 1 to both values before calculating the logarithms.

$$L_1 = \log D_1$$
$$L_2 = \log D_2$$

Step 3:
Calculate the range of logarithms (R_{log}) for each pair of duplicates. R_{log} is equal to the absolute value of the difference between the two numbers.

$$R_{log} = | L_1 - L_2 |$$

Step 4:

Calculate the mean of R_{log} $(\bar{R})$ for the duplicates analyzed

$$\bar{R} = \frac{\sum R_{log}}{n}$$

where

$\sum R_{log}$ = the sum of the ranges of logarithms calculated for each pair of duplicates
n = the number of pairs of duplicates (in this case, n = 15)

Step 5:
Assess the precision of the duplicate analyses.

In order for the laboratory to demonstrate an acceptable level of precision, the range of logarithms for a particular duplicate must be less than the mean of the range of logarithms multiplied by 3.27:

$$R_{log} \leq 3.27 \times \bar{R}$$

Because field duplicates are not a current SWAMP requirement and the size of the field duplicate dataset is limited (~5% of the project sample count), precision in field duplicates is evaluated using a relative percent difference of ≤25 percent.

Table 6-3.
Precision Objectives

Quality Control Type	Accuracy Quality Control	Frequency	Measurement Quality Objective
Laboratory	Laboratory Duplicate	Per 10 samples or per batch, whichever is more frequent	$R_{log} \leq 3.27 \times \bar{R}$
Field	Field Duplicate	≥5% of project sample count	RPD ≤25%

Completeness is a measurement of the percentage of project-specific data that are valid. Percent completeness will be calculated by dividing the number of useable sample results by the total number of sample results planned. This calculation is shown below:

$$Completeness = \frac{Actual\ Number\ of\ Samples\ Collected\ (Valid\ Results)}{Project\ Required\ Total\ Samples\ Planned\ (Number\ of\ Sample\ Results\ Planned)} \times 100$$

A measurement quality objective of 90% will be applied to the project sample count.

Representativeness describes the degree to which the results of analyses represent the samples collected and the samples represent the environment from which they were taken. Sites were selected to best represent the Bacteria TMDL listed segment. Samples will be collected to be representative of the water body by following the sample collection procedures described in Section 10.0.

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7.0 SPECIAL TRAINING NEEDS/CERTIFICATION

7.1 Specialized Training or Certifications

All project field staff members are required to receive training on sampling standard operating procedures (SOP) and safety procedures prior to engaging in any field activities. Field staff will annually review the following:

- Sampling in accordance with the QAPP. Staff are required to read the QAPP and Field SOP provided in Appendix F.
- Safety procedures, site hazards, and safety awareness in accordance with consultant's safety documentation.

The bacteria analysis will be performed by California Department of Health Services (DHS) ELAP-certified analytical laboratories.

7.2 Training and Certification Documentation

The consultant will maintain records of training as detailed in Table 7-1. Documentation includes the date of training, the topic, the instructor name, and list of trainees.

Table 7-1.
Specialized Personnel Training or Certification

Specialized Training Course Title or Description	Training Provider	Personnel Receiving Training/Organizational Affiliation	Location of Records and Certification[(a)]
Sampling SOPs and Health and Safety Training	TBD	Consultant	TBD

Notes:
(a) If training records and/or certification are on file elsewhere, then document their location.

7.3 Training Personnel

Field staff will be trained on proper procedures for sampling, post-sampling processing, and sample handling in accordance with the QAPP and Monitoring Plan. The consultant's Project Manager is responsible for training employees prior to the start of sampling events, and for conducting any training sessions as needed throughout the course of the program.

Trained laboratory analysts will perform sample analysis for this program.
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8.0 DOCUMENTS AND RECORDS

Documentation and recordkeeping are essential to project organization, consistency, and data verification. There are many types of documents and records required by this project. Table 8-1 identifies the document and record types, the locations where they will be retained and archived, and their respective dispositions. Final and revised versions of the QAPP will be distributed to the SDRWQCB, the County of San Diego, analytical laboratories, and the consultant, as listed in Table 3.1. The Final Report will be the Annual Compliance Monitoring Report that will summarize the number and dates of wet and dry monitoring events, analytical results, and event data (total rainfall, duration of event, antecedent dry days, etc.). Sample results will be reported, along with calculated exceedance days for the year and how these results compare with TMDL compliance requirements. The Final Annual Compliance Monitoring Report will also contain a Data Quality Report.

Table 8-1.
Documents and Record Retention, Archival, and Disposition Information

Documentation Category	Identify Type Needed	Retention	Archival	Disposition
Project Plans	QAPP	Project Manager/ SDRWQCB	Document/Portable Document Format (*.pdf)	Minimum 5 years
	Monitoring Plan	Project Manager/ SDRWQCB	Document/*.pdf	Minimum 5 years
Sampling Records	Water Sampling Field Data Sheets/ Electronic Data Deliverable (EDD)	Consultant	Field Notebook/ *.pdf/ Excel Spreadsheet	Minimum 5 years
	Training Records	Consultant	Field Notebook/ *.pdf	Minimum 5 years
	Photographs	Consultant	Field Notebook/ Joint Photographic Experts Group (JPEG)	Minimum 5 years
Analytical Records	Chain-of-Custody	Analytical Laboratories	Field Notebook/ *.pdf	Minimum 5 years
	Laboratory Reports	Analytical Laboratories	*.pdf /Microsoft Excel Spreadsheet	Minimum 5 years
	EDD	Analytical Laboratories	Excel Spreadsheet or Database	Minimum 5 years
Data Records	Corrective Action Forms	Sampling Agency/ Analytical Laboratories	*.pdf	Minimum 5 years
Annual Compliance Monitoring Report (including Data Quality Report)	Final Report	Sampling Agency, Responsible Parties, SDRWQCB	Document/*.pdf	Minimum 5 years

All electronic documents will be stored on backup CDs as well as on project hard drives for the minimum duration described.

