County of San Diego

RICHARD E. CROMPTON
DIRECTOR

DEPARTMENT OF PUBLIC WORKS
5510 OVERLAND AVE, SUITE 410
SAN DIEGO, CALIFORNIA 92123-1237
(858) 694-2212 FAX: (858) 694-3597
Web Site: www.sdcounty.ca.gov/dpw/

June 26, 2015

Mr. David W. Gibson, Executive Officer
California Regional Water Quality Control Board
San Diego Region
2375 Northside Drive, Suite 100
San Diego, CA 92108-2700

Dear Mr. Gibson:

COUNTY OF SAN DIEGO, PERMIT R9-2013-0001, PIN 255223 – FINAL DELIVERABLE IN RESPONSE TO PROVISION B, WATER QUALITY IMPROVEMENT PLAN FOR THE SAN DIEGO RIVER WATERSHED MANAGEMENT AREA – PIN NO. 794853:CARIAS

On behalf of the Participating Agencies (PAs) in the San Diego River Watershed Management Area, the County of San Diego is pleased to submit the attached document in accordance with requirements set forth in Provision F.1.b.(1) of Order R9-2013-0001, the National Pollution 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, NPDES No. CAS0109266 (Permit).

In order to facilitate regulatory review, a "crosswalk" table is provided as Appendix 1A to indicate where specific permit provisions are addressed in the document. This WQIP follows the framework of Permit Provision B, Water Quality Improvement Plans:

- Section 1. Introduction
- Section 2. Priority Water Quality Conditions (Provision B.2)
- Section 3. Water Quality Improvement Goals, Strategies and Schedules (Provision B.3)
- Section 4. Water Quality Improvement Plan Monitoring and Assessment Program (Provision B.4)
- Section 5. Iterative Approach and Adaptive Management Process (Provision B.5)

We thank your staff for their willingness to provide feedback. We look forward to continued interaction with your staff on the Water Quality Improvement Plan for the San Diego River Watershed Management Area.

If you have any questions or comments, please contact me at (858) 694-3672 or via email at Todd.Snyder@sdcounty.ca.gov.

Sincerely,

Todd Snyder

TODD E. SNYDER, Manager
Watershed Protection Program

Attachment: San Diego River Water Quality Improvement Plan (one printed copy and one CD)

cc: Jaime Campos, City of El Cajon (PIN 222391)
Joe Kuhn, City of La Mesa (PIN 235927)
Clement Brown, City of San Diego (PIN 255222)
Cecilia Tipton, City of Santee (PIN 255749)
Roya Yazdanifard, California Department of Transportation (PIN 212814)

San Diego River Watershed Management Area, Water Quality Improvement Plan Provision B.3 Chapter

CERTIFICATION

"I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature 5-14-15
Date

Douglas Williford, City Manager (619) 441-1780
Printed Name, Title Phone Number

CITY OF
LA MESA
JEWEL of the HILLS

PUBLIC WORKS DEPARTMENT

SAN DIEGO RIVER WATERSHED MANAGEMENT AREA, WATER QUALITY IMPROVEMENT PLAN (PERMIT PROVISION F.1.b SUBMITTAL), STATEMENT OF CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Greg Humora
Director of Public Works/City Engineer
City of La Mesa

6/9/15
Date

CITY OF SANTEE

SAN DIEGO RIVER WATERSHED MANAGEMENT AREA, WATER QUALITY IMPROVEMENT PLAN (PERMIT PROVISION F.1.b SUBMITTAL), STATEMENT OF CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

PEDRO ORSO-DELGADO
Acting City Manager
City of Santee

5/19/15
Date

THE CITY OF SAN DIEGO

STATEMENT OF CERTIFICATION

San Diego River Watershed Management Area

Water Quality Improvement Plan (Permit Provision F.1.B Submittal)

I certify, under penalty of law, that this Water Quality Improvement Plan submittal and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for known violations.

6/19/15

Drew Kleis
Deputy Director
Transportation & Storm Water Department

Date

Transportation & Storm Water Department
9370 Chesapeake Drive, Suite 100, MS 1900 • San Diego, CA 92123
Hotline (619) 235-1000 Fax (858) 541-4350

County of San Diego

SARAH E. AGHASSI
DEPUTY CHIEF ADMINISTRATIVE OFFICER

LAND USE AND ENVIRONMENT GROUP
1600 PACIFIC HIGHWAY, ROOM 212, SAN DIEGO, CA 92101
(619) 531-6256 • Fax (619) 531-5476
www.sdcounty.ca.gov/lueg

SAN DIEGO RIVER WATERSHED MANAGEMENT AREA, WATER QUALITY IMPROVEMENT PLAN (PERMIT PROVISION F.1.B SUBMITTAL), STATEMENT OF CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sarah Aghassi

SARAH E. AGHASSI
Deputy Chief Administrative Officer
Land Use and Environment Group
County of San Diego

Date 5/26/15

DEPARTMENT OF TRANSPORTATION
DISTRICT 11
4050 TAYLOR STREET, M.S. 242
SAN DIEGO, CA 92110
PHONE (619) 688-0100
FAX (619) 688-4237
TTY 711
www.dot.ca.gov

Serious drought.
Help save water!

April 24, 2015

STATEMENT OF CERTIFICATION

SAN DIEGO RIVER WATERSHED MANAGEMENT AREA, WATER QUALITY IMPROVEMENT PLAN

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

BRUCE L. APRIL
Deputy District Director, Environmental

5/20/15
Date

SAN DIEGO RIVER
WATERSHED MANAGEMENT AREA
WATER QUALITY IMPROVEMENT PLAN

Submitted by

City of El Cajon
City of La Mesa
City of San Diego
City of Santee
County of San Diego
Caltrans

Prepared by:

Larry Walker Associates

amec

Modeling by:

Geosyntec consultants

June 2015
DRAFT

[page left intentionally blank]

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

CHAPTER 1

CHAPTER 2

CHAPTER 3

CHAPTER 4

ACRONYMS AND ABBREVIATIONS

%	Percent
<	less than
ASBS	Area of Special Biological Significance
BIOL	Biological Habitats of Special Significance
BMP	Best Management Practices
CALTRANS	California Department of Transportation
CEDEN	California Environmental Data Exchange Network
CLRP	Comprehensive Load Reduction Plan
CWA	Clean Water Act
FIB	Fecal Indicator Bacteria
GIS	Geographical Information System
HPWQC	Highest Priority Water Quality Condition
IBI	Index of Biological Integrity
IDDE	Illicit Discharge Detection and Elimination
JRMP	Jurisdictional Runoff Management Program
JURMP	Jurisdictional Urban Runoff Management Program
LTEA	Long-Term Effectiveness Assessment
MEP	Maximum Extent Practicable
MLS	Mass Loading Station
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
PERMIT	San Diego Regional Water Quality Control Board Order Number R9-2013-0001, National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer System (MS4) Draining the Watersheds Within the San Diego Region
PWQC	Priority Water Quality Condition
RMR	Annual Receiving Waters and Urban Runoff Monitoring Report; or Regional Monitoring Report
RW	Receiving Water
RWQCB	Regional Water Quality Control Board, San Diego Region
SANDAG	San Diego Association of Governments
SBPAT	Structural BMP Prioritization and Analysis Tool

SDR	San Diego River
SMC	Southern California Stormwater Monitoring Coalition
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
TWAS	Temporary Watershed Assessment Station
USEPA	United States Environmental Protection Agency
WMA	Watershed Management Area
WMAA	Watershed Management Area Analysis
WQBEL	Water Quality Based Effluent Limit
WQIP	Water Quality Improvement Plan
WQO	Water Quality Objective
WURMP	Watershed Urban Runoff Management Program

[page left intentionally blank]

EXECUTIVE SUMMARY

The California Regional Water Quality Control Board, San Diego Region (Regional Board) adopted a Municipal Separate Storm Sewer System Permit (Order R9-2013-0001, NPDES No. CAS0109266) (Permit) for the San Diego Region on May 8, 2013. The adoption of this Permit represents a shift from prescriptive, activity-based permit requirements to a strategic, outcome-driven approach. The new approach is watershed based, focusing more on specific improvements within each watershed and less on jurisdictional boundaries. Provision B of the Permit requires the phased development and implementation of a Water Quality Improvement Plan (Plan) for the San Diego River Watershed.

The *goal* of this Plan is to further the Clean Water Act's objective to protect, preserve, enhance, and restore water quality and beneficial uses. By prioritizing and addressing water quality conditions that are influenced by storm drain discharges, the participating agencies in the watershed will be able to utilize key resources to address the most important issues. Furthering the Clean Water Act's objective will be accomplished through an adaptive planning and management process. The process identifies the highest priority water quality condition (HPWQC) linked to storm drain discharges and implements strategies through the Jurisdictional Runoff Management Programs (JRMPs). These strategies will be utilized to achieve improvements in the quality of storm drain discharges and receiving waters.

The *purpose* of the Plan is to guide Participating Agencies' jurisdictional programs. These programs will be implemented to achieve goals associated with improved water quality.

The development process is based on guidance from the Permit, and is outlined in the adjacent figure. The Plan was developed in phases. These phases include:

1) Identification of the priority and highest priority water quality conditions;
2) Identification of numeric goals for bacteria in the watershed;
3) Identify potential sources and develop implementation strategies to achieve the numeric goals;
4) Development of the monitoring and assessment program to evaluate progress of implemented strategies toward achieving the goals;
5) Assess progress periodically through the adaptive management process.

The San Diego River Watershed is located in central San Diego County and is bordered to the north by the Peñasquitos and San Dieguito River Watersheds and to the south by the Pueblo San Diego and Sweetwater River Watersheds. The River extends over 52 miles across central San Diego County forming a watershed with an area of approximately 277,543 acres, ultimately discharging to the Pacific Ocean at Dog Beach in Ocean Beach.

The population in the watershed is approximately 517,219 (U.S. Census Bureau, 2011), mostly concentrated in the Lower San Diego River Hydrologic Area, reflective of the more urban residential land use categories in that area. Land use within the watershed is predominantly undeveloped (44%). Other land use classifications include open space/parks and recreation (23%), residential and spaced rural residential (19%), and transportation (6%). (SANDAG, 2010).

The Participating Agencies in the development of the Plan include the Cities of El Cajon, La Mesa, San Diego, Santee, the County of San Diego, and the California Department of Transportation (Caltrans). Caltrans is not subject to the Municipal Separate Storm Sewer System Permit, but is regulated under a separate permit from the California State Water Resource Control Board (Order No. 2012-0011-DWQ); however, Caltrans has voluntarily participated in the development of the Water Quality Improvement Plans across the San Diego Region.

PUBLIC PARTICIPATION PROCESS

As required by the Permit, the Participating Agencies implemented a public participation process to solicit data, information, and recommendations throughout the development of the Plan. The public process included two public workshops and three Consultation Panel reviews. Feedback received at the workshops, online, and at Panel meetings was vital to the development of this Plan. Specific modifications to the Plan based on feedback can be found in Chapter 1, Section 1.4.2 Public Participation.

On September 23, 2013 the Participating Agencies issued a public call for data and information, announced future public workshops, and advertised a schedule of the opportunities for the public to participate in the Plan development process.

The first public workshop was held on October 3, 2013. The workshop provided an overview of the Plan development process and Participating Agencies received the public's suggestions for water quality improvement priorities, likely sources, and potential strategies. The second public workshop was held on June 26, 2014, and focused on potential numeric goals for the highest priority water quality condition identified and the strategies that could be implemented to achieve the numeric goals.

The Consultation Panel consists of representatives from the Regional Board, the environmental community, the development community, and an at-large member from the Industrial Environmental Association. The first Consultation Panel meeting was held on January 29, 2014, to discuss the draft Provision B.2 document. The document contained proposed priority water quality conditions, likely sources, and potential strategies to improve water quality conditions in the watershed. The second Consultation Panel meeting was held on August 20, 2014, to provide an overview of the draft Provision B.3 document and discuss the proposed goals, strategies and schedules. A third Consultation Panel meeting was held on October 29, 2014, to review the Participating Agencies jurisdictional goals.

PRIORITY WATER QUALITY CONDITIONS (CHAPTER 2)

The Participating Agencies were required to identify water quality priorities to be addressed by the plan that are specifically linked to storm drain discharges from the jurisdictions' stormwater conveyance system (discharges). The priorities were identified after evaluating receiving water conditions and impacts from storm drain discharges. Bacteria was identified as the highest priority water quality condition.

The Permit requires an assessment of receiving water conditions based on regulatory status (e.g., total maximum daily loads, 303(d) listings), historical and current water quality, relevant data, impacts of hydromodification, and other considerations. Building on previous assessments, multiple lines of evidence were utilized to support identification of chemical, physical, and biological impacts to receiving waters.

An assessment of the impacts of storm drain discharges on receiving water quality that considers discharge prohibitions, available storm drain outfall data, locations, and discharge characteristics at storm drain outfalls to receiving waters was also required. Based on these assessments, a list of priority water quality conditions was developed for the watershed. As required, this list was narrowed to identify bacteria as the highest priority water quality condition. A summary of the highest and priority water quality conditions is included in **Table ES-1**.

Table ES-1. Priority Water Quality Conditions in the San Diego River Watershed

	Dry Weather	Wet Weather
Highest Priority Water Quality Condition	· Bacteria	· Bacteria
Priority Water Quality Conditions	· Nitrogen and Phosphorus · Total Dissolved Solids · Eutrophic Conditions · Index of Biological Integrity	· None

Agencies have also been tasked with identifying and prioritizing sources of stormwater and non-stormwater pollutants and/or stressors associated with discharges from stormwater conveyance systems that cause or contribute to the HPWQC, bacteria. Based on the HPWQC and on the evaluation of potential sources, the Participating Agencies developed a list of potential strategies that could result in improvements to water quality within the watershed. These strategies build upon the robust jurisdictional programs and the Comprehensive Load Reduction Plan (Geosyntec, 2012) developed to comply with the Bacteria TMDL (Regional Board, 2010) and Permit requirements. Potential strategies developed include nonstructural best management practices (BMPs), structural BMPs, retrofits, and stream restoration projects.

WATER QUALITY IMPROVEMENT GOALS, STRATEGIES, AND SCHEDULES (CHAPTER 3)

The Participating Agencies then developed specific water quality improvement goals and strategies to address the priority water quality conditions identified for the watershed, as defined in Provision B.2. Examples of goals established by the Participating Agencies are included in **Table ES-2**.

Table ES-2. Participating Agencies' Example Goals for 1st Permit Term [a]

Dry Weather Goal	Wet Weather Goal
Restore 900 Linear Feet of Alvarado Creek	Conduct Alvarado Trunk Main Sewer Replacement Project which will replace .75 miles of trunk sewer
Reduce by 20 % the aggregate flow volume or the number of persistently flowing outfalls.	58.4 acres of drainage area treated through construction of 4 green infrastructure BMPs

[a] See Tables 3-4 through 3-13 for full list of goals

The goals include interim and final numeric (i.e., quantifiable) goals to address the highest priority water quality condition, bacteria, for wet weather and dry weather in the watershed. The Bacteria TMDL requires Participating Agencies to reduce bacteria levels during both dry weather and wet weather conditions within 10- and 20-year compliance timelines, respectively. The goals within the Plan were selected to demonstrate progress towards compliance with the Bacteria TMDL, and the strategies are the actions to be taken to obtain compliance. Multi-benefit strategies have been prioritized to achieve goals for bacteria, as well as other pollutants, and will thereby address both the HPWQC and other priority water quality conditions in the watershed. The approach to achieving Plan goals, and corresponding Plan sections, is shown in **Figure ES-1.**

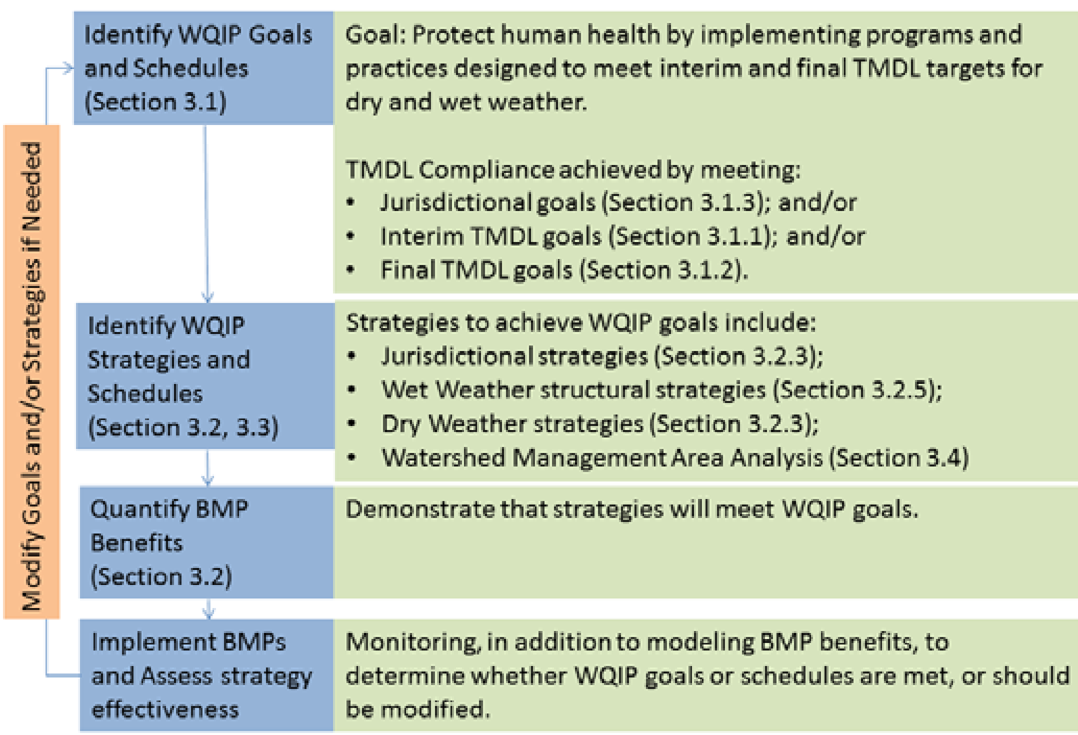


Figure ES-1. Approach for Achieving Plan Goals

The jurisdictional interim and final goals are based on the compliance options for the Bacteria TMDL listed in Attachment E of the Permit. The goals are presented for dry and wet weather conditions as follows:

- Interim goals include:
  - Jurisdictional specific goals based on current Permit term (through 2018)
  - Jurisdictional specific goals for each 5 year Permit term following Plan acceptance, based on the Bacteria TMDL schedules, to demonstrate progress toward meeting the final goals.
- Final goals include compliance options based on final TMDL compliance requirements.

Since the Permit allows multiple pathways to achieve compliance (i.e. demonstration of progress toward all compliance pathways is not required), the numeric goals are independent of each other.

Each jurisdiction has developed strategies that will be implemented to work toward jurisdictional goals. The Participating Agencies also developed optional jurisdictional and watershed strategies that, if needed, will be implemented through coordination amongst the Participating Agencies. The strategies are generally broad in nature and include suites of programmatic (i.e., non-structural) and structural BMPs that are expected to improve conditions within the watershed. The strategies selected to address bacteria in the watershed are summarized in **Table ES-3**. The majority of the strategies selected are multi-benefit in nature, addressing multiple pollutants, beyond bacteria.

Table ES-3. Strategies Identified to address Bacteria in the San Diego River Watershed

Baseline Strategies	Non-Structural Strategies	Structural Strategies
· Development and Redevelopment Planning · Construction Management and Inspections · Existing Development Management · Illicit Discharge Detection and Elimination · Education of Municipal, Industrial, Commercial, and Residential audiences · Public Outreach and Participation · Stormwater Conveyance System Cleaning · Street Sweeping · Commercial/Industrial Inspections · Municipal Audits	· Identification and control of sewage discharge to the stormwater conveyance system · Pet waste programs · Trash cleanups · Onsite wastewater treatment source reduction · Commercial/industrial good housekeeping · Irrigation runoff reduction and good landscaping practices · Animal facilities management · Erosion Monitoring and Repair · Street and median sweeping · stormwater conveyance system cleaning · Education and Outreach · Homelessness waste management · Property Based Inspections and Enforcement	· Infiltration BMPs (e.g., basins, bioretention, permeable pavement) · Rainwater harvesting · Biofiltration BMPs · Green Streets · Infrastructure improvements · Pretreatment BMPs · Strategic retrofits in areas of existing development; · Water course rehabilitation (e.g., stream restoration/ enhancements) · Advanced treatment and proprietary devices · Potential Public Private Partnership Program · Redevelopment and LID implementation

Expected load reductions were estimated for dry and wet weather to evaluate the proposed strategies' ability to achieve the numeric goals established in the Plan. To provide reasonable assurance and demonstrate that the load reduction target for the watershed can be achieved through implementation of this Plan, quantitative wet weather load reduction modeling was performed for the structural BMPs identified. The predicted wet weather load reduction is greater than the estimated target load reduction, indicating that Plan implementation is expected to meet the HPWQC final numeric goal. For dry weather, an analytical spreadsheet approach was used to demonstrate reasonable assurance that compliance will be reached through implementation of this Plan. Per the requirements of Attachment E in the Permit, the structural BMPs proposed in the Comprehensive Load Reduction Plan were included in this Plan.

The overall strategy of the Plan is to pursue aggressive non-structural BMPs as the initial method for achieving wet weather load reduction goals. Non-structural BMPs will be utilized as the primary method for achieving dry weather load reduction goals. Distributed structural BMPs would be implemented as needed by the individual Participating Agencies. Determination of need will be based on modeling, the adaptive management process, and using the Report of Waste Discharge assessment process. As with distributed structural BMPs, regional structural BMPs would be implemented as needed and as funding is available by the individual Participating Agencies. The benefit calculations summarized in Section 3.2.4 support the viability of this strategy.

Optional Watershed Management Area Analysis

The Watershed Management Area Analysis (WMAA) is an optional task described in the Permit that is intended to characterize important processes and characteristics of each watershed through creation of GIS layers and analyses that may be used for the following purposes:

1) To identify candidate projects that could potentially be used as offsite alternative compliance options in lieu of satisfying full onsite retention, biofiltration, and hydromodification runoff requirements.
2) To identify and/or prioritize areas where it is appropriate to allow certain exemptions from onsite hydromodification management BMPs.

The Participating Agencies elected to perform the watershed characterization and hydromodification management exemption mapping on a regional scale under a separate but concurrent effort to development of the plans, and it is included in Appendix 3H. As part of this process, a list of candidate projects within the watershed was also generated and is included in Appendix 3G.

Monitoring and Assessment Program (Chapter 4)

Based on the requirements of the Permit and the WQIP planning process, the Participating Agencies have developed an integrated Monitoring and Assessment Program that:

- Measures the progress toward addressing the highest priority water quality condition established in Chapter 2;
- Assesses the progress toward achieving the numeric goals and schedules provided in Chapter 3; and
- Evaluates each Participating Agency's overall efforts to implement the Plan.

The Monitoring and Assessment Program incorporates requirements of Provision D of the Permit along with the specific monitoring and assessment requirements for the Bacteria TMDL listed in Attachment E of the Permit.

The Monitoring Program includes three major components: receiving water monitoring, storm drain discharge monitoring, and special studies.

The receiving water monitoring program measures the long term health of the watershed. The purpose of the receiving water monitoring program is to characterize trends in the chemical, physical, and biological conditions of a receiving water to determine whether beneficial uses are protected, maintained, or enhanced. This program is designed to meet requirements set forth in Provision D.1 of the Permit. Long-term monitoring occurs during both wet and dry conditions for water quality and physical and biological integrity, along with sediment quality monitoring and participation in regional monitoring. The Permit also stipulates how TMDL monitoring requirements are to be incorporated into the receiving water monitoring program as described in Attachment E of the Permit. Receiving water monitoring includes the following programs:

- Long-term receiving water monitoring,
- Regional monitoring participation,
- Sediment quality monitoring, and
- TMDL monitoring.

The dry weather monitoring program evaluates the potential contribution from storm drain discharges on receiving water quality during dry weather conditions. The monitoring program also assesses the ability of programs to effectively eliminate non-storm water discharges to waterbodies or waterways. The program consists of field screening and storm drain outfall monitoring during dry weather.

The wet weather storm drain discharge monitoring program investigates the condition of the water quality of the flows that exit the storm drain outfalls during storm events. The purpose of the wet weather storm drain discharge monitoring program is to evaluate the potential effects of stormwater discharges on receiving water quality. The program consists of storm drain outfall monitoring during wet weather.

Special studies have been selected to further investigate the HPWQC and meet requirements of Provision D.3 of the Permit. The special studies will include a both a regional special study and a special study specific to the watershed.

The assessment portion of the Monitoring and Assessment Program will evaluate the data collected under the monitoring programs, as well as the information collected as part of the JRMP. The data collected from these two programs will be used to assess the progress toward achieving the numeric goals and schedules established in the Plan, and to measure the progress toward addressing the HPWQC.

The Assessment Program includes an annual analysis of the monitoring data and an integrated analysis. The integrated analysis combines all analyses previously performed at the end of the Permit term, which includes the following components:

- Annual Reporting
    - Receiving Water Assessment
    - Storm Drain Outfall Discharge Assessment
    - Special Studies Assessment
- Permit Reporting (Report of Waste Discharge at end of Permit Cycle)

- Integrated Assessment

ITERATIVE APPROACH AND ADAPTIVE MANAGEMENT (CHAPTER 5)

The Permit includes requirements for adaptive management in multiple provisions. Provisions A.4, B.5, D.4.d, and F.2.c each contain requirements related to adaptive management. Chapter 5 of the Plan elaborates on the adaptive management process, including the frequencies of adaptation required by the Permit (annual versus once per Permit term), triggers, and resulting actions.

The Permit contains two conditions that may trigger adaptation annually:

1) Exceedances of water quality standards in receiving waters, and
2) New information.

In either case, modifications may be appropriate for the water quality goals, strategies, schedules, and/or Monitoring and Assessment Program. Priority water quality conditions may be modified as needed during the Permit term, but would likely be modified only as a result of assessments conducted for the Report of Waste Discharge.

The Permit also contains specific assessments to be performed during preparation of the Report of Waste Discharge. The assessments are longer term in nature, occurring only once during the Permit cycle. Because the updates to the Plan are required to undergo a full public participation process, including reconvening the Consultation Panel, modifications will consider input from the public and the Regional Board. Adaptation of Plan elements will also consider new regulations or policies as appropriate. In the Report of Waste Discharge preparation, all elements of the Plan are eligible for modifications through the required adaptive management processes. Elements that will be evaluated include the water quality conditions (i.e., priorities), goals and accompanying schedules, strategies and accompanying schedules, and the Monitoring and Assessment Program.

1 INTRODUCTION

1.1 PURPOSE AND GOAL OF THE WATER QUALITY IMPROVEMENT PLAN

On May 8, 2013 the California Regional Water Quality Control Board, San Diego Region (Regional Board) adopted Order No. R9-2013-0001, NPDES No. CAS 0109266, National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems Draining the Watersheds within the San Diego Region (Permit).

The Permit covers portions of San Diego County, Orange County, and Riverside County within the San Diego Region. There are two main goals for the Permit, which now covers all Copermittees regardless of County. The first goal involves more consistent implementation, improved communication among participating agencies (particularly in the case of watersheds that cross jurisdictional boundaries), and minimizing resources spent on the Permit renewal process. The second goal establishes requirements that focus on the achievement of goals and water quality improvement outcomes rather than completing specific actions, giving the Copermittees more control over how their Jurisdictional Runoff Management Programs (JRMPs) are implemented.

The current Permit, which became effective on June 27, 2013, mandates the development of watershed-based Water Quality Improvement Plans (Plan(s)). The Cities of El Cajon, La Mesa, San Diego, and Santee, County of San Diego, and Caltrans (hereafter referred to as the Participating Agencies) are responsible for development of the Plan in the San Diego River Watershed. Caltrans is not subject to this Permit, but is regulated under a separate permit from the California State Water Resource Control Board (Order No. 2012-0011-DWQ). However, Caltrans has voluntarily participated in the development of Plans throughout the San Diego Region.

The purpose of the Plan is to guide updates to the Participating Agencies' jurisdictional programs. These programs will be implemented to achieve the outcome of improved water quality in storm drain discharges and receiving waters. The goal of the Plan is to further the Clean Water Act's objective to protect, preserve, enhance, and restore the water quality and designated beneficial uses of waters of the state, specifically by addressing adverse water quality conditions that are associated with storm drain discharges. This goal will be accomplished through an adaptive planning and management process that identifies the Highest Priority Water Quality Condition (HPWQC) linked to storm drain discharges within a watershed. The Plan identifies strategies that will be implemented through the jurisdictional programs to achieve improvements in the quality of storm drain discharges and, in turn, the receiving waters.

1.2 PHYSICAL SETTING

The San Diego River Watershed is located in central San Diego County. The watershed is bordered to the north by the Peñasquitos and San Dieguito River Watersheds and to the south by the Pueblo San Diego and Sweetwater River Watersheds. The San Diego River originates in the Cuyamaca Mountains near Santa Ysabel, over 6,000 feet above sea level, along the western border of the Anza Borrego Desert Park. The River extends over 52 miles across central San Diego County, forming a watershed with an area of approximately 277,543 acres or 434 square miles. It ultimately discharges to the Pacific Ocean at Dog Beach in Ocean Beach, a community within the City of San Diego. Of the ten watershed management areas in the San Diego region, the San Diego River Watershed is the fourth largest.

The San Diego River Watershed (Hydrological Unit (HU) 907) consists of four hydrologic areas: Lower San Diego (907.1), San Vicente (907.2), El Capitan (907.3), and Boulder Creek (907.4). The San Vicente and El Capitan Reservoirs are located just upstream of the Lower San Diego Hydrologic Area.

This Plan addresses the entire watershed. However, for planning purposes, the watershed was divided into the upper and lower watershed to reflect the portions above and below the reservoirs. The upper portion, above the reservoirs, is comprised of the San Vicente (907.2), El Capitan (907.3), and Boulder Creek (907.4) Hydrologic Areas, while the lower portion, below the reservoirs, is the Lower San Diego (907.1) Hydrologic Area. A map of the watershed is shown in **Figure 1-1**.

Using block group level population data from the 2010 Census Summary File for California (U.S. Census Bureau, 2011), the population in the watershed was estimated to be 517,219 persons or 1,193 persons per square mile. The major population center is in the Lower San Diego Hydrologic Area, which reflects the more urban residential land use categories located there.

Land use within the overall watershed is predominantly undeveloped (44%). Other land use classifications include open space / parks and recreation (23%), residential and spaced rural residential (19%), and transportation (6%). Agriculture, commercial, commercial recreation, industrial, military, public facility, and water land uses each make up less than 2% of the land use acreage (SANDAG, 2010).

Several jurisdictions cover the watershed. Most of the watershed is unincorporated land (75%) under the County of San Diego's jurisdiction. The remaining jurisdictional areas of the watershed include the Cities of El Cajon, La Mesa, San Diego, Santee, and Caltrans. Although the County of San Diego generally would have land use authority in unincorporated areas, a significant percentage of the unincorporated area is under the jurisdiction of the federal government. As such, it is effectively outside the jurisdictional land use authority of the County.

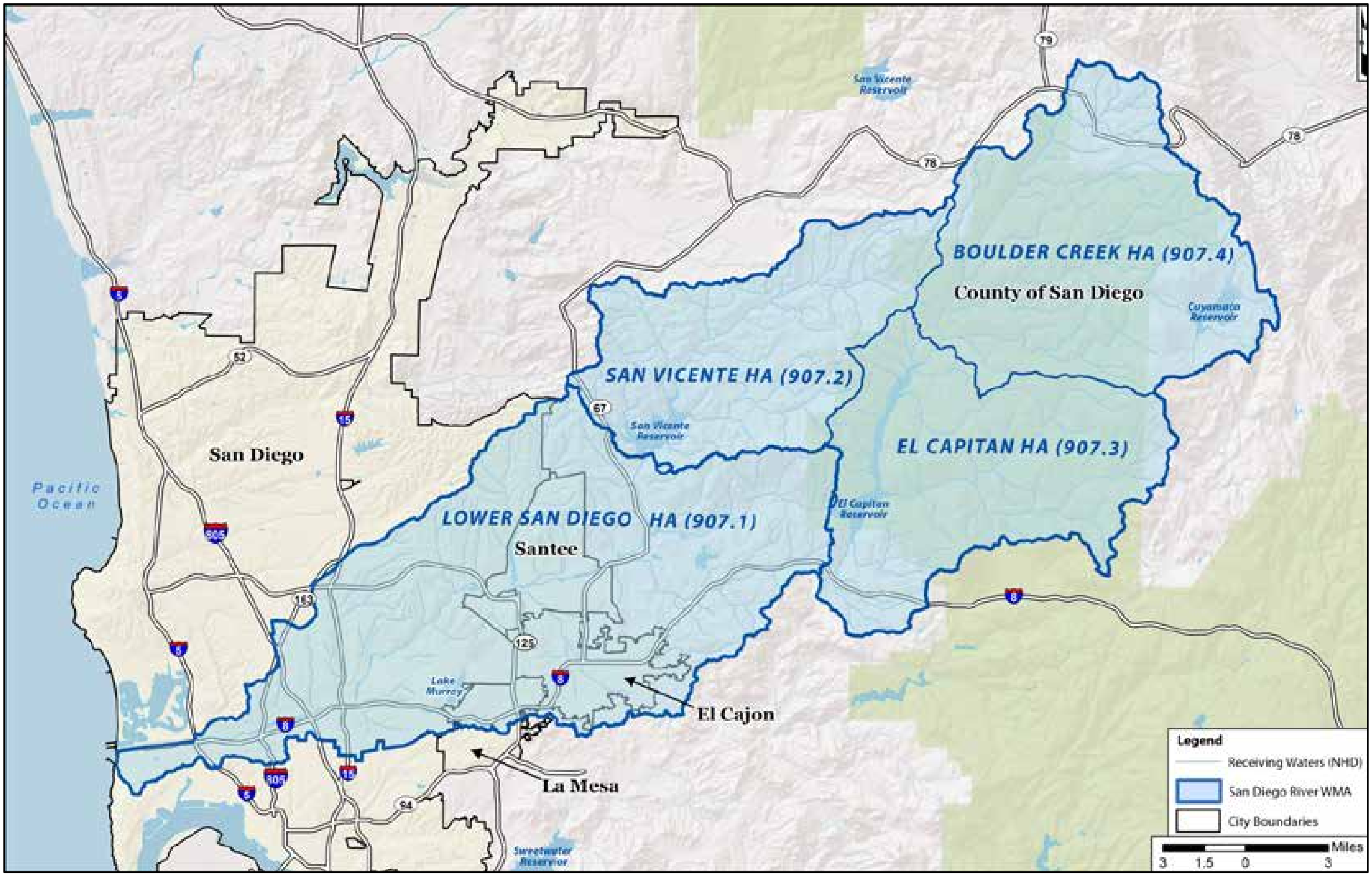


Figure 1-1. San Diego River Watershed

1.3 REGULATORY AUTHORITY AND PERMIT REQUIREMENTS

1.3.1 *JURISDICTION AND RESPONSIBILITIES*

Each Copermittee must comply with the discharge prohibitions and receiving water limitations outlined in the Permit through timely implementation of control measures, other actions specified in the Permit, and collaborative development of and adherence to Water Quality Improvement Plans. The Permit limits the Copermittees' responsibilities to discharges from Copermittees' outfalls; the Permit does not require the Copermittees to manage stormwater outside of their jurisdictional boundaries, but rather to work collectively to improve stormwater management within watersheds.

To demonstrate adherence to the Permit, the Water Quality Improvement Plan is one of several documents required under the Permit. The Water Quality Improvement Plan provides an overarching "road map" to meet water quality improvement goals for the highest priority water conditions in the watershed. Key dual oversight roles, especially for business, inspections, and illicit discharge detection and elimination responsibilities, are outlined in each entity's Jurisdictional Runoff Management Plan. Each entity further refines the key requirements necessary to satisfy the Permit through a "stormwater" ordinance. Furthermore, jurisdictional specific BMP Design Manuals provide minimum BMP guidelines for redevelopment and new development. These documents are being developed concurrently with the Water Quality Improvement Plan to meet Permit deadlines and to demonstrate compliance with the Permit.

The San Diego River Watershed contains stormwater conveyance features under the jurisdiction of the Participating Agencies, and those that are owned and operated by other parties and regulated by separate National Pollutant Discharge Elimination System permits or other regulatory mechanisms. Discharges from non-municipal sources and activities regulated by separate permits include, for example, discharges regulated under the Phase II Small Municipal Separate Storm Sewer System General Permit (State Board Order No. 2013-0001-DWQ), discharges from industrial and construction activities regulated under the General Industrial Permit (State Board Order No. 2014-0057-DWQ) and General Construction Permit (State Board Order No. 2012-0006-DWQ), and conditional waivers that exclude certain activities from coverage under the National Pollutant Discharge Elimination System permit program; examples of such activities include noncommercial agricultural, silvicultural, and animal operations.

Under this regulatory framework, there are two general areas of stormwater management responsibilities: (1) jurisdictional inspection and oversight, and (2) pollutant discharge control. In terms of jurisdictional inspection, the Participating Agencies have inspection responsibilities over all lands within their jurisdictional boundaries (including industrial and construction sites), except for Phase II, noncommercial agricultural, state, federal, Caltrans and Indian tribal lands, which are the primary inspection responsibility of the USEPA, State Board and/or Regional Board. However, in terms of regulatory oversight, the Participating Agencies do have some regulatory oversight over industrial lands, construction sites, Phase II, agricultural, state, federal and Indian reservation lands. For example, the Participating Agencies implement programs to identify, investigate and enforce illicit discharges to their storm drains – any illicit discharge(s) from these lands entering a Participating Agency's storm drain(s) would be within the regulatory oversight of the affected Participating Agency and would be acted upon. Additionally, a "dual oversight" role responsibility through inspections of businesses and construction sites is acknowledged, even though the Participating Agencies are not the primary permitting authority.

With regards to pollutant discharge control, various permits or conditional waivers regulate stormwater and non-stormwater discharges within the watershed. While the Participating Agencies do not have authority under the Permit to require and regulate BMPs to treat pollutant discharges from properties/entities covered under other permits, the Permit requires the Participating Agencies to control pollutants that originate from these other properties/entities if the discharge will ultimately enter into the Participating Agencies' stormwater conveyance systems. For this reason, the Participating Agencies recognize that collaboration and improved communication between the various entities within the watersheds are vital so that discharges are appropriately regulated before entering the stormwater conveyance system and to improve water quality throughout the watershed.

1.3.2 Plan Requirements [Permit Provisions A.4 and B]

The Plan was developed to adhere to specific Permit provisions. Provision A.4., Compliance with Discharge Prohibitions and Receiving Water Limitations, states that "Each Copermittee must achieve compliance with Provisions A.1.a, A.1.c and A.2.a of this Order through timely implementation of control measures and other actions as specified in Provisions B and E of this Order, including any modifications. The plans required under Provision B must be designed and adapted to ultimately achieve compliance with Provisions A.1.a, A.1.c and A.2.a."

Provision A describes "Prohibitions and Limitations" with the following goal: "to protect the water quality and designated beneficial uses of waters of the state from adverse impacts caused or contributed to by MS4 discharges… [which] will be accomplished through the implementation of water quality improvement strategies and runoff management programs that effectively prohibit non-stormwater discharges into the Copermittees' MS4s, and reduce pollutants in stormwater discharges from the Copermittees' MS4s to the [Maximum Extent Practicable]." Provision A.1.a states that "Discharges from MS4s in a manner causing, or threatening to cause, a condition of pollution, contamination, or nuisance in receiving waters of the state are prohibited." Provision A.1.c states that "Discharges from MS4s are subject to all waste discharge prohibitions in the Basin Plan, included in Attachment A ["Discharge Prohibitions and Special Protections] to this Order."

Provision A.2.a describes Receiving Water Limitations, and specifically states that "Discharges from MS4s must not cause or contribute to the violation of water quality standards in any receiving waters".

Provision B describes the process that was followed in the development of the Plan. The process includes details describing the identification of priorities and potential strategies to address the priorities (Provision B.2), the development of goals, selection of strategies, and building of schedules to address the priorities (Provision B.3), the development of the monitoring and assessment program (Provision B.4), and a description of the iterative approach and adaptive management process to be employed over time (Provision B.5).

1.3.3 Reporting Requirements [Permit Provision F]

Copermittees must also comply with reporting and outreach provisions for this Plan, which are described in Permit Provision F. Permit Provision F.1.b details the following requirements for Plan submittal, requiring the Participating Agencies to submit the plan within 24 months after the commencement of coverage under the Permit (June 27, 2015).

The Participating Agencies must consider revisions to the Plan based on written comments received by the close of the public comment period. The Participating Agencies must submit revisions to the Plan to the Regional Board no later than 60 days after the close of the public comment period.

If issues concerning the Plan can be resolved informally through discussions among the Participating Agencies, the Regional Board, and interested parties, then the Regional Board Executive Officer is authorized to provide written notification of acceptance to the Participating Agencies that the Plan meets the requirements of Provision B. The Participating Agencies must commence with implementation of the Plan, in accordance with the water quality improvement strategies and schedules therein, upon written notification of acceptance of the Plan by the Regional Board Executive Officer. During implementation of the Plan, the Participating Agencies must correct any deficiencies in the Plan identified by the Regional Board in the updates submitted with the Annual Report following a request by the Regional Board.

The Plan must be made available on the Regional Clearinghouse, as required by Provision F.4, within 30 days of receiving the notification of acceptance of the Plan by the Regional Board Executive Officer.

Permit Provisions F.2.c and F.3.d provide specific reporting requirements for Plan updates and Annual Reports, as shown in **Table 1-1**.