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9.0 SAMPLING DESIGN

This section provides an overview of the sampling design. The sampling design is provided in detail within the Monitoring Plan (Appendix A).

9.1 Project Description and General Design

The scope of compliance monitoring accounts for the frequency and type of sampling activities required by the MS4 Permit to calculate exceedance frequencies for numeric targets. Table 9-1 provides the general scope of San Diego River Bacteria TMDL Monitoring Program.

Table 9-1.
Scope of Compliance Monitoring

Date Range	Number of Monitoring Locations	Event Type	Grab Samples Per Site Per Event	Event Frequency	Total Number of Samples[(a)]
April 1 through October 31	5	Dry	1	Weekly (minimum 5 events per month)	175
November 1 through March 31	5	Dry	1	Minimum monthly	25[(b)]
October 1 through April 30	5	Wet	1	At least once within the first 24 hours after the end of the storm event during the wet season (October 1 through April 30). Responsible Parties are targeting up to 3 storm events.[(c)]	15[(c)]

Notes:
(a) Not including QA samples.
(b) Number of samples represents monthly monitoring frequency.
(c) As specified in the MS4 Permit. Number of wet event samples represents maximum possible.

9.2 Monitoring Locations

The Bacteria TMDL, executed in 2011, requires receiving water compliance monitoring to occur at the same sites as those sampled under the California State Assembly Bill 411 (AB411) Monitoring Program and/or the Responsible Parties' MS4 monitoring programs. Table 9-2 provides monitoring location information. A watershed overview map with the monitoring locations is provided in Figure 9-1.

Monitoring at the Pacific Ocean Shoreline at Dog Beach (site FM-010) is being conducted at the historical (circa 2011) AB411 monitoring location, which is approximately 25 meters downcoast of where the San Diego River flows into the Pacific Ocean. This location is not the same as the location monitored from June 2013 through December 2014 (site SDR-DB), which is located at point zero.

Table 9-2.
Compliance Monitoring Locations

Site ID	Site Name	Site Type	Latitude	Longitude
FM-010[(a)]	Dog Beach at San Diego River Mouth	Pacific Ocean Shoreline	32.75631	-117.25318
SDR-MLS	San Diego River MLS at Lower San Diego River	River	32.76515	-117.16863
SDR-CDE	Lower San Diego River at Camino Del Este	River	32.77255	-117.14456
SDR-FC1	Forester Creek at Lower Forester Creek	River	32.83986	-117.00395
SDR-FC2	Lower Forester Creek at Prospect Ave	River	32.83130	-116.98572

Notes:
(a) Historical (circa 2011) AB411 monitoring location approximately 25 meters downcoast of river outlet
SDR-MLS – San Diego River-MLS
SDR-CDE – San Diego River-Camino Del Este
SDR-FC – San Diego River-Forester Creek

Figure 9-1. Compliance Monitoring Locations

9.3 Wet Weather Sampling

Wet weather monitoring will target up to three storms with a trigger rainfall of 0.1 inch or greater between October 1 and April 30. The NOAA NWS website will be used to track the forecast and initiate mobilization on the basis of recorded rainfall amounts at SDIA, as well as secondary gauges at the Project Manager's discretion. One grab sample will be collected and analyzed for FIB per storm event at each compliance monitoring location (Table 9-2) within 24 hours after the end of precipitation.

9.4 Dry Weather Sampling

Dry weather monitoring will occur at the compliance monitoring locations listed in Table 9-2 with variable frequency throughout the duration of the compliance period, as outlined in Table 9-1. Dry weather sampling will occur on dry weather days, which are defined as having an antecedent dry period of 72 hours with less than 0.1 inch of rainfall. Sampling may be conducted on any day of the month as long as the criteria for a dry weather days are met. One grab sample from each site will be collected and analyzed for FIB during each dry weather event.

9.5 Monitoring Logistics

Wet weather and dry weather sampling will be conducted by up to two field scientists, who will deliver samples to the laboratory courier at a designated meeting location or directly to the laboratory within the 6-hour holding time. Sample runners, independent of the sampling team, may be used during wet weather monitoring to deliver samples to the courier or laboratory. If samples are delivered to couriers, pre-designated meeting locations will be used to exchange samples between the couriers and sampling field staff (or runners).

9.6 Laboratory Distribution

Dry weather samples will be delivered to the City of San Diego EM&TS Laboratory. Wet weather samples may be delivered to either a wet weather laboratory or the City of San Diego EM&TS Laboratory. Sample delivery times for wet weather events may include weekends and 24-hour delivery (holidays excluded). However, sample collection may be timed by the consultant so that sample collection and delivery will occur during daylight hours. Timing of sample collection and delivery during the daytime is possible because sampling may occur at any time within 24 hours following the end of precipitation.

Dry weather samples will be delivered to the City of San Diego EM&TS Laboratory during business hours Monday through Thursday (holidays excluded) per the request of the laboratory. Laboratories will be ready to receive, preserve, and analyze bacteria samples as necessary according to this QAPP as they are delivered. Additional details regarding the sampling handling and distribution are provided in Section 11.0.

10.0 SAMPLING METHODS

Table 10-1 presents the sampling locations and methods. Samples will be collected and analyzed for FIB using methods listed in Table 5-1. The collection of samples will be consistent with sampling protocols outlined in the *2005–2006 Coastal Storm Drain Monitoring Appendix C: Standard Operating Procedures (SOP) for the Collection of Bacteria Samples from Storm Drains and Receiving Waters (Creeks, Lagoons, Bays, and Ocean)* used by the San Diego Copermittees for the Coastal Storm Drain and Lagoon Monitoring, as described in this section (San Diego County, 2007). Sample handling is described in Section 11.0, including containers, volumes, and preservation methods.

Table 10-1.
Sampling Locations and Sampling Methods

Sampling Type	Number of Sites	Station Code	Matrix	Constituent	Depth (inches)	Annual Maximum # Samples per Site[(a)]	Sample Type
Wet Weather	1	FM-010	Saltwater	Total coliform Fecal coliform *Enterococcus*	4 to 8	3	Grab
	4	SDR-MLS SDR-CDE SDR-FC1 SDR-FC2	Freshwater	Fecal coliform *Enterococcus* *E. coli*	Mid column		
Dry Weather	1	FM-010	Saltwater	Total coliform Fecal coliform *Enterococcus*	4 to 8	40[(b)]	Grab
	4	SDR-MLS SDR-CDE SDR-FC1 SDR-FC2	Freshwater	Fecal coliform *Enterococcus* *E. coli*	Mid column		

Notes:
Acceptable sampling containers, minimum volumes, and holding temperatures provided in Table 11-1.
(a) Maximum number of samples, not including QA samples. QA samples will be collected at the frequency described in Section 6.0.
(b) Assuming a total of 5 monthly and 35 weekly samples per site per year.

10.1 Field Observations and Documentation

Field observations are not required and will be recorded when feasible. General observations may include site conditions and actions taken during sampling. Potential sources of bacteria in the vicinity of the site may also be identified, including human-related sources, activities, and natural sources. An example field data form is provided in Appendix C.

The following general information may be recorded on a field data sheet during each site visit:

- Site identification (ID), location, and description (deposits, stains, vegetation, biology)
- Monitoring project name
- Grab sample ID, date, and time
- Field team personnel
- Water quality observations including but not limited to:
  - Flow status (flowing, trickle flow, ponded)
  - Floatables, surface scum, sheens, odor, color
- Potential bacteria sources including presence and approximate count of trash, wildlife, etc.
- Weather conditions (cloud cover, precipitation)
- Tide status (for beach location only)
- Runoff characteristics
- Miscellaneous comments

10.2 Wet and Dry Weather Grab Sampling SOP

Grab samples will be representative of the environmental conditions of the site and will be consistent with sampling protocols outlined in the *2005–2006 Coastal Storm Drain Monitoring Appendix C:Standard Operating Procedures (SOP) for the Collection of Bacteria Samples from Storm Drains and Receiving Waters (Creeks, Lagoons, Bays, and Ocean)* (San Diego County, 2007) as described in this section.

For beach water sampling, grab samples will be collected at the surf line. The field staff sampler will wade into the surf carefully in a manner that does not disturb the sediment until he or she reaches approximately 1 foot in water column height, or a level that reaches the middle of the sampler's shinbone. During an incoming wave, not outgoing wave, the sampling staff member will reach out or extend the bottle and/or sampling pole a far as practicable. The sample container will be submersed into the water column, facing downward, to mid-depth (approximately 4 to 8 inches) and turned slightly upward while the bottle is moved horizontally through the water until full to eliminate cross contamination from the sampling equipment. Sampling will occur below the water surface to avoid floating debris.

For freshwater sampling, grab samples will be collected in the middle of the water column height, or just below the water surface, to avoid collection of surface scum and sediment from the bottom to the maximum extent practicable. The sample container will be submersed into the water column, facing downward, to mid-depth (or just below the surface) and turned slightly upward while the bottle is moved upstream through the water until full to eliminate cross contamination from the sampler. The sampler will take precautions and will collect the samples in a manner that does not disturb the bottom sediments. A grab pole may be required if the creek cannot be safely reached by hand. During extreme high or low flows, samples may be collected with a sterile transfer vessel using a grab pole. The field team will note the use of a transfer container on the field datasheet. If receiving water is not flowing and is pooled/ponded, the sample will not be taken.