Table 1-1. Reporting Requirements

Permit Required Reporting	Frequency	Detailed Data and Information
Water Quality Improvement Plan Updates (Provision F.2.c)	· As needed; and · Upon Office of Administrative Law and USEPA approval of any TMDL Basin Plan amendment with WLAs assigned to Participating Agencies during the term of the Permit	· Participating Agencies must "develop and implement a public participation process to obtain data, information and recommendations for updating" the Plan; · Participating Agencies must consult with the Consultation Panel on proposed updates to the Plan; · Participating Agencies must submit proposed updates and supporting rationale, and recommendations from the public and Consultation Panel in the Annual Reports, or as part of the Report of Waste Discharge.
Water Quality Improvement Plan Annual Reports (Provision F.3.d)	· Annual	· Receiving water and storm drain outfall discharge monitoring data summary (Provisions D.1 and D.2); · Progress of special studies (Provision D.3); · Findings from assessments (Provision D.4); · Plan implementation progress (Provisions F.3.d.i-vi); · Jurisdictional Urban Runoff Management Program Annual Report form; and · Data or documentation used in developing the Annual Report, upon request from Regional Board.

1.4 Water Quality Improvement Plan Development Process

The Plan has been developed in three phases, according to the process for Plan development described in the Permit. The process for development of the Plan is outlined by the diagram below.

The first phase of development identified the priority water quality conditions and potential water quality improvement strategies (Provision B.2). The results were summarized in the first submittal to the Regional Board and in Chapter 2.

The second phase of development identified numeric goals for bacteria in the watershed, and strategies that will be implemented to achieve the numeric goals (Provision B.3). The second phase is included as Chapter 3.

The third phase of development included a monitoring and assessment program (Provision B.4) to provide feedback to program managers, see Chapter 4. An adaptive management process (Provision B.5), to facilitate future adjustments and changes to the plan, is described in Chapter 5.

1.4.1 DOCUMENT OVERVIEW

As described above, the Plan is organized into the following chapters to address Permit requirements for Plan development (**Table 1-2**).

Table 1-2. Plan Structure

Chapter Content	Permit Requirements Addressed
Chapter 2. Priority Water Quality Conditions	
Presents the water quality priorities that were identified after evaluating receiving water conditions and impacts from storm drain discharges.	B.2.Priority Water Quality Conditions
Chapter 3. Water Quality Improvement Goals, Strategies, and Schedules	
Jurisdictional interim and final goals are presented for dry and wet weather conditions, along with strategies to work toward achieving the goals.	B.3 Water Quality Improvement Goals, Strategies and Schedules
Chapter 4. Monitoring and Assessment Program	
Presents the integrated Monitoring and Assessment Program developed based on the requirements of the Permit and Plan development process.	B.4. Water Quality Improvement Plan Monitoring and Assessment Program
	D. Monitoring and Assessment Program Requirements
Chapter 5. Iterative Approach and Adaptive Management	
Elaborates on the adaptive management processes, including the frequencies of adaptation required by the Permit (annual versus once per Permit term), triggers, and resulting actions.	B.5 Iterative Approach and Adaptive Management

In addition, the Participating Agencies have crafted a document "crosswalk" to provide Permit provision references to the corresponding document's sections. This crosswalk is intended to ease the review process and is included as Appendix A1.

1.4.2 PUBLIC PARTICIPATION

The Participating Agencies implemented a public participation process to solicit data, information, and recommendations that were utilized in the development of the Plan. On September 23, 2013, the Participating Agencies issued a public call for data and information, announced future public workshops, and advertised a schedule of the opportunities for the public to participate in the Plan development process. Participation included the opportunity for members of the public to provide comments during the various stages of the Plan development process. The first public workshop was held on October 3, 2013. The workshop provided an overview of the planning process and Participating Agencies received the public's suggestions for water quality improvement priorities, likely sources, and potential strategies. The second public workshop was held on June 26, 2014, and focused on potential numeric goals for the highest priority water quality condition identified and the strategies that should be implemented to achieve the numeric goals.

The Participating Agencies formed a Consultation Panel (Panel) to provide recommendations during the development of the Plan. The Panel consists of representatives from the Regional Board, the environmental community, the development community, and an additional member from the industrial community. The Panel includes the following individuals:

- Christina Arias (Regional Board)
- Jim Peugh, primary; Joe Thompson, alternate (Environmental Community)
- Brendan Hastie, primary; Mike McSweeney, alternate (Development Community)
- Nancy Gardiner, representing Industrial Environmental Association (At-large Seat)

The first Consultation Panel meeting was held on January 29, 2014, to discuss the draft Provision B.2 document. The document contained proposed priority water quality conditions, likely sources, and potential strategies to improve water quality conditions in the watershed. The second Consultation Panel meeting was held on August 20, 2014, to provide an overview of the draft Provision B.3 and discuss the proposed goals, strategies and schedules. A third Consultation Panel meeting was held on October 29, 2014, to review the Participating Agencies jurisdictional goals.

Feedback received at the workshops, online, and at Panel meetings was vital to the development of this Plan. Specific modifications to the draft chapters that were made in response to feedback are detailed below.

1.4.2.1 Chapter 2 Priority Water Quality Conditions

The Panel was provided a draft of Chapter 2, *Priority Water Quality Conditions*, for review and comment prior to their first meeting on January 29, 2014. The Participating Agencies gave a presentation describing the draft during the public meeting. Comments from the Consultation Panel were received in mid-February. The Panel's recommendations were considered by the Participating Agencies and the draft chapter was revised according to Panel input, where appropriate.

The primary focus of the revisions in response to Panel comments was on the methodology for the identification of priority water quality conditions (Section 2.3). The Participating Agencies developed a revised methodology for determining the priority and highest priority water quality condition(s) to more effectively incorporate various sources of data indicating water quality impacts. While the methodology remains a four step process, a scoring system was developed to make the process quantitative and transparent. Additionally, per the request of the Panel, best professional judgment was included in the updated process to allow effective focus of resources to solve problems.

Key revisions to the January 2014 draft of Chapter 2 based on Panel input include:

- Inclusion of an Executive Summary;
- Section 2.4, Identification of storm drain discharge Sources of Pollutants and/or Stressors was expanded to provide clarification of storm drain discharge sources;
- Section 2.5, Identification of Potential Water Quality Improvement Strategies was updated to include potential implementation strategies recommended by Consultation Panel. Upon production of the complete Plan, the section has been included as Appendix 3A. The

appendix identifies the water quality improvement strategies that form the foundation for implementation of the Plan.

- Appendix 2D was updated with the revised methodology scoring; and
- Appendix 2E was added to include larger format watershed maps to assist with readability.

These revisions have been included in the complete plan; however, appropriate modifications have been made (e.g., the Chapter 2 Executive Summary has been combined into the Executive Summary for the complete plan).

1.4.2.2 Chapter 3 Goals, Strategies and Schedules

The second Consultation Panel meeting was held at the County of San Diego on August 20, 2014 to discuss Provision B.3, *Goals*, *Strategies and Schedules*. A third Panel meeting was held on October 29, 2014 to discuss draft goals. The Participating Agencies coordinated schedules to provide the public with the time and opportunity to participate during the development of the plans. Feedback received at the workshops, through written comments, and at panel meetings was considered during the development of goals, strategies, and schedules. In response to the Consultation Panel's comments on the draft Provision B.3 document, the goals were streamlined and the text was expanded to provide a comprehensive explanation of the anticipated outcomes, and how the outcomes would be measured. Additionally, a strategy section was added to improve the linkage between the actions and the anticipated outcomes.

2 PRIORITY WATER QUALITY CONDITIONS

The San Diego River Participating Agencies are required to identify the water quality priorities in the watershed that are associated with storm drain discharges and that are addressed by the Plan. Where appropriate, watershed may be separated into sub-watersheds to focus water quality prioritization and jurisdictional runoff management program implementation efforts. For the purposes of this Plan, the watershed was separated into the upper and lower portions of the watershed to better focus water quality prioritization and jurisdictional runoff management program implementation efforts.

2.1 ASSESSMENT OF RECEIVING WATER CONDITIONS [B.2.A.]

Provision B.2.a of the Permit specifies that the Participating Agencies must consider the following to identify water quality priorities based on impacts of storm drain discharges on receiving water beneficial uses:

1) Receiving waters listed as impaired on the Clean Water Act Section 303(d) List of Water Quality Limited Segments (303(d) List) **(Section 2.1.1)**
2) TMDLs adopted and under development by the Regional Board (**Section 2.1.2)**;
3) Sensitive or highly valued receiving waters (**Section 2.1.3)**;
4) Receiving water limitations of Permit Provision A.2 (**Section 2.1.4)**;
5) Known historical versus current physical, chemical, and biological water quality conditions (**Section 2.1.5**);
6) Physical, chemical, and biological receiving water monitoring data (**Section 2.1.6**);
7) Available evidence of erosional impacts in receiving waters due to accelerated flows (i.e., hydromodification) (**Section 2.1.7**);
8) Available evidence of adverse impacts to the chemical, physical, and biological integrity of receiving waters (**Section 2.1.8**); and
9) The potential improvements to the overall condition of the watershed that can be achieved (**Section 2.1.9**).

The information listed above is summarized in the following subsections.

2.1.1 Clean Water Act Section 303(d) List of Water Quality Limited Segments

The receiving waters listed as impaired according to the Clean Water Act Section 303(d) List of Water Quality Limited Segments (303(d) List), as well as potential sources of the impairments identified in the 303(d) List, are shown in Appendix 2A. The 303(d) listed receiving waters are shown in **Figure 2-1**.

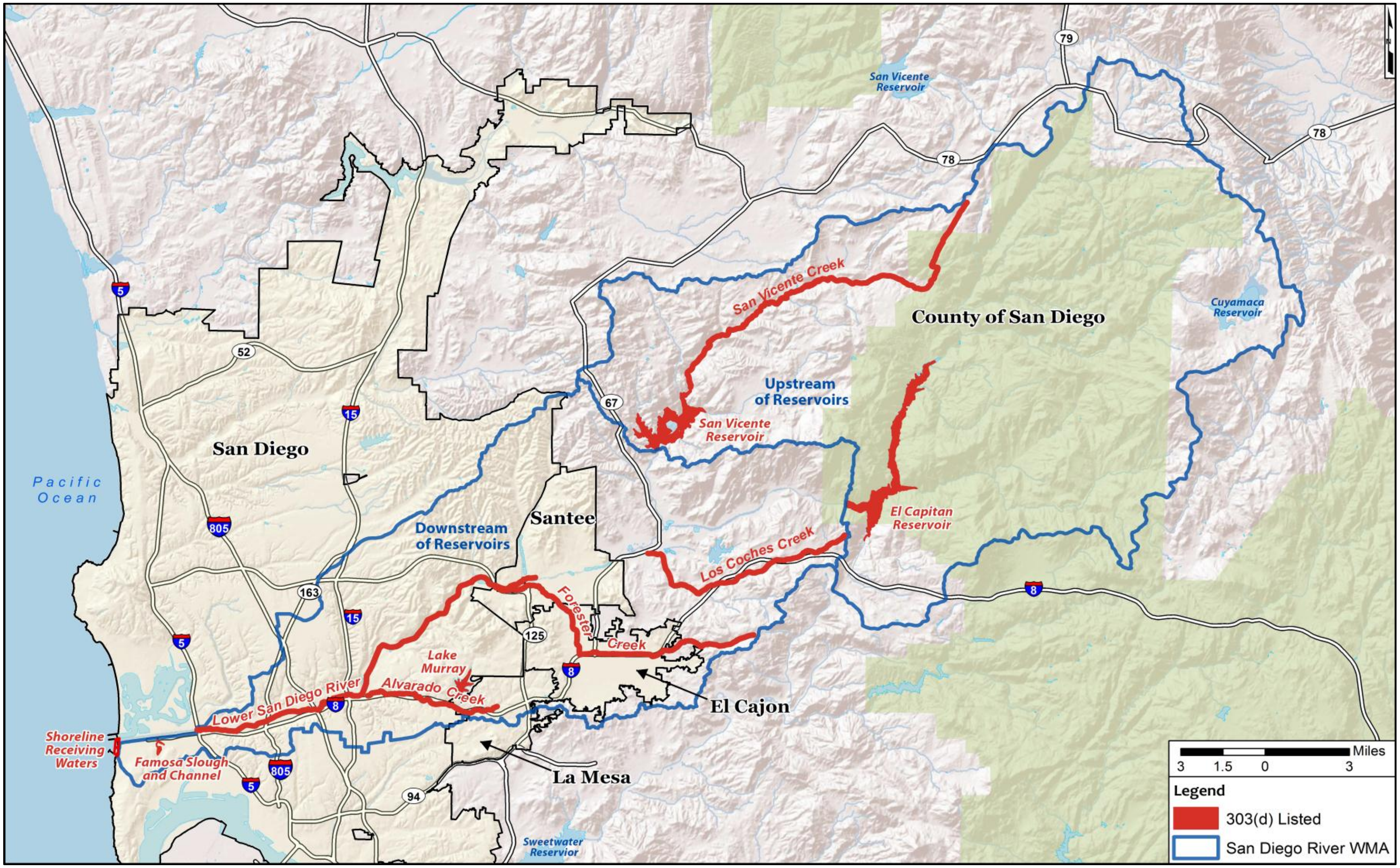


Figure 2-1. Water bodies within the San Diego River Watershed with 303(d) List Impairments

2.1.2 TMDLs Adopted and Under Development

There is one TMDL for bacteria that has been adopted regionally and includes waterbodies in the San Diego River Watershed – the *Revised Total Maximum Daily Loads for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region*. The receiving waters that are covered by the Bacteria TMDL and the draft TMDL that is under development for Famosa Slough are summarized in **Table 2-1. Water quality-based effluent limits (WQBELs) for TMDLs in the San Diego River are shown in Appendix 2B.**

Table 2-1. TMDLs Adopted in the San Diego River Watershed

Sub Watershed	Water Body Name	Water Body Type	Pollutant	Adoption Date
Downstream of Reservoirs	Forester Creek	River & Stream	Bacteria	2010
Downstream of Reservoirs	San Diego River (Lower)	River & Stream	Bacteria	2010
Downstream of Reservoirs	Pacific Ocean Shoreline	Shoreline	Bacteria	2010
Downstream of Reservoirs	Famosa Slough	Wetlands	Eutrophication	Under Development

2.1.3 Sensitive or Highly Valued Receiving Waters

Receiving waters recognized as sensitive or highly valued include water bodies designated as estuaries according to the National Estuary Program under Clean Water Act Section 320, wetlands as defined by the State or U.S. Fish and Wildlife Service's National Wetlands Inventory, waters having the Preservation of Biological Habitats of Special Significance (BIOL) beneficial use designation, and water bodies identified as Areas of Special Biological Significance.

Figure 2-2 shows the receiving waters which fall under the categories described above. Parts of the watershed have been studied in detail, resulting in spatial disparities in the level of available information across the watershed that is presented in **Figure 2-3.**

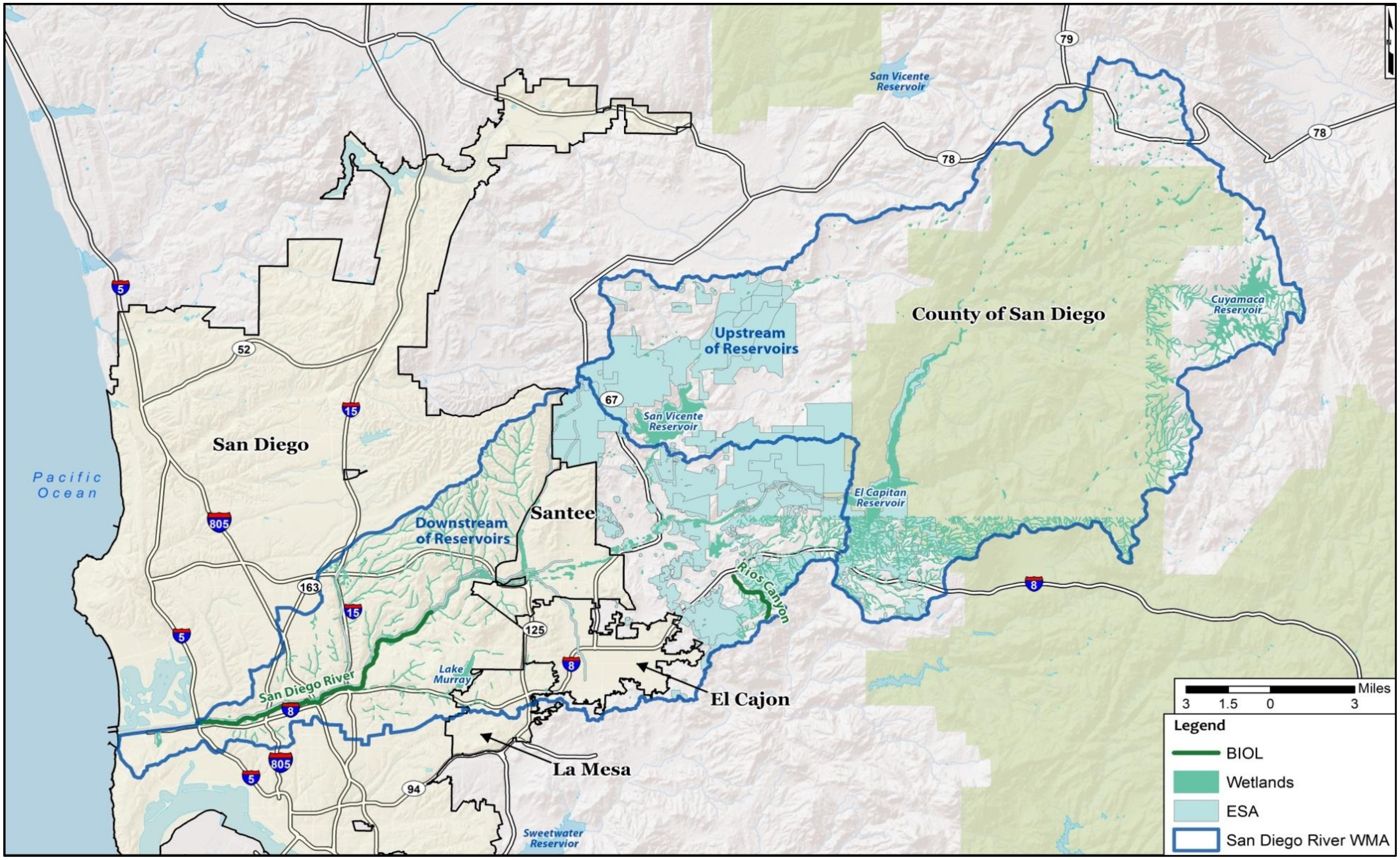


Figure 2-2. Sensitive or Highly Valued Water Bodies in San Diego River Watershed –
(Data: County of San Diego Planning and Development Services and US Fish and Wildlife)

2.1.4 Receiving Water Limitations of Provision A.2

Provision A.2 of the Permit states that storm drain discharges "may not cause or contribute to the violation of water quality standards in any receiving waters", including but not limited to the following:

(a) The Water Quality Control Plan for the San Diego Basin (Basin Plan, 2012);

(b) Other State Board Plans, such as the Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries, and the Ocean Plan;

(c) State Board policies on water and sediment quality such as the Water Quality Control Policy for the Enclosed Bays and Estuaries of California, the Sediment Quality Control Plan, and the Statement of Policy with Respect to Maintaining High Quality of Waters in California;

(d) Priority pollutant criteria defined by the USEPA through the National Toxics Rule and the California Toxics Rule;

In addition, this Provision states that storm drain discharges "must not alter natural ocean water quality in an Area of Special Biological Significance." However, since there are no Areas of Special Biological Significance in the watershed, this portion of the Provision is not applicable.

Available monitoring data were evaluated with respect to the receiving water limitations listed above, and the results of this evaluation are discussed in the following sections.

2.1.5 Known Historical Versus Current Physical, Chemical, and Biological Water Quality Conditions

The Participating Agencies assessed historical and current water quality conditions using the following datasets:

- 2005 - 2010 Long-Term Effectiveness Assessment (LTEA) (Weston, 2011).
- 2011 - 2012 Receiving Waters and Urban Runoff Monitoring Report (Weston, 2013)
- The 2005 Baseline LTEA (BLTEA).

The LTEA was developed by the Participating Agencies, along with other San Diego County Permittees, in accordance with the 2007 San Diego Municipal Stormwater Permit (NPDES Order No. R9-2007-0001), to assess the effectiveness of the Receiving Waters Monitoring Program and regional, watershed, and jurisdictional programs. The LTEA report was released in 2011 (Weston, 2011). The LTEA includes annual trend assessments using historical wet weather data from the Mass Loading Station (MLS) and three additional Temporary Watershed Assessment Stations (TWAS) to assess data on a watershed-wide scale. The general LTEA process for receiving water assessment includes: 1) compilation of data, 2) comparison of data to benchmarks (developed specifically by the Copermittees Regional Monitoring Workgroup), 3) determination of frequency of exceedance of benchmarks, 4) establishment of a "water quality rating", and 5) preparation of tables, maps, summaries, etc. The LTEA builds upon the assessment methods used in the BLTEA and provides a robust analysis of water quality and program implementation for San Diego County.

The LTEA for the receiving waters in the watershed was performed by compiling data from regional monitoring conducted under the Permit (i.e., previous Regional Monitoring Reports), the Stormwater Monitoring Coalition (SMC) monitoring, and from third-parties (i.e., Coastkeeper, Padre Dam Municipal Water District). All receiving water data were collected from the Lower San Diego Watershed. Of these data sources, only monitoring data collected under the regional monitoring programs under the Permit were representative of wet weather conditions. Dry weather data were provided by all of the above sources. Current data for the watershed are presented in the annual Regional Monitoring Report, which covers the 2011-2012 sampling season (Weston, 2013). For this assessment, data from the 2011-2012 Regional Monitoring Report were analyzed along with the LTEA dataset. It should be noted that the LTEA dataset is extensive and representative of historical conditions while the Regional Monitoring Report data is the most current and limited to only one year.

Data from the LTEA and Regional Monitoring Report were compared to benchmarks for physical, chemical and bacteriological water quality data. Constituents were identified as high or medium priority based on the percentage of the dataset that exceeded the benchmarks. Constituents with greater than 50% exceedances were considered high priority, and constituents with 25-50% exceedances were considered medium priority. Biological water quality conditions were assessed using data from toxicity testing and bioassessment monitoring (Index of Biotic Integrity [IBI] scoring, California Rapid Assessment Method [CRAM], and observed/expected [O/E] ratios). Results are discussed for wet and dry weather in the following subsections. The receiving water quality priorities from the LTEA are similar to those of the previous assessment in the 2005 BLTEA.

The wet weather and dry weather chemistry data were compared to the water quality benchmarks shown in **Table 2-2.** The table is not inclusive of all analytical measurements that were conducted. In general, water quality objectives are defined in the San Diego County Copermittee Regional Monitoring Program as benchmarks for comparison to monitoring results and do not necessarily reflect regulatory compliance for municipal stormwater discharges. Additional water quality benchmarks and sources are included in the Appendix 2C tables.

Table 2-2. Water Quality Benchmarks

Constituent	Units	Wet Weather Water Quality Benchmark	Dry Weather Water Quality Benchmark	Source
pH	pH units	6.5-9.0	6.5-9.0	a. Basin Plan
Nitrate as N	mg/L	10	10	a. Basin Plan
Nitrate/Nitrite as N	mg/L	10	10	a. Basin Plan
Nitrite as N	mg/L	1	1	a. Basin Plan
Total Nitrogen	mg/L	NA	1	a. Basin Plan
Total Phosphorus	mg/L	2	0.1	b. MSGP 2000, a. Basin Plan
Dissolved Phosphorous	mg/L	2	0.1	b. MSGP 2000, a. Basin Plan
Total Suspended Solids	mg/L	100	58	b. MSGP 2000
Total Dissolved Solids	mg/L	500	500	a. Basin Plan
Fecal Coliform	MPN/100 mL	400	400	a. Basin Plan REC-1
Enterococci	MPN/100 mL	NA	151	a. Basin Plan
Total Coliform	MPN/100 mL	NA	NA	a. Basin Plan (Bays and Estuaries and Shell Criteria)

NA indicates no criteria or published value was available or applicable to the matrix or program.

[a.] San Diego Regional Water Quality Control Plan for the San Diego Region (Basin Plan), 1994 (with amendments effective prior to April 25, 2007).

[b.] Multisector General Permit for Industrial Activities, Section 2.

2.1.5.1 Wet Weather

Table 2-3 and **Table 2-4** show a summary of data from the LTEA (Weston, 2011) and the most recent Regional Monitoring Report (Weston, 2013), respectively, for wet weather for the watershed. The LTEA analyses were based on nine storm events monitored at the Mass Loading Station (MLS) and two storm events at each of the three Temporary Watershed Assessment Station (TWAS) sites. Regional Monitoring Report analyses are based on two storm events at each of the four sites.

Results from these reports indicate that the overall list of water quality conditions present in the watershed has remained consistent over time, with sediment, pesticides[1], and bacteria identified as the primary water quality conditions of concern during wet weather. Benthic alternations, included in the wet and dry weather assessments, were also identified as a concern across the monitoring stations. These four conditions of concern identified in the LTEA were supported by recent monitoring results presented in the Regional Monitoring Report. The LTEA also identified surfactants, biological oxygen demand, pH, Total Dissolved Solids, and toxicity as medium priorities at sites within the watershed. Chemical oxygen demand and total suspended solids were also identified as priority conditions of concern in the most recent Regional Monitoring Report, but were not identified in the LTEA. The Regional Monitoring Report did note toxicity and Total Dissolved Solids concerns in the one year of data at different locations than identified in the LTEA.

Table 2-3. Summary of LTEA Findings for Wet Weather in San Diego River Watershed

2005-2010 LTEA Receiving Water Assessment [a]				
Constituent Groups	Station (number of samples)			
	SDR-MLS (9)[b]	SDR-TWAS-1 (2)	SDR-TWAS-2 (2)	SDR-TWAS-3 (2)
Gross Pollutants	-	Surfactants (MBAS)	BOD, pH	-
Oil & Grease	-	-	-	-
Metals	-	-	-	-
Pesticides	Bifenthrin [b]	Bifenthrin	Bifenthrin, Permethrin	Bifenthrin
Organics	-	-	-	-
Toxicity	-	*C. dubia* reproduction	H. azteca acute	-
Benthic Alterations	Very Poor IBI, O/E, CRAM	Very Poor IBI, O/E, CRAM	Very Poor IBI, O/E	Very Poor IBI, O/E, CRAM
Bacteriological	Fecal Coliform	Fecal Coliform	Fecal Coliform	Fecal Coliform
Nutrients	-	-	-	-
Dissolved Minerals	-	total dissolved solids	-	-
Sediments	Turbidity	Turbidity	Turbidity, TSS	Turbidity

[a] Bold with gray shading indicates high priority conditions (greater than 50% of results above benchmark); gray shading alone indicates medium priority (between 25% and 50% of results above benchmark); no shading indicates low priority (less than 25% of results above benchmark).

[b] While most constituents were monitored during nine storm events at the MLS, bifenthrin was monitored during three storms.

[1] Note that the pesticides in **Table 2-3** are pyrethroids, and the priorities for these pesticides are based on samples collected prior to new CA Department of Pesticide Regulation rules governing the use of pyrethroids which went into effect July 2012.

Table 2-4. Summary of 2011-2012 Regional Monitoring Report for Wet Weather in San Diego River Watershed

2011-2012 Regional Monitoring Report Assessment [a]				
Constituent Groups	Station (number of samples)			
	SDR-MLS (2)	SDR- TWAS-1 (2)	SDR- TWAS-2 (2)	SDR- TWAS-3 (2)
Chemistry	Bifenthrin, Permethrin	Bifenthrin, Permethrin	Bifenthrin, COD, TSS, Permethrin	-
Toxicity	-	-	-	S. capricornutum
IBI[b]	Very Poor	Very Poor	Very Poor	Very Poor
Bacteriological	Fecal Coliform	Fecal Coliform	Fecal Coliform	-
Nutrients	-	-	-	-
Dissolved Minerals	total dissolved solids	-	-	total dissolved solids
Sediments	Turbidity	Turbidity	Turbidity	-

[a] Bold with gray shading indicates high priority conditions (greater than 50% of results above benchmark); gray shading alone indicates medium priority (between 25% and 50% of results above benchmark); no shading indicates low priority (less than 25% of results above benchmark).

[b] One Index of Biotic Integrity (IBI) bioassessment sample is collected each year during ambient (dry) conditions and is used for both the dry and wet assessment.

2.1.5.2 Dry Weather

Data from the LTEA and the most recent Regional Monitoring Report for dry weather for the watershed are summarized in **Table 2-5** and **Table 2-6**. Dry weather receiving water analyses for both the LTEA and the Regional Monitoring Report were based on two samples at each site. SMC data consist of one sample at each site, while third party data consists of larger datasets, as these monitoring programs generally occurred on a monthly basis. The SMC and third party data were included in the LTEA and Regional Monitoring Report as appropriate.

The list of water quality conditions of concern during dry weather was consistent between the LTEA and the most recent Regional Monitoring Report. The primary water quality conditions of concern identified in the LTEA during dry weather include bacteria, nutrients, and dissolved minerals. Benthic alternations, included in the wet and dry condition assessments, also appear to be a concern across the monitoring stations. These four conditions of concern identified in the LTEA were supported by recent monitoring results in the Regional Monitoring Report.

Dissolved oxygen was identified as high priority at the SDR-TWAS-3 site in the LTEA dataset, but was not supported as a concern based on the single year of data for the Regional Monitoring Report. BOD was identified in the LTEA as a medium priority but was also not supported as a priority by the Regional Monitoring Report data set. Toxicity was not noted as a high priority across the watershed in the LTEA, but was present in both of the samples collected at SDR-TWAS-3. Similar toxicity was demonstrated at SDR-TWAS-3 in the data presented in the Regional Monitoring Report.

Table 2-5. Summary of LTEA Findings for Dry Weather in San Diego River Watershed

2005-2010 LTEA Receiving Water Assessment [a]				
Constituent Groups	Station (number of samples)			
	SDR-MLS (2)	SDR-TWAS-1 (2)	SDR-TWAS-2 (2)	SDR-TWAS-3 (2)
Gross Pollutants	-	BOD	-	DO
Oil & Grease	-	-	-	-
Metals	-	-	-	-
Pesticides	-	-	-	-
Organics	-	-	-	-
Toxicity	-	-	-	Selenastrum acute
Benthic Alterations	Very Poor IBI, O/E, CRAM	Very Poor IBI, O/E, CRAM	Very Poor IBI, O/E	Very Poor IBI, O/E, CRAM
Bacteriological	Enterococci, Fecal Coliform *E. coli*	Enterococci, Fecal Coliform, *E. coli*	Enterococci, Fecal Coliform, *E. coli*	Enterococci
Nutrients	TN, DP, TP, OP	TN, TP, DP, Benthic Algae, OP	TN, TP, Benthic, DP, OP	TN, TP, DP
Dissolved Minerals	TDS, Chloride	TDS, Chloride	TDS, Chloride	TDS
Sediments	-	-	-	-

DP – Dissolved Phosphorous, TP – Total Phosphorous, OP – Orthophosphate, TN – Total Nitrogen, TDS – Total Dissolved Solids

[a] Bold with gray shading indicates high priority conditions (greater than 50% of results above benchmark); gray shading alone indicates medium priority (between 25% and 50% of results above benchmark); no shading indicates low priority (less than 25% of results above benchmark).

Table 2-6. Summary of 2011-2012 Regional Monitoring Report for Dry Weather in San Diego River Watershed

2011-2012 Regional Monitoring Report Assessment [a]								
Constituent Groups	Station (number of samples)							
	SDR- MLS (2)	SDR- TWAS-1 (2)	SMC07126 (1)	SDR- TWAS-2 (2)	SMC09174 (1)	SMC10198 (1)	SDR- TWAS-3 (2)	SMC11430 (1)
Chemistry	-	-	-	-	-	-	-	-
Toxicity	-	S. capricornutum	-	-	-	-	S. capricornutum, C. dubia	-
IBI	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Poor
Bacteriological	-	Enterococci	-	Enterococci, Fecal Coliform	-	-	-	-
Nutrients	DP, TP	DP, TP, TN	TN, TP	TN, TP, DP	TN, TP	TN, TP	TN, TP	Nitrate as N, TN, TP
Dissolved Minerals	TDS	TDS	TDS Chloride	TDS	TDS Chloride	TDS Chloride	TDS	-

DP – Dissolved Phosphorous, TP – Total Phosphorous, OP – Orthophosphate, TN – Total Nitrogen, TDS – Total Dissolved Solids

[a] Bold with gray shading indicates high priority conditions (greater than 50% of results above benchmark); gray shading alone indicates medium priority (between 25% and 50% of results above benchmark); no shading indicates low priority (less than 25% of results above benchmark).

2.1.6 Physical, Chemical, and Biological Receiving Water Monitoring Data

The Permit requires the Participating Agencies to consider "available, relevant, and appropriately collected and analyzed physical, chemical, and biological receiving water monitoring data, including, but not limited to, data describing:

(a) Chemical constituents,

(b) Water quality parameters (i.e. pH, temperature, conductivity, etc.),

(c) Toxicity Identification Evaluations for both receiving water column and sediment,

(d) Trash impacts,

(e) Bioassessments, and

(f) Physical habitat."

Available data for the watershed was discussed in the previous section. **Table 2-7** summarizes the locations of receiving water sites and the constituents that have been measured. **Figure 2-3** includes a map of the locations where receiving water sampling data have been collected. It should be noted that all receiving water sampling locations are in the Lower San Diego Watershed.

Table 2-7. Receiving Water Data Stations and Associated Measured Parameters

Station IDs	Data	Wet/ Dry	Chemical constituents	Water quality parameters	Toxicity identification Evaluations	Trash Impacts	Bioassessments	Physical habitat
SDR-MLS; SDR-TWAS1; SDR-TWAS2; SDR-TWAS3	NPDES Program	Wet/ Dry	☑	☑	☑	☑	☑	☑
SMC07126; SMC09174; SMC10198; SMC11430	SMC Regional Monitoring	Dry	☑	☐	☑	☐	☑	☐
SDG-010; SDG-020	Third Party - Coastkeeper	Dry	☑	☐	☐	☐	☐	☐
Old Mission Dam; Mast Bridge; Sycamore Creek; Sycamore-Upstream; Sycamore-Downstream; Carlton Hills Bridge; Forester Creek	Third Party - Padre Dam	Dry	☑	☐	☐	☐	☐	☐

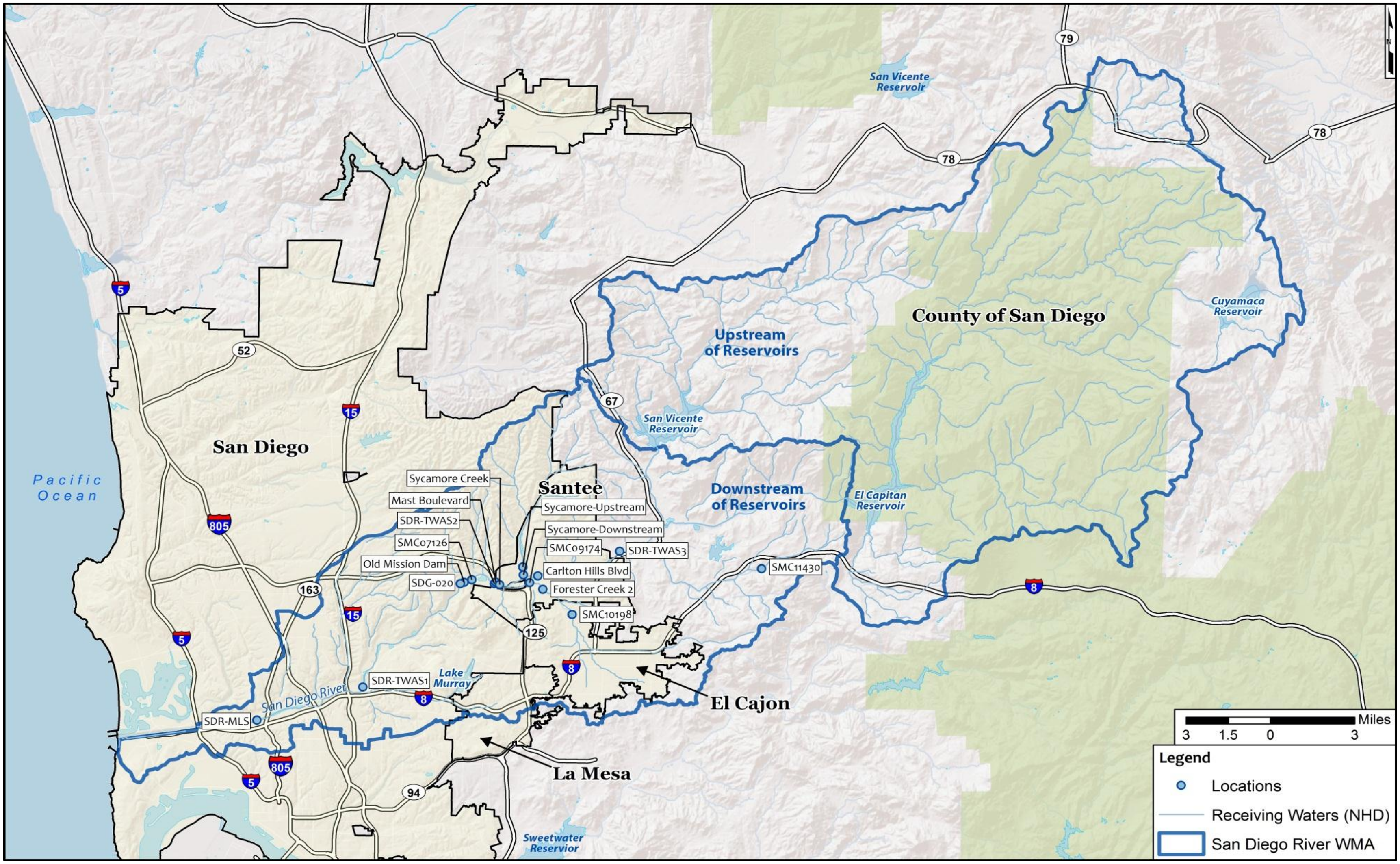


Figure 2-3. Receiving Water Sample Locations

2.1.7 Hydromodification

A review of the available regional-scale data did not identify increased erosional impacts in the receiving waters as a result of accelerated flows (hydromodification). Based on information gathered during the Public Workshop held on October 3, 2013, sediment may be a concern at Murphy Canyon. From review of data submitted by the City of San Diego's Storm Water Division, an accumulation of sediment has been identified in Alvarado Creek, although the source is unknown and it may be a natural occurrence. Monitoring programs to measure the impacts of hydromodification are in their early stages. A GIS mapping exercise evaluating the potential for soil erosion was conducted to proactively identify areas at risk.

2.1.8 Available Evidence of Adverse Impacts to the Chemical, Physical, and Biological Integrity of Receiving Waters

As discussed earlier, the most current receiving water quality data are available in the LTEA and annual Regional Monitoring Report. The assessments are based on exceedances of established benchmarks and provide evidence of adverse impacts receiving waters. However, exceedances of benchmarks, although indicative of water quality impacts, do not necessarily correlate to adverse impacts to beneficial uses of the receiving waters.

Water quality conditions of concern identified for wet weather include: bacteria, pesticides, benthic alterations (represented by 'very poor' IBI scores), total dissolved solids, sediments (TSS and turbidity), COD, and toxicity. Of these, bacteria, turbidity, pesticides, and benthic alterations are the most widespread of the water quality concerns.

Water quality conditions of concern identified for dry weather include: bacteria, nutrients, benthic alterations, chloride, total dissolved solids, and toxicity. Of these, bacteria, nutrients, total dissolved solids, and benthic alterations are the most widespread.

2.1.9 Potential Improvements That Can be Achieved in the Watershed

In addition to ongoing JRMP implementation and enhancement, the Participating Agencies have identified a number of strategies that are expected to address the water quality conditions in the watershed and therefore result in improvements in the condition of the watershed. These strategies are discussed in detail in **Chapter 3.**

Potential improvements include: bacteria reduction through various nonstructural programs; stream restoration/enhancement, such as the Las Colinas Channel project in Santee; and nutrient reduction through various nonstructural programs and structural projects. Another example of a potential improvement includes regional mitigation projects such as those presented in the 2012 Comprehensive Load Reduction Plan for the San Diego River Watershed (Geosyntec, 2012). These strategies are expected to improve the overall condition of the watershed and result in improved scores for IBI, and lowered toxicity in receiving waters.

2.2 ASSESSMENT OF IMPACTS FROM STORM DRAIN DISCHARGES [B.2.B.]

Provision B.2.b of the Permit requires the Participating Agencies to consider the following information to identify potential impacts to receiving waters that may be caused or contributed to by discharges from the Copermittees' stormwater conveyance outfalls:

1) The discharge prohibitions of Provision A.1 and effluent limitations of Provision A.3 (**Section 2.2.1**);
2) Available monitoring data from storm drain outfalls (**Section 2.2.2**);
3) Locations of each Copermittees' storm drain outfalls that discharge to receiving waters (**Section 2.2.3**);
4) Locations of outfalls that are known to persistently discharge non-stormwater to receiving waters likely causing or contributing to impacts on receiving water beneficial uses (**Section 2.2.4**);
5) Locations of outfalls that are known to discharge pollutants in stormwater causing or contributing to impacts on receiving water beneficial uses (**Section 2.2.5**); and
6) The potential improvements in the quality of discharges that can be achieved (**Section 2.2.6**).

The requirements listed above are addressed in the following subsections. As with the receiving water assessment, the LTEA served as a significant source of information for determining potential impacts associated with storm drain discharges.

The 2007 Permit required the submittal of the LTEA in June 2010 to evaluate the effectiveness of programs and to inform program modifications for the next Permit (issued in 2013). To accomplish this, receiving water and storm drain discharge water quality data were analyzed by comparing concentrations to existing benchmarks, and by using multiple lines of evidence, including chemistry, toxicity, and biological data. The storm drain discharge monitoring program was relatively new and had limited data available for the LTEA. Accordingly, the Copermittees used a conservative definition of the potential for storm drain discharges to contribute to the identified receiving water conditions.