10.2.1 Sample Handling

The following sample handling protocols will be employed when collecting samples to minimize the possibility of contamination (further information regarding sample handling and custody is provided in Table 11-1):

- Field personnel will be thoroughly trained in the proper use of sample collection gear.
- Unused (new), clean, powder-free nitrile gloves will be worn while collecting samples and will be replaced with new, clean gloves between samples and sites.
- FIB samples will be collected directly into a sterilized polyethylene or polypropylene containers provided by the analyzing laboratory. Sample bottles will remain sealed and protected from dust or other contaminants during storage and bottle handling.
- Field personnel will make an effort, within reason, to prevent large gravel and uncharacteristic floating debris from entering the sample containers.
- The insides of the sampling containers and lids will not be touched during preparation and sampling activities.
- New bags of previously unopened ice will be used to cool samples following collection.

Once sample containers are filled, they will be promptly placed on ice, in a clean cooler (maximum temperature of 10 degrees Celsius), in the dark and transported to the laboratory for processing to meet holding times (State Board, 2015).

After sampling is complete, all waste (gloves, ice bags, etc.) will be placed in the trash. Extra sample water volume will be disposed of according to laboratory protocols. New, sterile containers provided by the laboratories will be used during each event.

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11.0 SAMPLE HANDLING AND CUSTODY

All bottles will be pre-labeled with the following information:

- Project name
- Date and time
- Sampling location name and number
- Sample matrix
- Collector's initials
- Sample ID number
- Analysis name

Grab samples will be marked with a unique sample ID that will be used to track the sample throughout its analyses. These sample IDs will also be entered directly onto field and laboratory data sheets. All field observations and processed sample information will be recorded and transcribed onto Microsoft Excel spreadsheets. Hard copies of these field and laboratory data sheets will be maintained by the consultant.

Once sample containers are filled, they will be placed on ice, in a cooler, in the dark and transported to the laboratory for processing. The Chain of Custody (COC) form provided in Appendix B will accompany the water samples. The member of the field staff delivering the samples as well as the receiving member of the laboratory staff will sign the COC form when samples are delivered. Sampled water will be kept in the dark and below 10 degrees Celsius and transferred to an analytical laboratory within holding times. COC forms for the samples will be completed and transported with the samples to the analytical laboratory. Transportation will be coordinated to ensure that all samples are handled and analyzed within the proper holding time requirements. Sample holding times are listed in Table 11-1. Custody of all samples will be transferred from the field personnel to laboratories.

Table 11-1.
Sample Handling and Custody

Analysis	Container	Minimum Sample Volume[(a)]	Initial Preservation	Holding Time
E. coli	Factory-sealed and/or pre-sterilized, 500- or 1000-mL sterile plastic (high density polyethylene or polypropylene) container	500 mL	< 10°C in the dark	8 hours[(b)]
Enterococcus				
Fecal coliform				
Total coliform				

Notes:
(a) Minimum sample volume is representative of total volume needed to analyze all constituents.
(b) Sample analysis should begin as soon as possible after receipt. For compliance monitoring, sample incubation must be started no later than 8 hours from time of collection.
°C – degrees Celsius

If a failure to meet a QAPP requirement occurs, sampling teams will notify the Sampling Lead immediately to reschedule the event in coordination with the laboratory. The consultant Project Manager will notify the County of San Diego immediately and complete a write-up of the issue and corrective action using the Corrective Action Form provided in Appendix H. Failures may include samples not delivered within specified holding times, potential contamination of samples, or improper handling.

12.0 ANALYTICAL METHODS

The types of laboratory analyses and the analytical methods are provided in Table 12-1. The laboratories are certified by the California DHS ELAP.

Table 12-1.
Laboratory Analytical Methods

Analyte	Laboratory	Project Reporting Limit (per 100mL)[a]	Analytical Method	
			Analytical Method/SOP	Modified for Method (Yes/No)
E. coli[b]	EM&TS	1 MPN	SM 9223B*	No
Enterococcus	EM&TS	1 CFU	EPA1600*	No
		1 MPN	Enterolert	No
Fecal Coliform	EM&TS	2 CFU	SM 9222D*	No
		2 MPN	SM 9221E	No
Total Coliform[c]	EM&TS	2 CFU	SM 9222B*	No
		2 MPN	SM 9221B	No

Notes:
* Preferred Method
(a) The reporting limits may increase depending on dilution to achieve valid results.
(b) Applies to freshwater sites only.
(c) Applies to beach sites only.

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13.0 QUALITY CONTROL

This section addresses QA/QC activities associated with both field sampling and laboratory analyses. The field QC samples are used to evaluate potential contamination and sampling error introduced prior to submittal of samples to the analytical laboratory. Laboratory QA/QC activities provide information needed to assess laboratory contamination, analytical precision, and analytical accuracy. If any QA/QC standards are not met, the appropriate corrective actions will be taken in accordance with Section 22.0 of this document and the laboratories' QA Manuals. The Laboratory Manager is responsible for making decisions on corrective actions pertaining to laboratory analysis. If issues are identified by the Sampling Agency's staff, the Laboratory Project Manager or Sampling Agency's Project Manager will be notified immediately and documentation of the issue and the corrective action will be made.

13.1 Quality Control Types

A set of QC samples will be submitted to the laboratory to achieve the frequencies required in Section 6.0 and described in further detail in this section. The analytical laboratory may also require more QC samples if one type of analysis is to be run in more than one batch. The main types of QC samples that will be utilized for this study include field blanks, field duplicates, laboratory replicates, and positive and negative controls.

The field blanks, duplicate samples, and laboratory replicates may be collected from different sites during a particular sampling event. The number and frequency of field QC samples to be collected are presented in Table 13-1. Field QC samples will be submitted blind to the analytical laboratory. For laboratory replicates, additional sample volumes will be collected.

13.2 Field Quality Control Samples

Field Blanks
Field blanks are samples of reagent-grade, analyte-free, sterile deionized water processed in the field to verify that the field conditions (air deposition, etc.) and actions associated with sample collection, manipulation, storage, transport, and handling are non-contaminating. Field blanks will be analyzed for the same suite of analyses as regular samples. The project frequency for field blanks is 5% of the total sample count. Concentrations of field blanks should be below the RL for each analyte.

Field Duplicates
Field duplicate samples consist of two distinct samples (an original and a duplicate) of the same matrix collected at the same time and location using the same sampling technique. Field duplicate samples will be collected by filling two grab sample containers at the same time, or in rapid sequence. The purpose of field duplicates is to measure the consistency of field sampling. The project frequency for field duplicates is 5% of samples. The result for each field duplicate will be compared with the sample result via the calculation provided in Section 6.0.

Table 13-1 presents summary of field quality control criteria.

Table 13-1.
Field QC

Field QC	Frequency	Acceptance Limits
Field Blank	≥5% of all project samples	Concentrations should be below the RL
Field Duplicate	≥5% of all project samples	RPD ≤25%

13.3 Laboratory Quality Control

Laboratory QC samples include laboratory duplicates, and positive and negative controls as follows (Table 13-2 describes the frequency and types of quality control samples for each constituent category):

- **Laboratory Replicate –** For a laboratory replicate, a sample is prepared and analyzed twice to assess the repeatability of results (precision). The precision is evaluated using the equation presented in Table 13-1. A minimum of one laboratory replicate will be analyzed per batch or per 10 samples analyzed, whichever is more frequent.
- **Positive and Negative Controls –** A negative control is performed for every new batch or lot of media and is filtered and incubated the same way as a sample. There should be no bacteria growth on the filter after incubation. It is used to detect laboratory bacterial contamination of the sample. Laboratory blanks and sterility checks are additional forms of negative controls analyzed in a similar manner and used to establish sterility/lack of contamination in dilution water, filters, and/or glassware. A positive control is performed for every new batch or lot of media using a water sample known to contain target bacteria (such as wastewater treatment plant influent), which is filtered and incubated the same way as a sample. There should be positive target bacteria growth on the filter after incubation. It is used to detect procedural errors or the presence of contaminants in the laboratory analysis that might inhibit bacteria growth (USEPA, 2012).

Table 13-2.
Laboratory Quality Control

Constituent Category	Method Blanks	
	Frequency	Acceptance Limits
Laboratory Replicate	One per 20 samples or analytical batch, whichever is more frequent	$R_{log} \leq 3.27 \times \bar{R}$
Positive and Negative Controls	Per new lot or batch	Positive Control = Growth on filter Negative Control = No growth on filter

Notes:
Evaluation of data quality is also addressed in Section 18.0.

14.0 INSPECTION/ACCEPTANCE OF CONSUMABLES AND SUPPLIES

All glassware, sample bottles, and collection equipment will be inspected prior to use. All ordered supplies will be examined for damage as they are received. Bottles and caps will be inspected for damage prior to sampling, and only sound bottles with intact threads will be used. The container caps will be tested for tightness prior to transport of samples.

The consultant will ensure that sufficient field supplies are on hand prior to the start of sampling for each period. Field supplies will be stored at the consultant's offices. Laboratory supplies will be stored at the laboratories conducting the work. Table 14-1 presents the acceptance criteria for consumables and supplies that will be used for field sampling efforts in this study.

Table 14-1.
Inspection/Acceptance Testing Requirements for Consumables and Supplies

Project-Related Supplies/Consumables	Inspection/Testing Specifications	Acceptance Criteria	Frequency	Responsible Individual
Pre-cleaned, sterile sample containers	Open container	Lids screwed on bottles	100%	Consultant
Sample transport coolers	Dirty	Clean	100%	Consultant

Acceptance criteria for consumable and supplies that will be used for laboratory analysis are outlined by the respective laboratories in their QAPPs (Appendices D and E).

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15.0 INSTRUMENT CALIBRATION

There are no field measurements included in the San Diego River Bacteria TMDL Monitoring Program.

The laboratory instrument calibration procedures are described in their respective QA Manuals (Appendices D and E).

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16.0 NON-DIRECT MEASUREMENTS

Several non-direct measurements, as described below, are fundamental to the success of this project.

16.1 Weather

16.1.1 Forecast and Mobilization

Weather will be tracked by the consultant Sampling Leads for monitoring purposes for the duration of the wet season (October 1 through April 30). Throughout the wet season, the forecast and recorded precipitation at SDIA as reported by NWS and local ALERT systems will be the main data source used to determine whether mobilization criteria are met.

The consultant will target continuous rain events and avoid events predicted to be episodic and/or scattered in nature. The following criteria will be used to determine whether mobilization will occur for an impending storm event:

- Storms must be forecast to produce at least 0.10 inch of rainfall within a 24 hour period.
- The probability of precipitation occurring must be greater than 60%.
- Storm events must be preceded by at least 72 hours of dry conditions (<0.10 inch of precipitation).