This approach resulted in a long list of water quality conditions identified in the LTEA for storm drain discharges that could potentially adversely affect receiving water conditions. Furthermore, an additional 450 samples have been collected region-wide to supplement outfall discharge monitoring results **(Table 2-8).** The majority of these results were not available for the LTEA evaluation; however, the report containing the larger set of outfall data is currently in preparation and preliminary results appear to support the LTEA findings. Additional factors, such as relative contribution of discharges to receiving waters conditions and the controllability of the potential source(s) by the Participating Agencies, are considered in the report. This approach allows the Participating Agencies to focus implementation efforts on receiving water conditions that are likely a result of storm drain discharges and that are within their control.

Table 2-8. Summary of Program Monitoring Data Collection (2008-2013)

Program Year	Random Sites	
	Wet Weather	Dry Weather
2008-2009	39	40
2009-2010	50	35
2010-2011	54	42
2011-2012	54	49
2012-2013	55	44
Total	252	210

The LTEA provided a discussion of discharge loads for various constituents and ranked them for wet weather flows "to establish a baseline for future comparisons of changes in the loads." The LTEA identified bacteria and sediment as wet weather priority constituents for both outfalls and receiving waters. The LTEA also included observations of dry weather flow conditions at the outfalls.

2.2.1 Prohibitions and Limitations of Provisions A.1 and A.3

Provisions A.1 and A.3 of the Permit, which address discharge prohibitions and effluent limitations, were considered when assessing impacts from storm drain discharges. In addition, discharges are subject to prohibitions in the Basin Plan (e.g., solid waste, recycled water to lakes or reservoirs, dredged fill material, solid waste, sewage, radioactive wastes, chemical or biological warfare agents, earthen material from construction activity into waters of the state) in accordance with Provision A.1.c.

Effluent limitations for controlling discharges of pollutants to receiving waters are based on both the technology-based effluent limits (TBEL) and the water quality-based effluent limits (WQBELs) that are protective of the water quality standards of the receiving water. TBELs require a minimum level of treatment of pollutants for point source discharges based on available technologies. The Permit requires that pollutants be reduced in stormwater discharges to the maximum extent practicable.

Applicable WQBELs are established for the TMDLs for impaired water bodies (Attachment E of the Permit). The San Diego Water Board adopted a TMDL for bacteria (Resolution No. R9-2010-0001), which became effective April 4, 2011, requiring Participating Agencies to develop either a bacteria-specific, or comprehensive multi-pollutant approach to reducing loads of bacteria and other 303(d)-listed pollutants from their storm drain discharges. In 2012, the Participating Agencies developed a comprehensive, multi-pollutant approach to implementation (Comprehensive Load Reduction Plan). In addition to bacteria, the Comprehensive Load Reduction Plan addresses other water quality impairments, including nutrients. The applicable TMDL WQBELs appear in Appendix 2B. In addition to the San Diego River Phase I Comprehensive Load Reduction Plan, the City of San Diego developed a Phase II Comprehensive Load Reduction Plan which looked specifically at City of San Diego storm drain discharge pollutant contributions and improvement strategies for improvement of water quality in the watershed. Participating agencies are required to meet interim WQBELs for the bacteria TMDL under dry weather conditions by April 4, 2018, and for wet weather by April 4, 2021.

2.2.2 Available Monitoring Data from Storm Drain Outfalls

The Permit specifies assessment of the available, relevant, and appropriately collected and analyzed stormwater and non-stormwater monitoring data for the outfalls. Results from the following reports for the storm drain outfall monitoring program are summarized in this section:

- 2005 - 2010 Long-Term Effectiveness Assessment (LTEA) (Weston, 2011)
- 2010 - 2011 Receiving Waters and Urban Runoff Monitoring Report (RMR) (Weston, 2012)
- 2011 - 2012 Receiving Waters and Urban Runoff Monitoring Report (Weston, 2013)

The 2010 LTEA presented urban runoff data assessments for constituents of medium and high priorities based on the results of outfall monitoring for the Regional Monitoring Program initiated in 2008. The 2011 and 2012 Regional Monitoring Reports presented outfall data assessments for medium and high priority constituents based on the San Diego County Regional Copermittees' (SDCRC) 2010 Methodology for Annual and Long-Term Data Assessments for San Diego County Watershed Management Areas, Final Draft-Version 1 (SDCRC, 2010). As discussed in **Section 2.1**, priority ratings are based on the percentage of water quality benchmark exceedances, based on water quality benchmarks in the Basin Plan. Constituents with less than or equal to a 25% exceedance rate are considered low priority, constituents with a 25% to 50% exceedance rate are considered medium priority, and constituents with greater than a 50% exceedance rate are considered high priority.

Storm drain outfall data for wet and dry weather conditions are summarized by hydrologic area (HA) and sub-watershed. The sub-watersheds include, from east to west: El Capitan (907.30), San Vicente (907.20), and Lower San Diego (907.10). The stormwater conveyance system has a limited extent in many of the rural areas. Generally, structures are limited to road crossings with few major outfalls. Rural areas include the Boulder Creek Subwatershed, most of the San Vicente Subwatershed and the El Monte hydrologic subarea in the Lower San Diego River. The Boulder Creek Subwatershed (907.40) has only one identified storm drain discharge monitoring outfall, which has not been sampled. The medium and high priority constituents identified in the LTEA and Regional Monitoring Report datasets are summarized in this section. The locations of outfalls sampled are shown in **Figure 2-4**, and the datasets which were used in the analysis of sub-watershed outfall data are summarized in **Table 2-9** (El Capitan Watershed), **Table 2-10** (San Vicente Watershed), and **Table 2-11** (Lower San Diego Watershed) below.

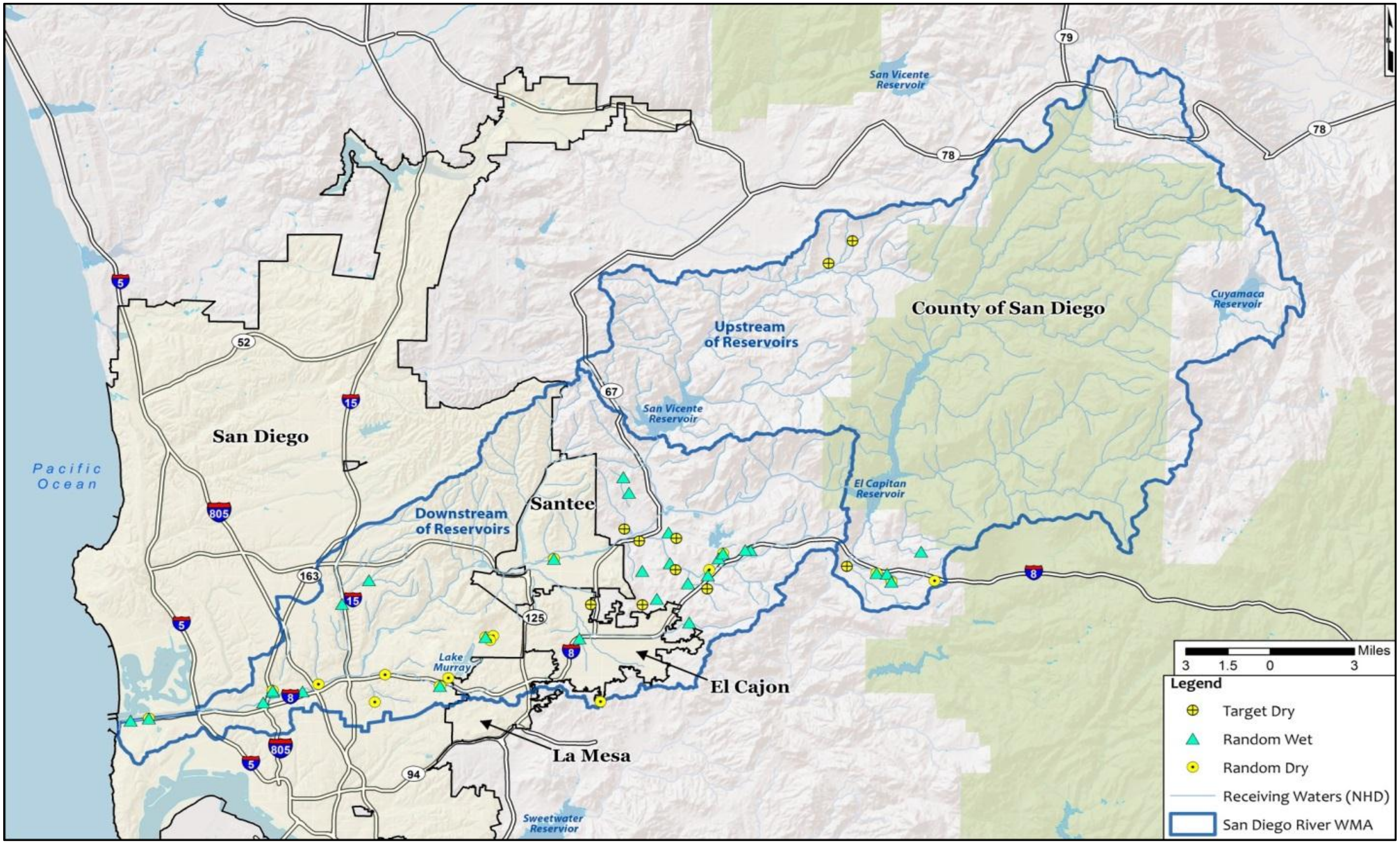


Figure 2-4. Locations of Outfall Monitoring Data

Table 2-9. Subwatershed Datasets for El Capitan Watershed

Subwatershed	DRY			WET		
	2010 LTEA	2011 RMR	2012 RMR	2010 LTEA	2011 RMR	2012 RMR
Alpine (907.33)	☑	☑	☑	☑	☑	☑
Conejos Creek (907.31)	☐	☐	☐	☑	☑	☑

Table 2-10. Subwatershed Datasets for San Vicente Watershed

Subwatershed	DRY			WET		
	2010 LTEA	2011 RMR	2012 RMR	2010 LTEA	2011 RMR	2012 RMR
Gower (907.23)	☑	☑	☑	☐	☐	☐

Table 2-11. Subwatershed Datasets for Lower San Diego River Watershed

Subwatershed	DRY			WET		
	2010 LTEA	2011 RMR	2012 RMR	2010 LTEA	2011 RMR	2012 RMR
Los Coches (907.14)	☑	☑	☑	☑	☑	☑
El Cajon (907.13)	☑	☑	☑	☑	☑	☑
Santee (907.12)	☑	☑	☑	☑	☑	☑
Mission San Diego (907.11)	☑	☑	☑	☑	☑	☑

2.2.2.1 Storm Drain Outfall Data Summary

The constituents commonly exceeding benchmarks in the 2010 LTEA, 2011, and 2012 Regional Monitoring Report dry weather storm drain outfall discharge data include: bacteria, nutrients, and total dissolved solids. The monitoring data assessed in the 2012 Regional Monitoring Report identified bacteria (fecal coliform) as a high-priority constituent during wet weather and fecal coliform, enterococci, nutrients, and total dissolved solids as high-priority constituents during dry weather. The dry and wet weather constituent priorities were generally confirmed in the recent Interim Five-Year MS4 Random Data Analysis memo dated January 2, 2014 (Weston, 2014).

Table 2-12 and **Table 2-13** summarize the results of outfall monitoring for dry and wet weather for the medium and high priority constituents identified in the 2010 LTEA, 2010-11 Regional Monitoring Report, and 2011-12 Regional Monitoring Report reports. Additional detail for the outfall monitoring, such as number of samples, is provided in Appendix 2C.

As previously discussed, the LTEA prioritizes constituents to focus resources in regional, watershed and jurisdictional programs. Priority constituents are identified based on data collected and the assessment process defined in the Watershed Assessment Methodology (SDCRC, 2010), which establishes priority categories based on the frequency of exceedance of numeric water quality benchmarks. Priority constituents are reported in the LTEA as those above the low priority threshold of less than 25 percent exceedance.

Table 2-12. Storm Drain Outfall Dry Weather Data Summary

<table>
<tr><th colspan="5">Storm Drain Outfall Dry Weather Monitoring Summary</th></tr>
<tr><th colspan="2">Data Source</th><th>2010 LTEA
Storm Drain Outfall Constituents</th><th>2011 Regional Monitoring Report
Storm Drain Outfall Constituents</th><th>2012 Regional Monitoring Report
Storm Drain Outfall Constituents</th></tr>
<tr><th rowspan="2">HA</th><th rowspan="2">HSA</th><th>High-Priority</th><th>High-Priority</th><th>High-Priority</th></tr>
<tr><th>Medium-Priority</th><th>Medium-Priority</th><th>Medium-Priority</th></tr>
<tr><td>Boulder Creek (907.40)</td><td>Cuyamaca (907.43), Spencer (907.42), Inaja (907.41)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="3">El Capitan (907.30)</td><td rowspan="2">Alpine (907.33)</td><td>TN, TP, TSS, Fecal Coliform, Enterococcus</td><td>TN, TP, DP, TDS, Fecal Coliform, Enterococcus</td><td>TDS, Enterococcus</td></tr>
<tr><td>--</td><td>--</td><td>TN, TP, Fecal Coliform</td></tr>
<tr><td>Conejos (907.31)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="3">San Vicente (907.20)</td><td rowspan="2">Gower (907.23)</td><td>TDS, Chloride, Sulfate</td><td>Nitrate, TN, TP, TDS, Enterococcus, Chloride, Sulfate</td><td>Nitrate, N/N, TN, TP DP, TDS, Fecal Coliform, Enterococcus, Chloride, Sulfate, DO</td></tr>
<tr><td>TP, Enterococcus</td><td>DP, TSS, Fecal Coliform</td><td>--</td></tr>
<tr><td>Barona (907.24), Kimball (907.22), Fernbrook (907.21)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="4">Lower San Diego (907.10)</td><td>El Monte (907.15)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="2">Los Coches (907.14)</td><td>TN, TDS, Enterococcus</td><td>TN, TDS, Enterococcus</td><td>TN, TP, TDS, Fecal Coliform, Enterococcus</td></tr>
<tr><td>TP, Fecal Coliform</td><td>Nitrate, Fecal Coliform</td><td>Nitrate, N/N</td></tr>
<tr><td>El Cajon</td><td>TN, TDS, Fecal Coliform,</td><td>TN, TDS, Fecal Coliform,</td><td>TN, DP, TDS, Fecal Coliform</td></tr>
</table>

Storm Drain Outfall Dry Weather Monitoring Summary				
Data Source		2010 LTEA Storm Drain Outfall Constituents	2011 Regional Monitoring Report Storm Drain Outfall Constituents	2012 Regional Monitoring Report Storm Drain Outfall Constituents
HA	HSA	High-Priority	High-Priority	High-Priority
		Medium-Priority	Medium-Priority	Medium-Priority
	(907.13)	Enterococcus	Enterococcus	
		Nitrate, TP	Nitrate, TP, DP	Nitrate, TP, TSS, Enterococcus
	Santee (907.12)	TN, TP, TDS, Enterococcus	TN, TP, DP, Fecal Coliform, Enterococcus	TN, TP, Fecal Coliform, Enterococcus
		Nitrate, N/N	TDS	DP, TDS
	Mission San Diego (907.11)	TN, TP, TDS, Enterococcus	TN, TDS, Enterococcus	TN, TP, Fecal Coliform, Enterococcus
		TSS, Fecal Coliform	TP, Fecal Coliform	TDS
Common High Priority Constituents Summary		TN, TDS, TP, Enterococcus	TN, TDS, Enterococcus	TN, TDS, TP, Enterococcus, Fecal Coliform

DP – Dissolved Phosphorous, TP – Total Phosphorous, OP – Orthophosphate, TN – Total Nitrogen, N/N – Nitrate/Nitrite, TDS – Total Dissolved Solids

-- Indicates that outfalls were not sampled or medium or high priority constituents were not identified.

Table 2-13. Storm Drain Outfall Wet Weather Data Summary

<table>
<tr><th colspan="5">Storm Drain Outfall Wet Weather Monitoring Summary</th></tr>
<tr><th colspan="2">Data Source</th><th>2010 LTEA
Storm Drain Outfall Constituents</th><th>2011 Regional Monitoring Report
Storm Drain Outfall Constituents</th><th>2012 Regional Monitoring Report
Storm Drain Outfall Constituents</th></tr>
<tr><th rowspan="2">HA</th><th rowspan="2">HSA</th><th>High-Priority</th><th>High-Priority</th><th>High-Priority</th></tr>
<tr><th>Medium-Priority</th><th>Medium-Priority</th><th>Medium-Priority</th></tr>
<tr><td>Boulder Creek (907.40)</td><td>Cuyamaca (907.43), Spencer (907.42), Inaja (907.41)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="3">El Capitan (907.30)</td><td rowspan="2">Alpine (907.33)</td><td>Fecal Coliform</td><td>Fecal Coliform, TSS</td><td>Fecal Coliform, TSS</td></tr>
<tr><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Conejos (907.31)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="3">San Vicente (907.20)</td><td rowspan="2">Gower (907.23)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Barona (907.24), Kimball (907.22), Fernbrook (907.21)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="9">Lower San Diego (907.10)</td><td>El Monte (907.15)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="2">Los Coches (907.14)</td><td>Fecal Coliform</td><td>--</td><td>Fecal Coliform</td></tr>
<tr><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="2">El Cajon (907.13)</td><td>Fecal Coliform</td><td>Fecal Coliform</td><td>--</td></tr>
<tr><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="2">Santee (907.12)</td><td>Fecal Coliform</td><td>Fecal Coliform</td><td>--</td></tr>
<tr><td>--</td><td>--</td><td>--</td></tr>
<tr><td rowspan="2">Mission San Diego (907.11)</td><td>Fecal Coliform</td><td>Fecal Coliform</td><td>Fecal Coliform</td></tr>
<tr><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="2">Common High Priority Constituents Summary</td><td>Fecal Coliform</td><td>Fecal Coliform</td><td>Fecal Coliform</td></tr>
</table>

-- Indicates that outfalls were not sampled, or medium or high priority constituents were not identified.

2.2.3 Storm Drain Outfall Locations that Discharge to Receiving Waters

The Permit defines an outfall as the following:

> "Outfall means a point source as defined by 40 CFR 122.2 at the point where storm drains discharge to waters of the U.S. and does not include open conveyances connecting two municipal separate storm sewers, or pipes, tunnels or other conveyances which connect segments of the same stream or other waters of the U.S. and are used to convey waters of the U.S."[2]

The storm drain outfall locations for the Participating Agencies that discharge to the receiving waters are shown in **Figure 2-5**.

[2] The new Permit has adopted the definition of "outfall" from the federal Clean Water Act regulations. The City of San Diego is currently reviewing its inventory of storm drain infrastructure to verify whether all of the structures listed as "outlets" in **Figure 2-5**, **Figure 2-6,** and **Table 2-14** are "outfalls" as defined by the Permit and Clean Water Act.

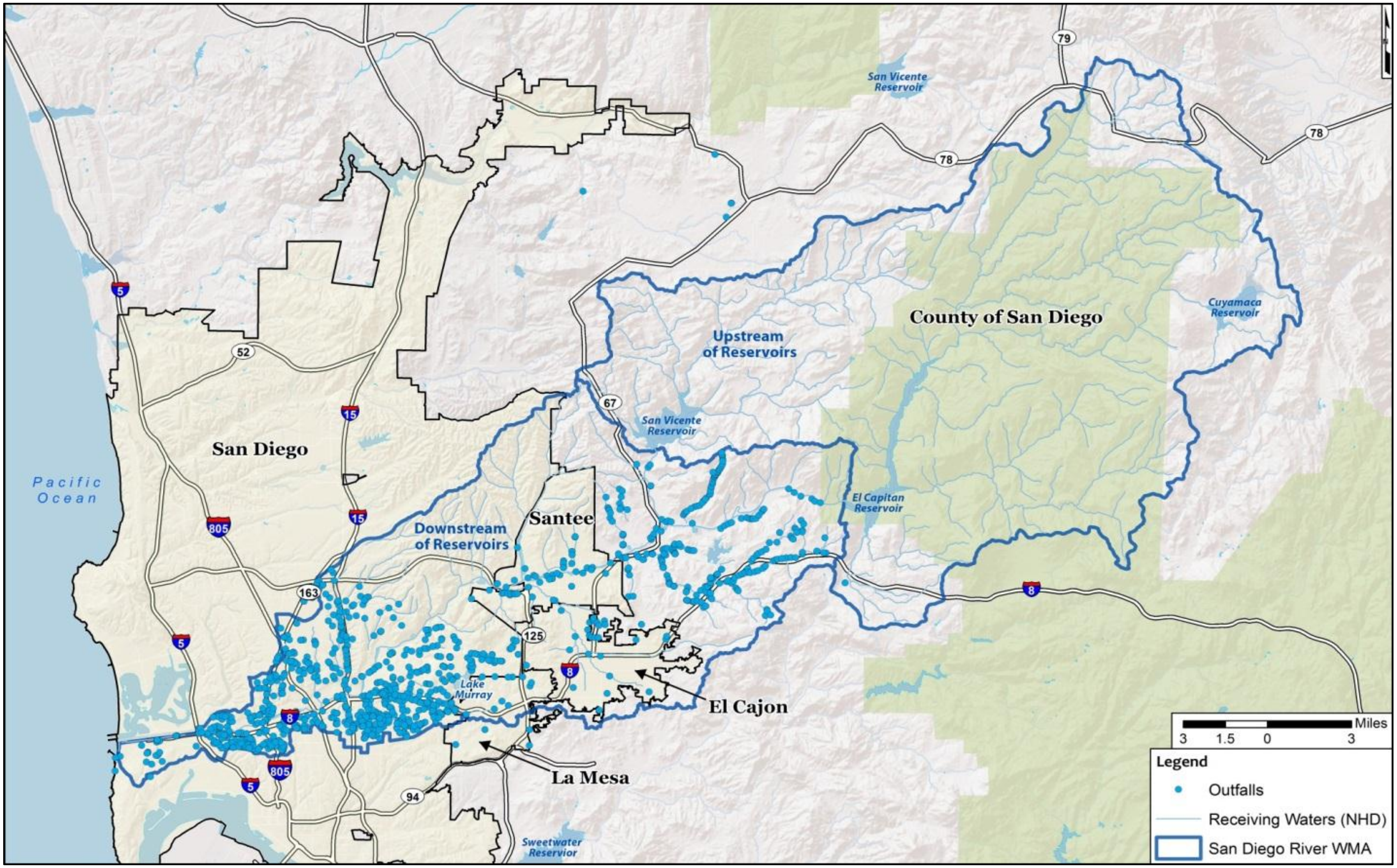


Figure 2-5. Storm Drain Outfall Locations

2.2.4 Storm Drain Outfalls with Persistent Non-Stormwater Discharges

Persistent flow is defined in the Permit as:

“the presence of flowing, pooled, or ponded water more than 72 hours after a measureable rainfall event of 0.1 inch or greater during three consecutive monitoring and/or inspection events. All other flowing, pooled, or ponded water is considered transient.”

Table 2-14 summarizes the Participating Agencies’ storm drain outfalls with persistent non-stormwater flows draining directly to receiving waters. **Figure 2-6** shows the location of these outfalls.

Table 2-14. Number of Copermittee Storm Drain Outfalls with Persistent Non-Stormwater Flow

Jurisdiction	Persistent Outfalls
City of El Cajon	3
City of La Mesa	8
City of Santee	13
City of San Diego	86
County of San Diego	9

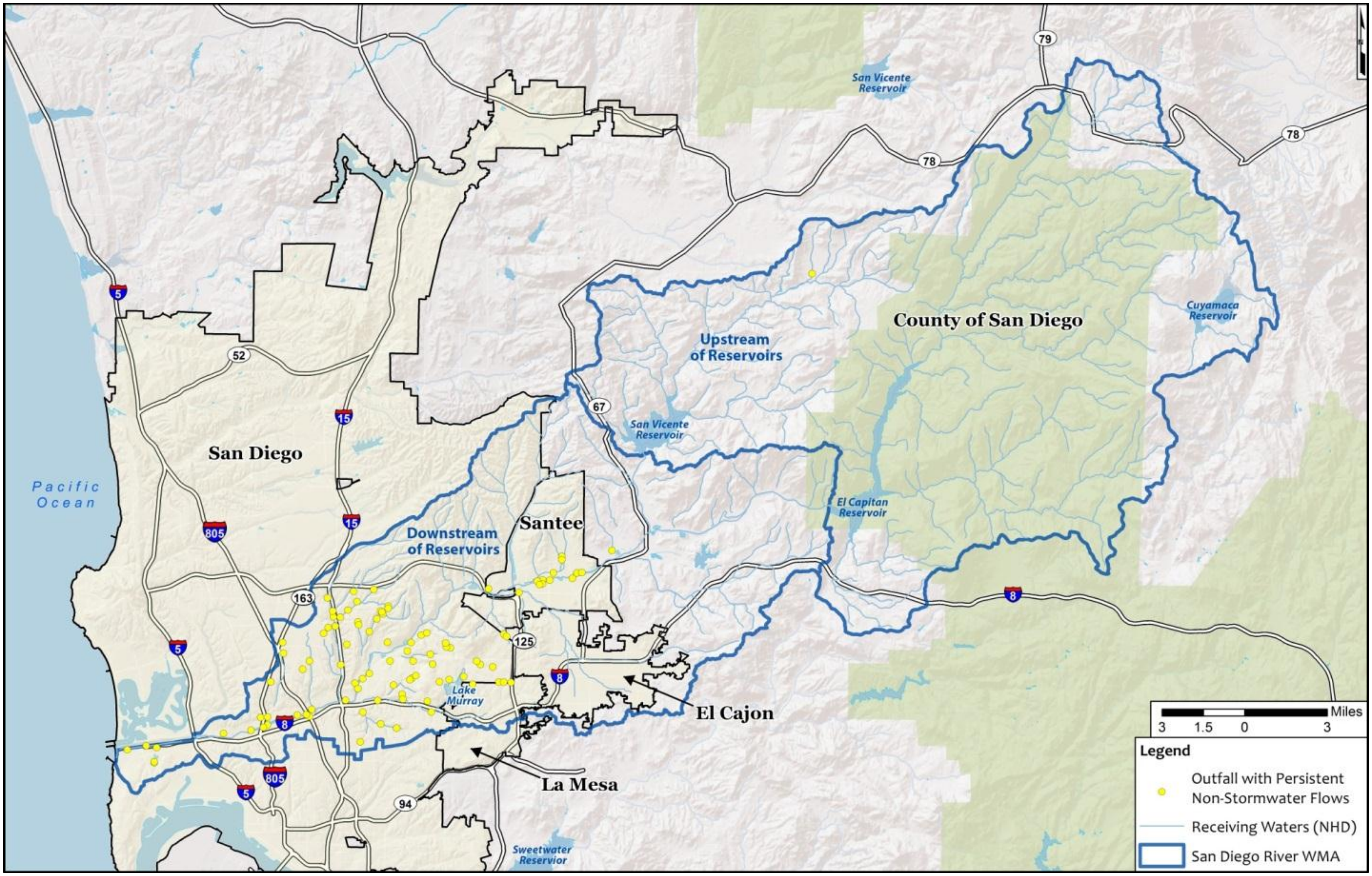


Figure 2-6. Storm Drain Outfalls with Persistent Non-Stormwater Flow Discharge

2.2.5 Storm Drain Outfalls Known to Discharge Pollutants

The Permit (Provision B.2.b.5) requires an assessment of the locations of storm drain outfalls that are known to discharge pollutants causing or contributing to impacts on receiving water beneficial uses. The Outfall Monitoring Workplan aims to assess the locations known to discharge pollutants causing or contributing to impacts on receiving water beneficial uses over a five year period. The 2012 Regional Monitoring Report provided four years of data for the random wet weather discharge monitoring program. Qualitative comparisons of results of the 2012 Regional Monitoring Report to the previous 2011 Regional Monitoring Report and the LTEA suggest similar potential linkages between water quality in storm drain outfall discharges and receiving water quality, as discussed below.

Bacteria was identified as a priority constituent during wet weather at the MLS, SDR-TWAS-1, and SDR-TWAS-2 monitoring locations in both receiving waters and stormwater discharges. At the SDR-TWAS-3 monitoring location, there were no priority constituents common to both receiving water and stormwater discharges identified.

During dry weather conditions, bacteria, nutrients, and total dissolved solids (TDS) were identified as priority constituents at the MLS, SDR-TWAS-1, and SDR-TWAS-2 monitoring locations in both receiving waters and urban runoff. At the SDR-TWAS-3 monitoring location, nutrients and total dissolved solids were identified as priorities in both the receiving water and urban runoff. Bacteria, total dissolved solids, and nutrients are regional issues during dry weather and were identified as priority constituents during storm drain discharge assessments and receiving water monitoring in the watershed.

The primary sources of dry weather flow are groundwater and potable water supply (e.g., irrigation runoff), both of which often have high background levels of total dissolved solids in San Diego County. Total dissolved solids are different than bacteria and nutrients. Bacteria and nutrients have lower levels in the source water, but urban hardscapes, storm drain infrastructure, and materials deposited on land surfaces potentially contaminate the source water during flow to the storm drain outfalls.

2.2.6 *Potential Improvements That Can be Achieved in Storm Drain Discharges*

This section addresses the potential improvements (as well as activities resulting in potential improvements) in the quality of discharges from the storm drains that can be achieved as required by Permit Provision B.2.b(6). Careful consideration was given to the potential improvement in quality of discharges that can be achieved in determining priority water quality conditions. A point of emphasis in establishing this list is achievability and controllability, particularly with respect to the storm drain infrastructure and sphere of responsibility. Potential improvements are summarized in **Table 2-15**.

Table 2-15. Strategies to Improve Storm Drain Discharge Water Quality

Improvement Strategy (weather condition addressed)	Description
Irrigation Runoff Reduction Program (dry weather)	Reduce irrigation runoff through water efficiency and turf replacement programs.
Enhanced property-based inspection program (dry weather)	Reduce pollutant discharge sources at residential land uses.
Mitigation projects (wet and dry weather)	Mitigation plan development and program standardization; develop regional mitigation projects, with an emphasis on encouraging collaborative, watershed-based planning within the jurisdictional planning departments of the Participating Agencies.
Bacteria source reduction programs (wet and dry weather)	Implementation of other bacteria source control programs, such as ordinances, outreach and education, pet waste collection dispensers, public restrooms and other homeless-targeted programs, etc. (see Bacteria TMDL Comprehensive Load Reduction Plan for additional examples).
Education and outreach (wet and dry weather)	Improve stormwater outreach and education programs to target specific actions.
Storm Drain Maintenance and repair (wet and dry weather)	Improve or develop storm drain maintenance, cleaning and/or replacement programs.
Source tracking investigation and follow-on remediation activities (wet and dry weather)	Prevent wildlife access into storm drains, outreach to specific homeowners suspected of illicit recreational vehicle discharges, structural controls for capture and infiltration of dry weather flows, etc.

The strategies listed include existing efforts to improve water quality as well as new opportunities to enhance or expand upon existing programs, and identify new initiatives for water quality improvement.

Although the strategies listed may improve water quality, there are several factors contributing to water quality issues that are not easily controllable, such as non-storm drain sources of pollutants. For example, drinking water from both imported and groundwater sources contain high levels of total dissolved solids. This conclusion is supported by a County of San Diego study titled, “An Analysis of Total Dissolved Solids in San Diego County,” which indicates that sources for total dissolved solids include groundwater, source water supplies, or the receiving water itself (County of San Diego, 2003).

The Comprehensive Load Reduction Plan identified other potential non-storm drain discharge dry weather sources to receiving waters including: rising groundwater (or seeps and springs), stream sediments, homeless encampments along the riparian corridor, birds and other wildlife, beach sand, beach wrack, pets on beach, bather shedding, failing septic systems, open space recreational activities, etc. These non-storm drain discharge sources are not currently considered in the Bacteria TMDL, however many of these have been shown to contribute to bacteria concentrations in other Southern California coastal watersheds.

2.3 Identification of Priority Water Quality Conditions [B.2.c]

The Permit requires that Participating Agencies identify the highest priority water quality conditions (HPWQC) in the watershed. The HPWQC may consist of pollutants, stressors, or receiving water conditions that are caused or contributed to by storm drain discharges. These conditions are the basis for identifying water quality improvement strategies that will be implemented (through the jurisdictional programs) to achieve needed improvements in the quality of storm drain discharges and receiving waters. The following sections present the process used to establish the HPWQC based on the information and data presented in **Sections 2.1** and **2.2**.

2.3.1 Process to Identify Priority and Highest Priority Water Quality Conditions

The following process was used to identify the pollutants, stressors or receiving water conditions that, based on available data, are believed to most adversely affect the quality of receiving waters in the watershed. This multi-step process was designed to increase confidence that water quality conditions are consistently and clearly evaluated according to the Permit criteria (described below) to identify the highest priorities for the watershed.

The 4-step HPWQC screening process is shown schematically in **Figure 2-7**. The process began with assessing the receiving water and watershed-level conditions (step 1, accomplished in **Section 2.1**), followed by an assessment of potential storm drain discharge contributions to these conditions (step 2, accomplished in **Section 2.2**). The primary data sources for the known conditions were the LTEA and the most recent Regional Monitoring Reports (Weston, 2012) (Weston, 2013), as well as conditions submitted for consideration by the public and 3rd party sources of data during the initial data call associated with the public workshop conducted on October 3, 2013. Conditions that were considered were inclusive of chemical, physical, *and* biological conditions of potential concern, as discussed in detail in **Sections 2.1** and **2.2**. Regulatory documents such as the 303(d) list, TMDLs, and associated studies were also consulted.

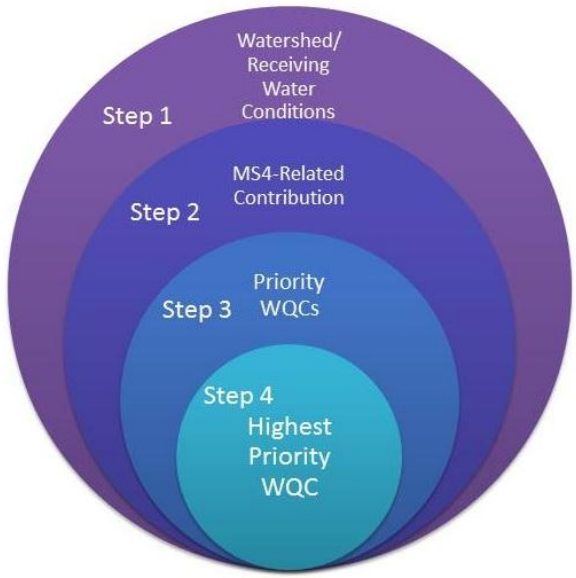


Figure 2-7. Schematic Representation of General Methodology to Determine Highest Priority Water Quality Condition

Step 3 involved screening potential conditions according to Permit criteria and watershed-specific considerations to establish a list of ***priority water quality conditions*** (PWQC). The Permit criteria include the following:

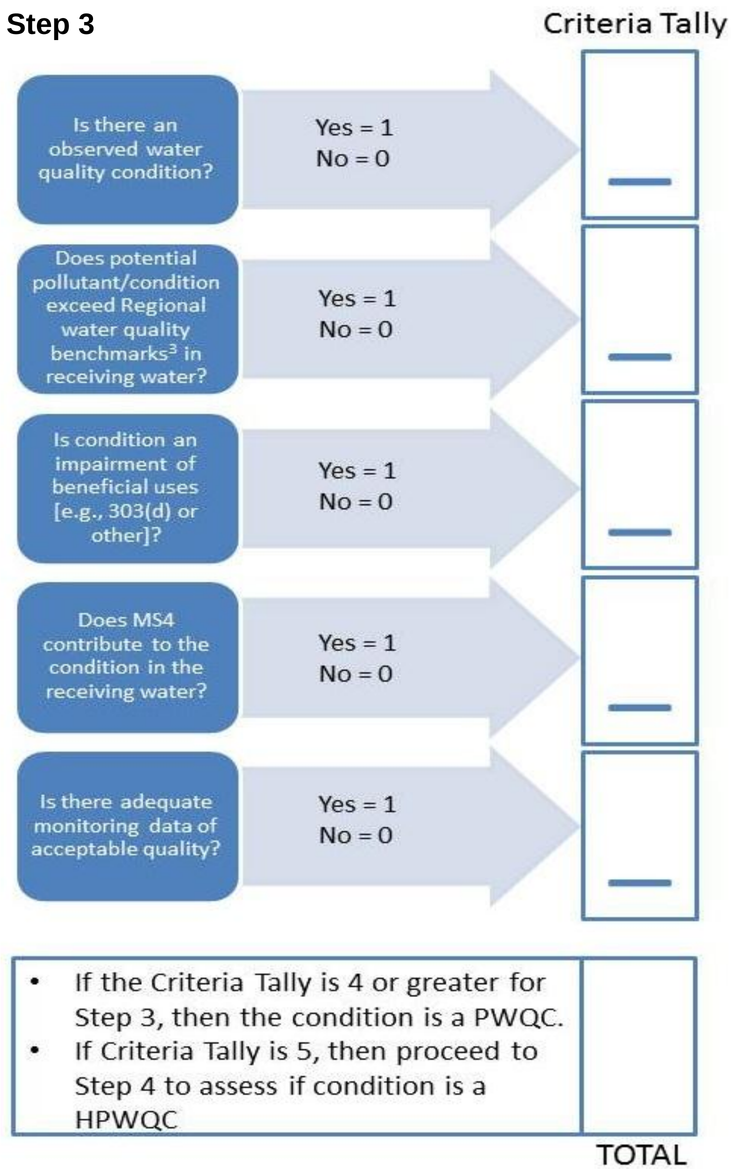
(a) Associated impaired beneficial use(s);

(b) Geographic and temporal extent of the condition;

(c) Storm drain discharge may cause or contribute to condition; and

(d) Adequacy of data used to determine condition.

Noted conditions were evaluated through a series of questions developed from the Permit criteria as shown in **Figure 2-8**. Conditions were scored according to a "Yes/No" outcome and then tallied to assess if the condition met a minimum threshold to qualify as a PWQC. Stakeholder-defined priorities were evaluated based on the availability and quality of supplemental information provided by agencies and/or stakeholders during the call for data. Each condition was also assessed separately for wet and dry weather.



Stormwater managers use **Best Professional Judgment** (BPJ) to aid in prioritization of programs and projects. Factors to be included limit the number of HPWQCs, and are based on consideration of multiple benefit effects of current BMPs and other jurisdictional programs, as well as the cost effectiveness of new strategies.

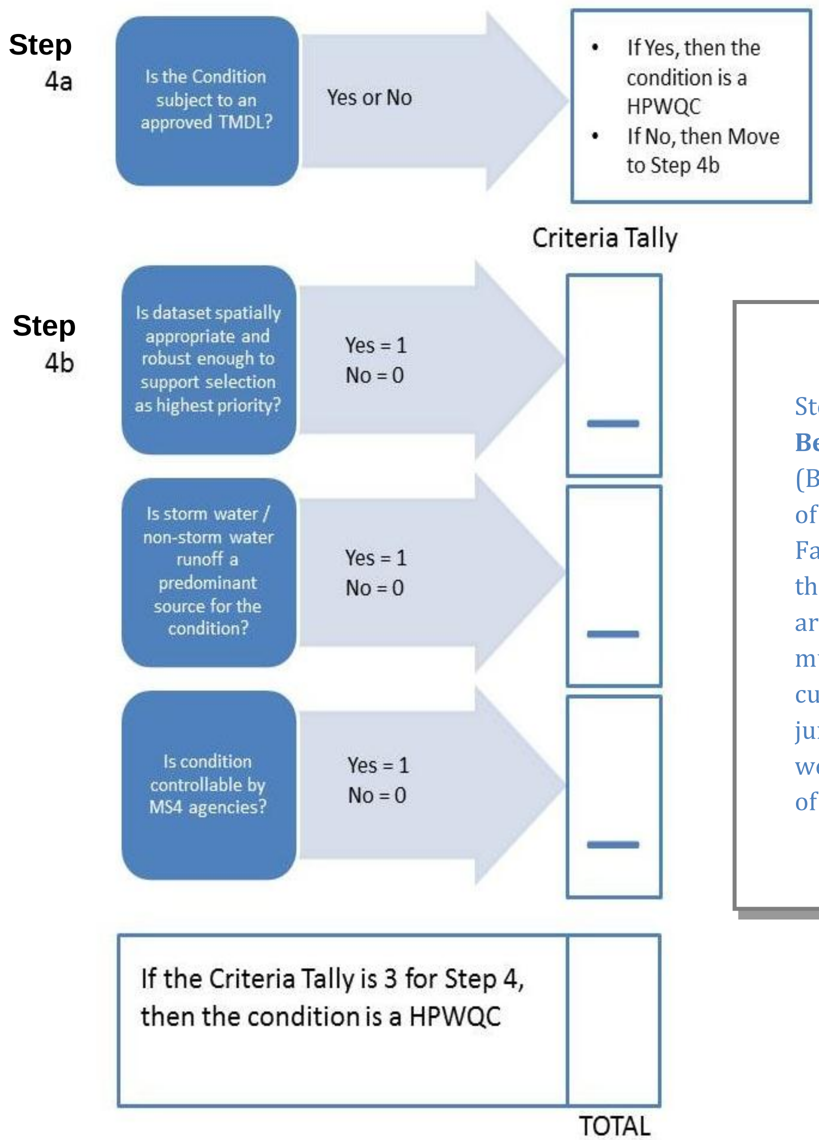
Figure 2-8. Steps to Determine PWQC (Step 3)[5]

PWQCs identified through the process described in **Figure 2-8** (step 3) then advanced to the ***highest priority water quality condition*** (HPWQC) screening process (step 4). A series of *additional* factors were considered in determining the HPWQC as described below:

[3] Regional water quality benchmarks were developed by the San Diego Regional Monitoring Workgroup for use in assessing the regional monitoring program results.