16.1.2 Recorded Rainfall

Recorded rainfall as observed at the SDIA gauge will be used for the following purposes:

- Identification of end of precipitation

The recorded rainfall as observed at the SDIA and Santee gauges will be used for the following purposes:

- Determination of antecedent dry days
- Classification of wet and dry weather days to support compliance evaluations

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17.0 DATA MANAGEMENT

Data will be submitted in a standardized CEDEN-compatible format. The consultant will work with the laboratories to compile analytical data. A final dataset will be provided to the County of San Diego Contract Manager.

17.1 Field Observations

The consultant will review all Field Data Sheets for completeness, maintain the original hardcopies, and scan electronic copies to portable document format (*.pdf) for storage in the project file. Any photographs of the monitoring sites taken by field personnel will be uploaded into the project file within three business days of field visits. Field team members will name the photographs using the site ID and the date the photograph was taken. Copies of field data sheets and photographs for each event may be submitted to the consultant Project Manager with each sampling summary.

17.2 Analytical Data

The laboratories will provide data in electronic format (*.pdf copies of lab reports and an EDD). Formal analytical results will be submitted to the consultant and/or County of San Diego in *.pdf format and as an EDD within three weeks of submittal of samples. The consultant will review all laboratory reports and EDDs for accuracy and completeness and will convert the submitted EDDs into a CEDEN-compatible format. Laboratories will retain original COC forms and copies of the preliminary and final data reports.

Within two weeks of receipt of formal results, the consultant Project Manager will screen preliminary data deliverables for the following major items:

- A 100-percent check between electronic data provided by the laboratory and the hard copy reports.
- Conformity check between the COC Forms and laboratory reports.
- A check for laboratory data report completeness.
- A check for typographical errors on the laboratory reports.
- A check for suspect values, data qualifiers, and review of laboratory QC data.

In addition to providing formal results within three weeks of submittal of samples, the laboratories will report the results of indicator bacteria analyses of sample submittal via call or email upon completion. For dry weather samples, the laboratory will report preliminary results to the County of San Diego, the consultant, and the San Diego County Department of Environmental Health (DEH) if AB411 levels are exceeded. For wet weather samples, the laboratory will report preliminary results to the consultant, who will then inform the County of San Diego.

The Responsible Parties will be responsible for initiating any follow up monitoring on the basis of indicator bacteria results obtained at the compliance monitoring location. Detailed follow-up investigations are not required until the first interim milestone; however, Responsible Parties may choose to voluntarily conduct follow-ups to identify and abate sources, where there is a preponderance of evident to support the action.

18.0 ASSESSMENT AND RESPONSE ACTIONS

The consultant Project Manager will be responsible for the day-to-day oversight of monitoring activities, laboratory analyses, and/or data reporting. Any failures that occur during data collection and/or laboratory analyses will be the responsibility of the field crew or laboratory conducting the work, respectively. It is the responsibility of the Laboratories' QA Officers and consultant Project Manager to report any assessments and proposed corrective actions to the County of San Diego Contract Manager. The consultant Project Manager will relay deviations to the Project's QA Officer. The Project's QA Officer has the authority to stop all sampling and analytical work if the deviations noted are considered detrimental to data quality. The following describes how deviations from the QAPP will be identified.

Three types of assessments will be performed as part of this project to ensure that the sampling and analysis activities are in accordance with the approved QAPP. Assessment activities and results will be documented in writing first by field or laboratory reports, then in final reporting. They are as follows:

- **Surveillance of Sample Collection Activities:** The consultant Project Manager or Field Lead will be responsible for overseeing sampling activities and reviewing field datasheets to verify that the samples were collected in accordance with QAPP requirements. If any field activities are deemed in violation of QAPP requirements, the consultant Project Manager will be contacted immediately. The consultant Project Manager has the authority to stop field activities until corrective actions are successfully implemented. Corrective actions may include additional training to improve field team performance and QAPP compliance, or appropriate resampling of sites, as needed. Any corrective actions will be documented and communicated to the County of San Diego Contract Manager. Assessment of wet weather sample collection will be conducted by the Project QA Officer once per field season; assessment of dry weather sample collection will occur at the beginning and end of dry weather collection. The Project QA officer will audit field activities in accordance with the QAPP and SOPs and will summarize findings on the Field Audit Form provided in Appendix G.
- **Data Quality Assessment:** The Laboratory Managers will be responsible for providing a summary of QC data to the Project QC Officer. If it is determined that the precision and accuracy objectives were not met, the Project QA Officer will notify the Laboratory Managers. Laboratory techniques will be reviewed to minimize errors, and samples will be reanalyzed, if possible.
- **Assessment of Data Entry:** Once the performance criteria are met, the Project Manager or Field Lead will review 20% of the data files to ensure that any errors are detected and corrected. If errors are detected, then a 100% check of data will be completed. The consultant Project Manager will retain original data files and qualified data will be retained in the project EDD. Data will be qualified in the EDD according to CEDEN protocols.

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19.0 REPORTS TO MANAGEMENT

19.1 Reporting Schedule

The consultant will provide monthly summaries to the County of San Diego Contract Manager as a status of monitoring activities. Wet weather sampling summaries will be provided to the County Contract Manager within five weeks of each storm event monitored and may be submitted with the monthly summaries. Upon completion of the annual sampling cycle as defined in the task order, the consultant will provide the Annual Compliance Monitoring Reports to the County of San Diego Contract Manager and a CEDEN-compatible EDD of all collected data.