- **Approved TMDL in effect.** Conditions subject to an approved TMDL are automatically elevated to a HPWQC, as regulatory goals and schedules included in the Permit are in effect and urgency established. Existence of an approved TMDL is not a requirement for designation as an HPWQC, however.
- **Robust dataset or other basis to support condition**. This criterion underscores the need to have well-supported information that is collected and reported by Participating Agencies, or other parties as appropriate. The dataset or basis is considered robust if the condition is encountered in multiple data sources and is spatially relevant.
- **Storm water/non-storm water runoff a predominant source.** Where storm water or non-storm water discharges are considered a predominant or major source for the wet or dry weather condition, respectively, then the condition may be considered a HPWQC. This would exclude conditions, such as total dissolved solids during dry weather, which are primarily derived from groundwater or source water supplies rather than being derived from urban hardscapes or other land surfaces.
- **Controllable by Participating Agencies (i.e., availability of effective treatment options).** Consistent with the scope of the Permit, this requirement stipulates that conditions are controllable (or can be feasibly addressed or treated) at the point of entry, within, or at the outlets from the storm drains. This requires the availability of feasible options for treating the condition. Pollutants/conditions determined to be uncontrollable would not be considered a HPWQC.

These criteria are depicted as a step-wise process in **Figure 2-9.**



Stormwater managers use **Best Professional Judgment** (BPJ) to aid in prioritization of programs and projects. Factors to be included limit the number of HPWQCs, and are based on consideration of multiple benefit effects of current BMPs and other jurisdictional programs, as well as the cost effectiveness of new strategies.

Figure 2-9. Steps to Determine HPWQC (Step 4)

All water quality conditions that were identified based on the data sources discussed in **Section 2.4** were evaluated according to the process illustrated in **Figure 2-9** (step 4). Results of this evaluation are shown in matrix tables located in Appendix 2D for both wet and dry weather conditions. The condition and associated subwatershed/impacted water body are indicated in the first 3 columns. Column 4 indicates if the condition has been observed in the watershed, as supported by agency data, stormwater manager's Best Professional Judgment, public input, or other 3rd party data.

Column 5 indicates whether the condition is subject of a 303(d) listing. Column 6 indicates if the condition exceeds benchmarks established in the LTEA or Regional Monitoring Reports. Regional water quality benchmarks were developed by the San Diego Regional Monitoring Workgroup for use in assessing the regional monitoring program results. This series of columns indicates the watershed-level and receiving water conditions as developed in **Section 2.1** as step 1 of the process shown in **Figure 2-7.** Columns 7 and 8 indicate whether storm drain discharges contribute to the condition, and column 9 contains an assessment of the data adequacy, comprising step 2 of the process.

As indicated in **Figure 2-8**, if the criteria tally equals 4 or more, then the condition becomes a PWQC (step 3). This determination as to whether each condition is or is not a PWQC is shown in column 10 of each table.

The remaining columns on the right side of the matrix tables (columns 11 through 15) show the process for determining whether a PWQC is a HPWQC (step 4 from Figure 2 7), based on the methodology shown in **Figure 2-9.** PWQCs subject to an approved TMDL are automatically elevated to HPWQC. PWQCs not subject to an approved TMDL are evaluated with regards to the robustness of the data set identifying the condition (Column 12), whether stormwater or non-stormwater is the predominant source for the PWQC (Column 13), and finally whether the PWQC is controllable to a substantial degree by the stormwater conveyance system (Column 14). As indicated in **Figure 2-9**, if the criteria tally equals at least 3, then the PWQC becomes a HPWQC.

Figure 2-10 and **Figure 2-11** show excerpts from the matrix tables in Appendix 2D. The following sections summarize the results of the evaluation described above.

San Diego River Watershed - Priority Water Quality Conditions - Wet Weather [B.2.c.(1)]								
STEP 3								
1	2	3		4			5	
Sub Water-shed	Extent (water body name) B.2.c.(1)(b)	Condition or Pollutant		Condition observed in watershed		Criterion Score (Observed Yes=1)	Impaired Beneficial Use B.2.c.(1)(a)	Criterion Score (Impaired Use Yes=1)
6		7	8		9			10
Exceeds LTEA/RMR Bench-marks	Criterion Score (Exceeds Bench-marks Yes=1)	Potential sources (2010 Integrated Report)	Storm Drain Discharge may contribute to condition B.2.c.(1)(d)	Criterion Score (Urban Runoff as Source=1)	Monitoring data and data gaps B.2.c(1)(e)/ Other Rationale	Criterion Score (Adequate Data Yes=1)	Criteria Tally	PWQC? (Score of 4 = PWQC, *Score of 5 = moves to HPWQC)

Figure 2-10. Left side of Appendix 2D table

San Diego River Watershed - Highest Priority Water Quality Conditions – Wet Weather [B.2.c.(2)]								
STEP 4								
11	12		13		14			15
Approved TMDL Yes - HPWQC No - Continue	Robust Dataset	Criterion Score (Yes=1)	Stormwater as predominant source	Criterion Score (Yes=1)	Sources controllable by Participating Agency	Criterion Score (Yes=1)	Criteria Tally	HPWQC? (Score of 3 in Step 4 = HPWQC)

Figure 2-11. Right side of Appendix 2D table

2.3.2 Priority Water Quality Conditions

According to the process described in **Section 2.3.1**, potential water quality conditions in the watershed were screened to identify a subset of priority conditions. The Appendix 2D tables present the assessment of conditions according to the aforementioned criteria, resulting in a subset of dry and wet weather PWQCs. The PWQCs identified were:

- Bacteria (for both wet and dry conditions)
- Nitrogen (dry only)
- Phosphorus (dry only)
- Eutrophic Conditions (dry only)
- Total Dissolved Solids (dry only)
- IBI (dry only)

2.3.3 Highest Priority Water Quality Conditions

PWQCs that scored a five (5) were further screened, as described in **Section 2.3,** to establish the HPWQC. The Appendix 2D tables indicate the screening process results for each of the priority conditions assessed, for both wet and dry weather. The criteria and results from these tables are summarized as follows:

- **Approved TMDL in effect.** The sole TMDL currently in effect for the Lower San Diego River Watershed is the Twenty Beaches and Creeks Bacteria TMDL, therefore bacteria was automatically elevated to a HPWQC.
- **Robust dataset or basis to support condition.** The data set for PWQCs selenium and toxicity was not robust enough to support stating that storm drain discharge contributions contributed to receiving water problems. On this basis, toxicity and selenium were removed from consideration.
- **Stormwater/non-stormwater runoff a likely predominant source**. Conditions and pollutants that do not meet this criterion include eutrophication, chloride, and nutrients for dry weather conditions. Regarding eutrophication, the Southern California Coastal Waters Research Project (SCCWRP) did a study in 2010 that showed that sediments were found to be the major contributor of the limiting nutrient (phosphorus) that is responsible for algal growth in Famosa Slough (SCCWRP, 2010).
- **Controllable by stormwater conveyance system and/or presence of effective treatment options.** The condition of poor IBI was determined to be controllable and restorable within receiving waters, but not within or upstream of the storm drain system. The LTEA indicated that potential causes of low IBI scores during dry weather are high total dissolved solids, of which urban runoff is not the predominant source.

Only one (1) HPWQC meets the above criteria in the San Diego River Watershed: ***bacteria in the Lower San Diego River Watershed.***

Bacteria has been a focus in the watershed since adoption of the Bacteria TMDL (Water Board Resolution No. R9-2010-0001). The purpose of the Bacteria TMDL is to protect the health of those who recreate at beaches and streams. The TMDL requires responsible agencies to attain required load reductions during both dry weather and wet weather conditions within a 10- and 20-year compliance timeline, respectively. In 2012, Participating Agencies developed a Comprehensive Load Reduction Program that proposed programs designed to achieve TMDL-specified bacteria load reductions, as well as reductions of loads of other 303(d)-listed pollutants. The 20-year cost in 2011 dollars to comply with the Bacteria TMDL is significant and was estimated to be between $810 and 1,700 million (Geosyntec, 2012).

2.4 Identification of Sources of Pollutants and/or Stressors [B.2.d.]

The Permit requires that the Participating Agencies "identify and prioritize known and suspected sources of stormwater and non-stormwater pollutants and/or stressors associated with storm drain discharges that contribute to the highest priority water quality conditions" as identified under **Section 2.3** (Provision B.2c). Provision B.2.d states that the identification of known and suspected sources of pollutants and/or stressors that contribute to the HPWQC must consider the following:

1) Pollutant generating facilities, areas, and/or activities;
2) Locations of the Copermittee's storm drain discharges;
3) Other known and suspected sources of non-stormwater or pollutants in stormwater discharges to receiving waters;
4) Review of available data;
5) Adequacy of available data to identify and prioritize sources and/or stressors associated with storm drain discharges.

The items listed above were used to identify pollutants and stressors that *potentially* contribute to the HPWQC, bacteria, and the findings of this evaluation are discussed further in the following sections. It should be recognized that the following discussion is not an admission that listed conditions, pollutants, and/or stressors from storm drain discharges are *known* to contribute to the HPWQC.

Table 2-16 presents a summary of the land uses, the corresponding number of acres for each land us, and the percent of the total area that each land use comprises to help in the prioritization of pollutants and their sources. Residential, commercial/industrial, and recreational areas, as well as schools, and freeways and roads within agencies' jurisdictional boundaries are generally considered to be within the storm drain system. Agriculture, vacant/undeveloped, and park/open space areas are typically outside of the storm drain system. Identification of sources therefore focuses on the first set of land use categories, since those are areas in which control strategies can more effectively be implemented. Identification of land uses within the watershed is presented in greater detail in Chapter 3 (SANGIS, 2012).

Table 2-16. San Diego River Watershed - Land Uses

Land Use	Acres	Percent Total Area
Undeveloped	129,825	47%
Parks and recreation	58,995	21%
Residential	49,548	18%
Municipal/government	14,328	5%
Agriculture	5,337	2%
Commercial	7,617	3%
Industrial	4,072	1%
Other	4,319	2%
Caltrans	3,459	1%
Construction	40	0%
Total	277,543	100%

2.4.1 Pollutant Generating Facilities, Areas, and/or Activities

The Permit requires the Participating Agencies to consider pollutant generating facilities, areas, and/or activities within the watershed, including, but not limited to:

1) Each Participating Agency's inventory of construction sites, commercial facilities or areas, industrial facilities, municipal facilities, and residential areas;

2) Publicly owned parks and/or recreational areas;

3) Open space areas;

4) All currently operating or closed municipal landfills or other treatment, storage or disposal facilities for municipal waste; and

5) Areas not within the Participating Agencies' jurisdictions (e.g., Phase II Permittees, tribal lands, state lands, federal lands) that are known or suspected to discharge to stormwater conveyance systems.

Table 2-17 provides a summary of the applicable pollutant generating facilities, areas, and/or activities within each Participating Agency's boundaries.

Table 2-17. Summary of Applicable Pollutant Generating Facilities, Areas, and/or Activities by Jurisdiction

Potential Pollutant Source Areas	County of San Diego	City of San Diego	City of Santee	City of La Mesa	City of El Cajon
Construction, Commercial, Industrial, Municipal, Residential Facilities and/or Areas	☑	☑	☑	☑	☑
Publicly Owned Parks and/or Recreational Areas	☑	☑	☑	☐	☑
Open Space Areas	☑	☑	☑	☐	☑
Municipal Landfills or Other Treatment, Storage or Disposal Facilities for Municipal Waste	☑	☑	☐	☐	☐
Areas Not Within the Copermittee's Jurisdictions	☑	☑	☐	☐	☐

Previous permits have required that Participating Agencies maintain a list of construction sites, municipally owned parks or recreation areas, landfills, and commercial, industrial, and municipal facilities which were used to identify potential sources of pollutants. These sites are inspected on a frequency detailed in the Permit and municipal specific jurisdictional programs.

The Participating Agencies have identified a number of potential sources for the bacteria HPWQC, including but not limited to food establishments, commercial animal facilities, nurseries, residential areas and agricultural areas, which are discussed in the subsections below in accordance with Permit Provision B.2.d.1.

2.4.1.1 Pollutant Generating Facilities

Table 2-18 presents a summary of the pollutant generating facilities, areas, and/or activities and the parks/recreational areas from the City of San Diego 2011-2012 JURMP Annual Report, 2012-2013 JURMP Annual Reports for the Cities of El Cajon, La Mesa and Santee, and 2011-2012 JURMP Annual Report for the County of San Diego. Specific facility location information is provided by the jurisdictional programs. The residential areas are presented in **Sections 2.4.1.1** and **2.4.1.1.2** for the Upper and Lower watersheds, respectively. The potential pollutant sources for the upper and lower watershed are discussed separately below.

Table 2-18. Pollutant Generating Facilities, Areas, and/or Activities

Land Use	County of San Diego	City of San Diego	City of Santee	City of La Mesa	City of El Cajon
Construction Sites	288	247	14	28	12
Commercial Sites	493	3,703	540	342	700
Industrial Sites	79		N/A	17	104
Municipal Sites	40	57	17	49	34
Parks/ Recreational Areas	25	67	279 acres	--	78 acres

2.4.1.1.1 Upper San Diego River Watershed (907.10)

The Upper San Diego River Watershed is comprised of undeveloped (66%) and park (19%) land uses. **Table 2-19** indicates the land uses in the Upper watershed.

Table 2-19. Upper San Diego River Watershed Land Uses

Land Use	Acres	Percent Total Area
Undeveloped	109,627	66%
Parks and recreation	31,209	19%
Residential	16,218	10%
Municipal/government	1,468	1%
Agriculture	3,445	2%
Commercial	740	<1%
Industrial	86	<1%
Other	3,341	2%
Caltrans	220	<1%
Construction	3	<1%
Total	166,357	100%

2.4.1.1.2 Lower San Diego River Watershed (907.10)

The Lower San Diego Watershed is comprised of primarily residential and spaced rural residential (30%) and open space/parks and recreation (25%) land uses. Vacant and undeveloped land accounts for 18% of the land use. Watershed land use becomes progressively less urbanized from west to east within the watershed. **Table 2-20** indicates the land uses in the Lower watershed.

Table 2-20. Lower San Diego River Watershed Land Uses

Land Use	Acres	Percent Total Area
Undeveloped	20,198	18%
Parks and recreation	27,786	25%
Residential	33,330	30%
Municipal/government	12,860	12%
Agriculture	1,892	2%
Commercial	6,877	6%
Industrial	3,986	4%
Other	978	1%
Caltrans	3,239	3%
Construction	37	<1%
Total	111,183	100%

2.4.1.2 Parks, Recreational and Open Space Areas

The number and/or area of publicly owned parks and/or open space areas for the watershed are presented above in **Section 2.4.1.1**. The inventory of municipal parks is available from the respective Agencies' jurisdictional programs.

2.4.1.3 Landfills or Other Treatment Facilities for Municipal Waste

Table 2-21 summarizes the available data from the 2011-2012 JURMP Annual Report for the County of San Diego for all currently operating or closed municipal landfills or other treatment, storage or disposal facilities for municipal waste. At the time this report was prepared, the Cities of El Cajon, La Mesa, and Santee did not have municipal treatment facilities or landfills within their jurisdiction.

Table 2-21. Landfills or Other Treatment Facilities for Municipal Waste

<table>
<tr><th>Facility Type</th><th>County of San Diego</th><th>City of San Diego</th><th>City of Santee</th><th>City of La Mesa</th><th>City of El Cajon</th></tr>
<tr><td>Burn Sites</td><td>2</td><td>2</td><td rowspan="2">None</td><td rowspan="2">None</td><td rowspan="2">None</td></tr>
<tr><td>Landfill Site</td><td>1</td><td>None</td></tr>
</table>

2.4.1.4 Areas not Within the Participating Agencies' Jurisdictions

Tribal lands, federal lands, state parks, and lands regulated by the State Board's Phase II Municipal Separate Storm Sewer Permit are considered to be outside of the jurisdictional land use authority of the Participating Agencies. Discharges from tribal, federal, and state owned lands are generally regulated directly by the USEPA. Large campuses (e.g., colleges, hospitals) are often regulated under a separate Phase II Permit issued by the State Board, provisions of which are enforced directly by the State Water Board. Therefore, the ability of the Participating Agencies to influence water quality-related decisions on these lands is severely limited. It is important to recognize that each of these land uses and jurisdictions contributes to the loading of pollutants, including bacteria, the highest priority pollutant in the watershed. **Figure 2-12** shows a map of the areas not within the Participating Agencies' jurisdictions, including tribal lands, state lands, and federal lands.

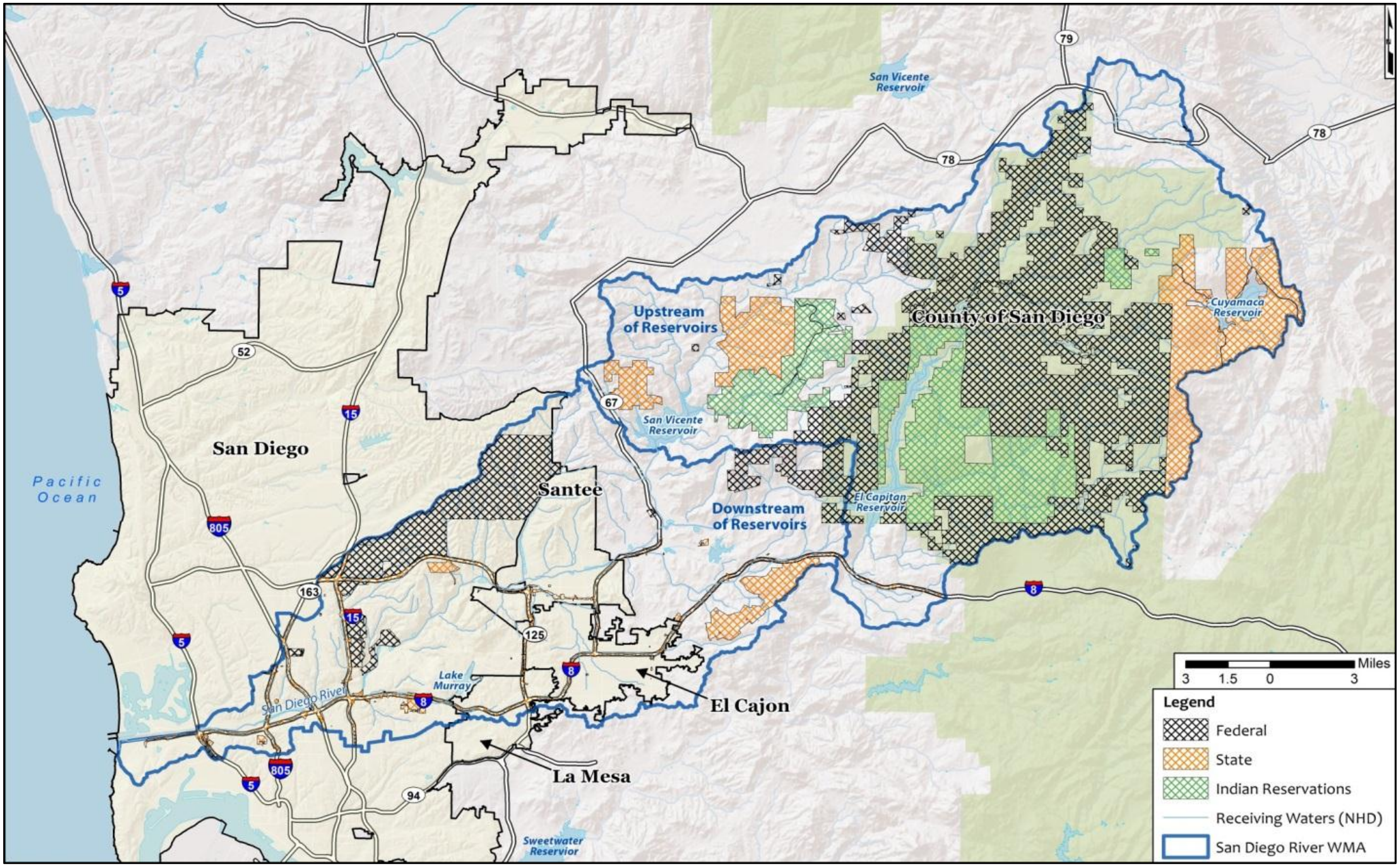


Figure 2-12. Areas Not Within the Participating Agencies' Jurisdictions

2.4.2 Location of the Participating Agencies' Stormwater Conveyance Systems

The Permit requires that the Participating Agencies provide the locations of their stormwater conveyance systems, including, but not limited to, the following:

(a) All storm drain outfalls that discharge to receiving waters, and

(b) Locations of major structural controls for stormwater and non-stormwater (e.g., retention basins, detention basins, major infiltration devices, etc.).

Figure 2-13 shows the storm drain system for the Participating Agencies.