The project reports are detailed within the Monitoring Plan. Table 19-1 presents the management reports.

Table 19-1.
Management Reporting Schedule

Type of Report	Frequency (Daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Dates	Person(s) Responsible for Report Preparation	Report Recipients
Sampling Summary, Dry Weather	Monthly	Each Month	Consultant Project Manager	County of San Diego
Sampling Summary, Wet Weather	Within five weeks after each storm event	NA	Consultant Project Manager	County of San Diego
Draft Annual Report	Annually	November	Consultant Project Manager	County of San Diego
Project Data Quality Report	Annually	December	Consultant Project Manager	County of San Diego
CEDEN Compatible EDD	Annually	December	Consultant Project Manager	County of San Diego
Final Annual Report	Annually	December	Consultant Project Manager	County of San Diego

19.2 Report Contents

19.2.1 Dry Weather Sampling Summaries

The consultant will submit monthly dry weather sampling summaries to the County of San Diego Contract Manager. They may include, but are not limited to, sampling event date, visual observations recorded, precipitation logs at relevant rain gauges, and bacteria concentrations reported.

19.2.2 Wet Weather Sampling Summaries

The consultant will submit post-event wet weather sampling summaries to the County of San Diego Contract Manager. They may include, but are not limited to, sampling event date, visual observations recorded, precipitation logs at relevant rain gauges, and bacteria concentrations reported. A brief hydrology summary detailing precipitation totals and time elapsed between end of precipitation and commencement of sampling effort may also be included. Wet weather sampling summaries may be incorporated with dry weather monthly summaries, if feasible.

19.2.3 Annual Compliance Monitoring Reports

The consultant will work with the County of San Diego to develop the Report to meet the minimum requirements of the MS4 Permit and to be easily incorporated into the Water Quality Improvement Plan Annual Reports. At a minimum, the Annual Report will describe and summarize the sample collection methods and sampling events, evaluate data quality, and provide a summary of key observations. Additionally, a compliance evaluation will be performed to determine 1) whether TMDL numeric targets are being met at the compliance monitoring locations, and (2) whether bacteria levels are improving at the compliance monitoring locations. The compliance evaluation will meet the requirements of the Bacteria TMDL as incorporated into the MS4 Permit and will include, but not be limited to, the assessments presented below. All exceedance frequency calculations and assessments will receive a 100% check for accuracy. A Data Quality Report will be included with the Annual Compliance Monitoring Report.

19.2.3.1 Dry Season Geometric Mean Exceedance Frequency Calculation

In accordance with the MS4 Permit, geometric means were calculated using methodology consistent with that of the Ocean Plan for beaches and with the Basin Plan for creeks (State Board, 2009; SDRWQCB, 2011c). For creeks, rolling geometric mean calculations were based on a minimum of five dry weather sample results within the previous 30 days. With each subsequent sample collected, the geometric mean was recalculated for the previous 30 days. For the beach monitoring locations, geometric mean calculations were based on the most recent five sample results within the previous 30 days. When less than five sample results were available, a geometric mean was not calculated.

Dry season geometric means were calculated only for dry weather samples collected during the dry season (May 1 through September 30). Geometric means were calculated as follows:

$$\text{30-Day Geometric Mean} = \sqrt[n]{(X_1)(X_2)(X_3)(X_4)\ldots(X_n)}$$

where: n is the number of individual results used in the calculation
x_n is week *n* result (e.g., x_1 = week 1 result)

A dry weather exceedance occurs when the geometric mean exceeds the dry weather limit. The number of exceedances was compared with the total number of calculated dry season geometric means to determine the dry season exceedance frequency.

19.2.3.2 Combined Dry and Wet Weather Geometric Mean Exceedance Frequency Calculation

In accordance with the MS4 Permit, the wet season exceedance frequency was calculated using both wet and dry weather results generated between October 1, 2014, and April 30, 2015. Dry weather sampling for both the Bacteria TMDL and AB411 monitoring programs was conducted during the wet season at varying frequencies.

Although a minimum of five samples within the previous 30-day period are specified in the Basin Plan for calculation of a geometric mean, recent findings from the Reference Stream Study were presented by the Southern California Coastal Water Research Project (SCCWRP) stating that a four-sample minimum is most appropriate (SCCWRP, 2015). Based on this guidance, wet season combined dry and wet weather geometric means for both beaches and creeks were calculated on the basis of a minimum of four samples for any 30-day period. When less than four sample results were available, a geometric mean was not calculated.

Bacteria TMDL monitoring samples are collected during at least one and up to three wet weather events within 24 hours after the end of precipitation, as required by the MS4 Permit monitoring requirements.

An exceedance occurs when a calculated geometric mean or result exceeds the dry weather numeric target. Wet weather samples are used in conjunction with dry weather samples to determine the overall wet season exceedance frequency. The number of exceedances is compared with the total number of calculated wet season geometric means to determine the wet season exceedance frequency.

19.2.3.3 Wet Weather Single-Sample Maximum Exceedance Frequency Calculation

Wet weather exceedances are based on a comparison of the inferred number of exceedances with the allowable 22% exceedance frequency.

Samples collected for the Bacteria TMDL monitoring program are collected in accordance with the MS4 Permit: one sample is collected per monitored storm event within 24 hours after the end of rainfall at each monitoring location.

A storm event is defined as an event having 0.1 inch or more recorded precipitation and includes the following 72 hours, resulting in a minimum of four associated wet weather days per event. The result from a sampling day was applied to each wet weather day associated with the same storm event. Daily rainfall amounts from the NOAA and NWS stations at SDIA and Santee are averaged to assign wet weather days for the San Diego River Watershed.

An average of the results from the monitored wet weather events is assigned to the remaining wet weather days in the wet season. The wet weather exceedance frequency is then determined by dividing the number of wet weather days that exceeded the single-sample maximum numeric target by the total number of wet weather days in the wet season.

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20.0 DATA REVIEW, VERIFICATION, AND VALIDATION

All analytical data will be reviewed and compared to the MQOs described in Section 6.0 of this QAPP, along with the applicable QA/QC practices. If results fail to meet any MQOs, the consultant Project Manager will flag them for further review. Batch QC samples will be reviewed to determine the potential cause of failure to meet the MQOs. Data will be separated into three categories: data meeting all MQOs (acceptable data), data failing precision or recovery criteria (further investigation warranted), and data failing to meet accuracy criteria (further investigation warranted).

If further investigation is warranted on the basis of data failing precision or recovery criteria, all aspects of the data may be assessed by the Project QA Officer. At that point, the data will either be accepted or rejected. If accepted, the data will be flagged with a qualifier per the United States Environmental Protection Agency (USEPA) specifications (USEPA, 2012). If data fail to meet accuracy criteria, or the cause of the failure cannot be identified and rectified, the data will be excluded from the results. All rejected data will be retained in the Project database, and qualified as "rejected." The ultimate decision of whether to accept or reject a data point will be made by the consultant Project Manager in consultation with the Project QA Officer.

If the analysis for more than 10% of data fails to meet the MQOs, the consultant Project Manager and Project QA Officer will meet to discuss the appropriateness of the MQOs and any potential modifications. All proposed modifications of MQOs will require a reissuance of the QAPP.

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21.0 VERIFICATION AND VALIDATION METHODS

Data verification is the process of evaluating the completeness, correctness, and conformance of the dataset against the method, procedural, or contractual requirements. The goal of data validation is to evaluate whether the data quality goals established during the planning phase have been achieved. Data quality indicators will be continuously monitored by the analysts producing the data (i.e., field and lab personnel) as well as the Laboratories or Project QA Officer throughout the project to ensure that corrective actions are taken in a timely manner. Data validation is an analyte-specific and sample-specific process that extends verification to determine the analytical quality of the dataset. Laboratory and field personnel responsible for conducting QC analysis will be responsible for documenting when data do not meet measurement quality objectives as determined by data quality indicators.

21.1 Data Verification and Validation Responsibilities

Data collected in the field will be verified by the Project QA Officer. The laboratories will maintain COCs and sample manifests.

Verification and validation of laboratory data is the responsibility of the laboratory QA Officers and Project Managers. Laboratories will maintain analytical reports, including QC documentation. The Laboratory QA Officers will perform checks of all of the laboratory's records.

The Project QA Officer and Project Manager are responsible for oversight of field data and laboratory data obtained from the contracted laboratory and sampling agency. All data records will be checked visually and recorded as checked by initials and dates.

Reconciliation and correction of any data that fail to meet the MQOs will be done by the consultant Project Manager in consultation with the Laboratory QA Officers and/or Project QA Officer. Any corrections require a unanimous agreement that the correction is appropriate.

21.2 Process for Data Verification and Validation

Data verification and validation for sample collection and handling activities will consist of the following tasks:

- Verification that the sampling activities, sample locations, numbers of samples collected, and types of analysis performed are in accordance with QAPP requirements.
- Documentation of any field changes or discrepancies.
- Verification that the field activities and field data (including sample locations, sample types, sample dates and times, names of field personnel, etc.) were properly documented.
- Verification of proper completion of sample labels and COC forms, and secure storage of samples.
- Verification that all samples recorded on COC forms were received by the laboratories.

Data verification and validation for the sample analysis activities will include all of the following:

- Verification that appropriate methodology has been followed.
- Verification that instrument calibrations have been adequately conducted.
- Verification that QC samples meet performance criteria.
- Verification that analytical results are complete.
- Verification that documentation is complete.

Verification and validation of data entry includes:

- Sorting data to identify missing or mistyped (too large or too small) values.
- Double-checking all typed values.
- Verifying that correct data types correspond to database fields (i.e., text for text, integers for integers, number for numbers, dates for dates, times for times, etc.).

22.0 RECONCILIATION WITH USER REQUIREMENTS

Water quality data collected during this project will provide a means for determining compliance with the Bacteria TMDL. The results of this project will provide valuable information for evaluating compliance with numeric targets and load allocations defined in the TMDL. Data from this study may also be used to support decisions regarding possible amendments to the TMDL, Clean Water Act Section 303(d) listing, modifications to monitoring or assessment requirements, and implementation of management measures and best management practices.

The data will be qualified if QA issues are identified. Uncertainty and limitations on data use will be described in the Data Quality Report included in the Final Annual Report.

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23.0 REFERENCES

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