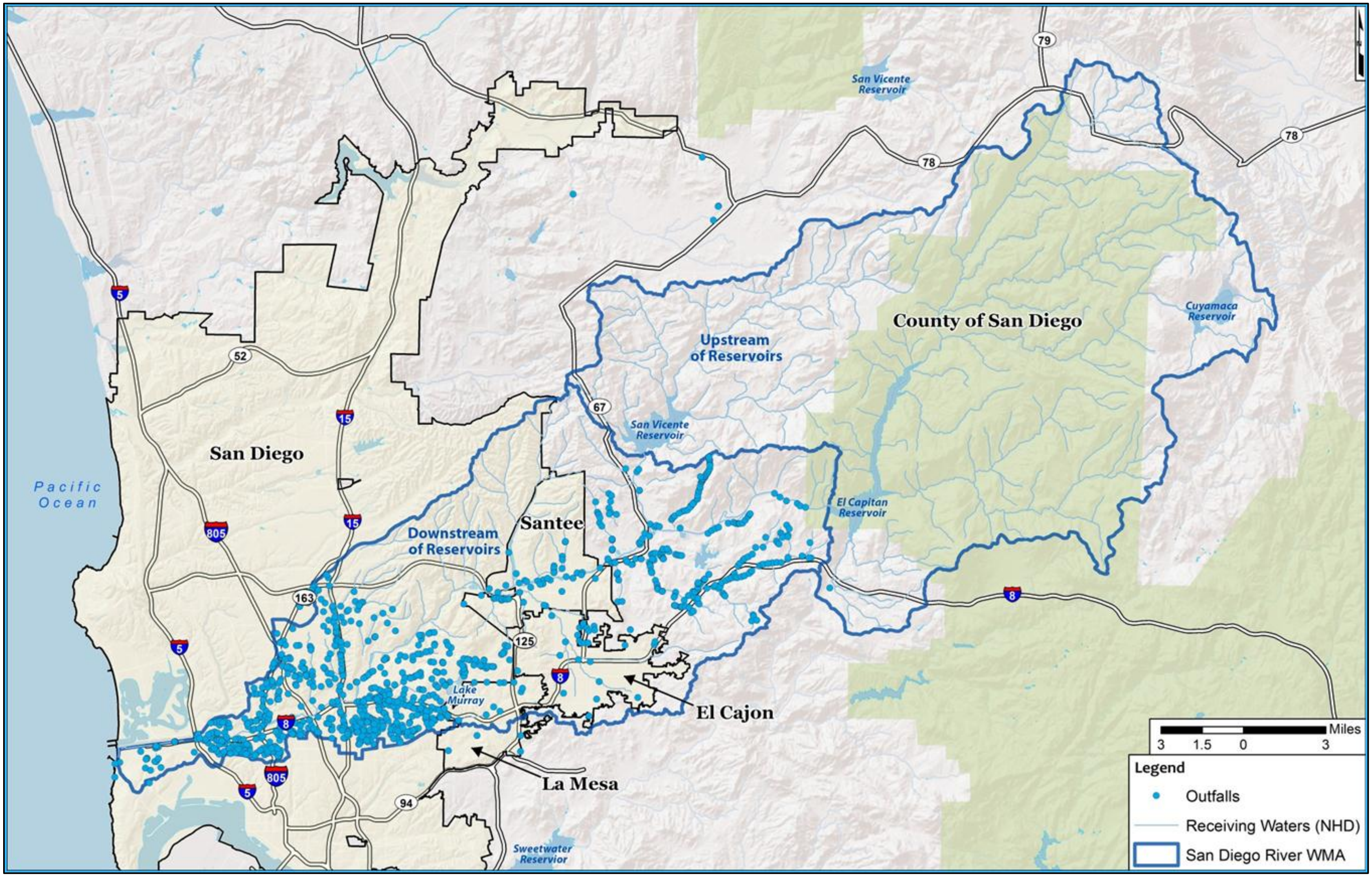


Figure 2-13. Locations of the Participating Agencies' Stormwater Conveyance Systems

2.4.3 Other Potential Sources

The Permit requires that the Participating Agencies consider other known and suspected sources of non-stormwater or pollutants in stormwater discharges to receiving waters, including, but not limited to, the following:

(a) Other storm drain outfalls (e.g., Phase II Municipal – see **Figure 2-12**);

(b) Other NPDES permitted discharges;

(c) Any other discharges that may be considered point sources (e.g., private outfalls); and

(d) Any other discharges that may be considered non-point sources (e.g., agriculture, wildlife or other natural sources).

Based on review of other potential sources, those identified generally fall into three categories: lands outside of the Participating Agencies' jurisdictions, discharges regulated under other statutes (e.g., individual or general NPDES permit, conditional waiver), and environmental sources.

Lands that are physically outside of Participating Agencies' jurisdictions include tribal and federal (e.g., military bases), and state owned lands (e.g., State Parks), as discussed in **Section 2.4.1.4**. Discharges from these lands are typically regulated by USEPA. Participating Agencies do not have authority to regulate these sources.

There are many point source discharges within the watershed that are regulated under other statutes by the Regional and/or State Boards. Examples of discharges and the associated regulatory mechanisms include:

- Discharges from small Storm Drain Systems: State Board Order No. 2013-0001-DWQ,
- Onsite wastewater treatment systems (OWTS): Water Board Conditional Waiver #1,
- Sanitary sewer overflows: State Board Order No. 2006-0003-DWQ,
- Publicly owned treatment works (POTWs): Individual NPDES permits,
- Groundwater: Multiple Water Board permits (e.g., Order R9-2008-0002),
- Industrial sites: State Board Industrial Stormwater General Permit Order 97-03-DWQ[4], and
- Construction sites (>1 acre): State Board Construction Stormwater General Permit Order No. 2012-0006-DWQ.

Regulation of these sources is generally the responsibility of the permitting agency (i.e., State Board, Regional Board), however, some are regulated by both the permitting authority and by Participating Agencies (e.g., industrial sites, construction sites, illicit discharges).

[4] Order 97-03-DWQ is in the process of revision, as of this writing, the new Industrial General Permit is in Final Draft form, but has not been adopted.

Sources of stormwater pollution are most often non-point in nature. This includes sources of pollution that are naturally present in the environment and others that are naturally present, but may be anthropogenically influenced. Participating Agencies have limited control over these sources through storm drain discharge regulation. Examples of environmental sources of pollution present within the watershed include wildlife, kelp, natural erosion, bacterial regrowth, natural groundwater, and wildfires. Natural sources that can be anthropogenically influenced include groundwater altered by imported water supply, aerial deposition of transportation and industrial pollutants, and erosion exacerbated by hydromodification[5].

In addition, several additional sources specific to bacteria were identified within the watershed including homeless populations living near receiving waters, sludge/sewage disposal sites, and portable bathroom facilities.

This Plan focuses on storm drain discharges. Though the Plan considers watershed conditions and priorities, it must do so in the context of the Participating Agencies' obligations for storm drain discharges. Where sources are outside of the regulatory authority or controllability of the Participating Agencies and these sources are impacting water quality within the watershed, the Participating Agencies will look for opportunities within the limits of their authority to address these sources themselves, or, where applicable and feasible, to collaborate with appropriate regulatory agencies to control these sources of bacteria.

2.4.4 Review of Available Data

The Permit requires that the Participating Agencies provide the findings of storm drain discharge sources of pollutants and/or stressors from the available data reviewed, including, but not limited to, the following:

(a) Findings from illicit discharge detection and elimination (IDDE) programs,

(b) Findings from outfall discharge monitoring, findings from receiving water monitoring, findings from outfall discharge and receiving water assessments, and

(c) Other available, relevant, and appropriately collected data, information, or studies related to pollutant sources and/or stressors that contribute to the highest priority water quality condition.

2.4.4.1 Illicit Discharge Detection and Elimination Programs

Table 2-22 summarizes the IDDE programs by jurisdiction from the City of San Diego 2011-2012 JURMP Annual Report, 2012-2013 JURMP Annual Reports for the Cities of El Cajon, La Mesa and Santee, and 2009-2010 JURMP Annual Report for the County of San Diego.

[5] In contrast to other anthropogenically influenced natural sources, erosion caused by hydromodification is addressed under the Permit through the Land Development requirements in Provision E.3.

Table 2-22. Illicit Discharge Detection and Elimination Inspections

	County of San Diego	City of San Diego	City of Santee	City of La Mesa	City of El Cajon
IDDE Inspections	34	210	68	52	109

Based on review of the findings of these programs, sources of bacteria and nutrients in the stormwater conveyance system could include the following:

- Food establishments
- Commercial animal facilities
- Nurseries
- Residential land uses

2.4.4.2 Findings from Storm Drain Discharge, Receiving Water Monitoring, and Associated Assessments

The Permit requires the Participating Agencies to present the findings of potential pollutant sources from storm drain outfall monitoring, receiving water monitoring, and storm drain outfall discharge and receiving water assessment data from the available sources.

Potential pollutant sources have not been well-identified in available reports. This may be due to the monitoring locations, which do not represent a single land use type and therefore cannot be used to distinguish pollutant sources. The 2011 LTEA states that single family residential land use areas may contribute to bacteria levels above water quality benchmarks. The Regional Monitoring Reports do not identify specific pollutant sources.

2.4.4.3 Other Data or Studies Related to Pollutant Sources

The Permit requires the Participating Agencies to consider "other available, relevant, and appropriately collected data, information, or studies related to pollutant sources and/or stressors that contribute to the highest priority water quality condition." The Phase II San Diego River Report (Weston, 2007) presented the following key observations about bacteria as a water quality condition:

- Potential sources of bacteria to Dog Beach: homeless encampments, wildlife, storm drains serving Ocean Beach community, Pump Station D. Sewer lines were determined to not be a source.
- Only a very weak human fecal contamination signal was found in one of 18 samples.[6]
- San Diego River itself was determined not to be the primary source of bacteria contamination to Dog Beach (at river mouth) during dry weather, but rather sources from the beach itself were implicated. Kelp on the beach, in particular, was identified as a possible source of elevated bacteria measured at the beach.

The San Diego River Park Foundation conducts regular trash cleanups and assessments of riparian conditions of the river. Detailed records of homeless encampments, trash locations and amounts of trash removed, and river conditions are maintained and distributed.

2.4.5 Data Adequacy

The Permit requires that the Participating Agencies consider the "adequacy of the available data used to identify and prioritize sources and/or stressors associated with storm drain discharges that contribute to the highest priority water quality conditions" in the watershed. As discussed above, potential pollutant sources have not been well-identified in available reports. This may be due to the monitoring locations, which do not represent a single land use type and therefore, cannot be used to distinguish specific pollutant sources. In these cases, Participating Agencies must use best professional judgment and local knowledge of watersheds to identify water quality issues.

The data used to determine the HPWQC for the watershed is spatially and temporally relevant to the area covered by this Plan, and was "appropriately collected and analyzed." Therefore, it is considered adequate to accurately identify bacteria as the HPWQC affecting the watershed. There is, however, a dearth of data available to assess the sources of bacteria to the stormwater conveyance system. Special studies, such as microbial source tracking and IDDE studies would be useful in addressing these data gaps. While there are active IDDE programs in much of the watershed, the only microbial source tracking study in the area is limited due to the significant changes in microbial source tracking protocols that have been established since the study was conducte

---

[6] It should be noted that the Weston MST study was conducted several years ago, and since that time, significant developments have occurred with regards to MST protocols. As a result, some of the methods used in this study may not conform to the current state of the practice (i.e. recently published findings from the California Source Identification Pilot Program [SIPP]).

3 WATER QUALITY IMPROVEMENT GOALS, STRATEGIES, AND SCHEDULES

Provision B.3 of the Permit, "Water Quality Improvement Goals, Strategies and Schedules," describes the requirements to develop specific water quality improvement goals and strategies to address the water quality conditions identified for the San Diego River Watershed. These goals and strategies must effectively prohibit non-stormwater discharges to the stormwater conveyance system, reduce pollutants in stormwater discharges from the stormwater conveyance system to the maximum extent practicable, and protect water quality in receiving waters.

Goals are set to measure progress towards addressing the highest priority water quality condition (bacteria) to protect recreational uses.

Strategies are the existing or planned activities or projects that can be implemented to demonstrate reasonable progress towards achieving the goals.

Provision B.3 defines the goals, strategies and schedules for achieving those goals. The goals include interim and final numeric (i.e., quantifiable) goals for the highest priority water quality condition (HPWQC), bacteria, for wet weather and dry weather in the lower watershed.

Wet Weather is a storm event of >0.1" of rainfall and the following 72 hours after the end of rainfall.

Dry Weather is defined as all days where the preceding 72 hours has been without measurable precipitation (>0.1 inch).

Bacteria are important indicators for recreational beneficial uses. Bacteria do not cause illness directly, but some epidemiologic studies[1] have shown correlations between the presence of indicator bacteria and gastrointestinal illness caused by pathogens. Indicator bacteria are used as detection surrogates or proxies for pathogens because they are easier and less costly to measure. Allowable bacteria loads for the watershed are defined by the Bacteria Total Maximum Daily Load (TMDL), identified in Attachment E of the Permit. The purpose of the Bacteria TMDL is to protect the health of those who recreate in waterbodies receiving runoff from the watershed by reducing the amount of bacteria discharged to the waterbodies through urban runoff, stormwater, and other sources.

[1] For example: EPA/600/R-10/168: "Report on the 2009 National Epidemiologic and Environmental Assessment of Recreational Water Epidemiology Studies (NEEAR): Boquerón Beach, Puerto Rico, and Surfside Beach, SC of the paper published in Environmental Health" (PDF, 449pp., 16.78 MB)

The control of bacteria presents unique challenges, since they are ubiquitous in the environment, are living organisms and the amount of bacteria from regrowth[2] as well as natural sources can be significant. Anthropogenic sources and natural sources contribute to bacteria within the watershed. To better understand the contribution from natural sources of bacteria, the San Diego Municipal Copermittees are currently carrying out a San Diego Region Reference Study. An objective of this study is to collect necessary data to account for the natural sources of bacteria in a watershed that are beyond the control of the Copermittees.

Anthropogenic sources of bacteria are caused or produced by humans and include, but are not limited to, failing septic systems, illegal sewage disposal, and pet waste.

Natural sources of bacteria include, but are not limited to, bird and wildlife feces, re-suspension from sediment, and regrowth.

The Bacteria TMDL requires Participating Agencies to attain required load reductions during both dry weather and wet weather conditions within a 10- and 20-year compliance timeline, respectively. The goals within the Plan are focused to demonstrate progress towards compliance with the Bacteria TMDL and the strategies are the actions to be taken to obtain compliance.

Multi-benefit strategies have been prioritized to achieve goals for bacteria as well as other pollutants and address both the highest priority and other PWQCs in the watershed. PWQC were identified according to the process described in **Section 2.3** of the Plan and typically include conditions where water quality analyses has identified and confirmed that the constituent or condition is not meeting water quality standards and the stormwater conveyance system is a likely contributor to the condition. The PWQCs were identified in **Chapter 2** of the Plan and are presented in **Table 3-1**.

Table 3-1. Priority Water Quality Conditions in San Diego River Watershed Management Area

	Dry Weather	Wet Weather
Highest Priority Water Quality Condition	• Bacteria	• Bacteria
Priority Water Quality Condition	• Nitrogen and Phosphorus • Total Dissolved Solids • Eutrophic Conditions • Index of Biological Integrity	• None

[2] Colford Jr., J. M., T. J. Wade, K. C. Schiff, C. C. Wright, J. F. Griffith, S. K. Sandhu, S. Burns, M. Sobsey, G. Lovelace, and S. B. Weisberg. 2007. "Water Quality Indicators and the Risk of Illness at Beaches with Nonpoint Sources of Fecal Contamination." Epidemiology, 18(1): 27-35, January 2007.

An iterative, adaptive management approach will be used that will improve water quality and increase the effectiveness of strategies to be used to achieve the numeric goals for bacteria. The approach, with corresponding **Chapter 3** sections noted, is presented in **Figure 3-1**, and is discussed further in **Chapter 5**.

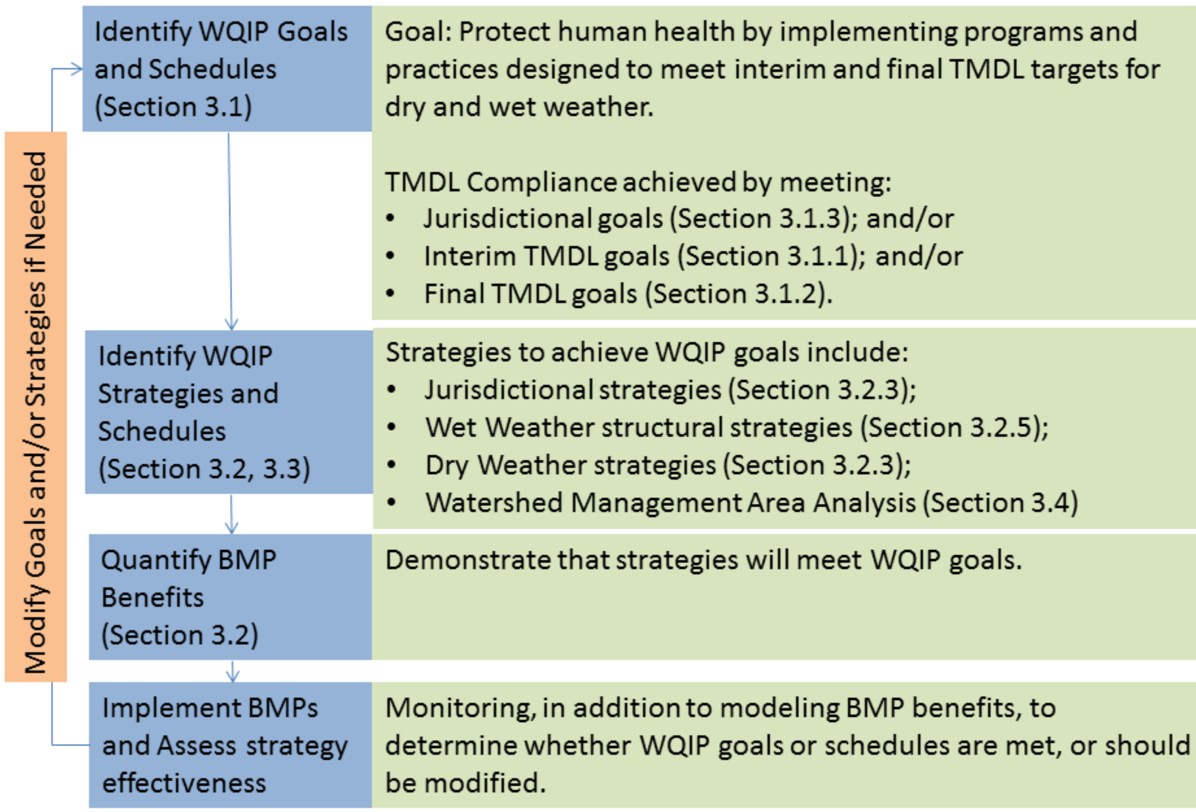


Figure 3-1. Approach for Achieving Goals

3.1 Water Quality Improvement Goals and Schedules

The purpose of establishing goals is to "support Water Quality Improvement Plan implementation and measure reasonable progress towards addressing the highest priority water quality condition" [B.3.a.(1)]. The Permit requires that goals be reflective of criteria or indictors to measure incremental progress towards addressing the HPWQC over the course of implementation of the Plan.

As described in **Chapter 2**, bacteria is the HPWQC for dry and wet weather in the watershed. The goals are focused to achieve compliance with the Bacteria TMDL from Attachment E of the Permit, which presents different options or pathways to achieve compliance. The goals are presented for dry and wet weather conditions are displayed in **Figure 3-2** and are as follows:

- Interim jurisdictional goals based on 5-year Permit terms.
- Interim goals based on the interim Bacteria TMDL compliance pathways.
- Final goals based on final Bacteria TMDL compliance options.

The latter two types of goals are already established in Attachment E of the Permit, and are herein referred to as "required goals". These goals are presented in this Plan to reflect the multiple pathways outlined in the Permit for compliance with the TMDL. Each compliance pathway would result in water quality improvements, but each demonstrates the improvements in a different way. Since the Permit allows any of these pathways to be followed to achieve compliance (i.e. demonstration of progress toward all compliance pathways is not required), the compliance pathways are independent of each other.

The compliance pathways are based on three types of metrics:

- receiving water conditions that are evaluated by comparing measured conditions with water quality objectives (numeric values and allowable exceedance frequencies – included to account for natural sources of bacteria);
- conditions of discharges from Copermittee's storm drain outfalls that are evaluated by comparing measured conditions to water quality objectives and/or required load reductions; and
- Implementation of the Plan (i.e., establishment of goals, implementation of strategies and schedules).

Modeling has been conducted to establish numeric targets for the goals. Since there is an opportunity in 2016 to update the bacteria TMDL based on sound scientific studies, which may amend the current targets, goals may be modified based on outcomes of the bacteria TMDL revision process. As the Plan is implemented, the Participating Agencies will use adaptive management, as discussed in **Chapter 5** to re-evaluate goals and improve strategies to effectively address priorities.

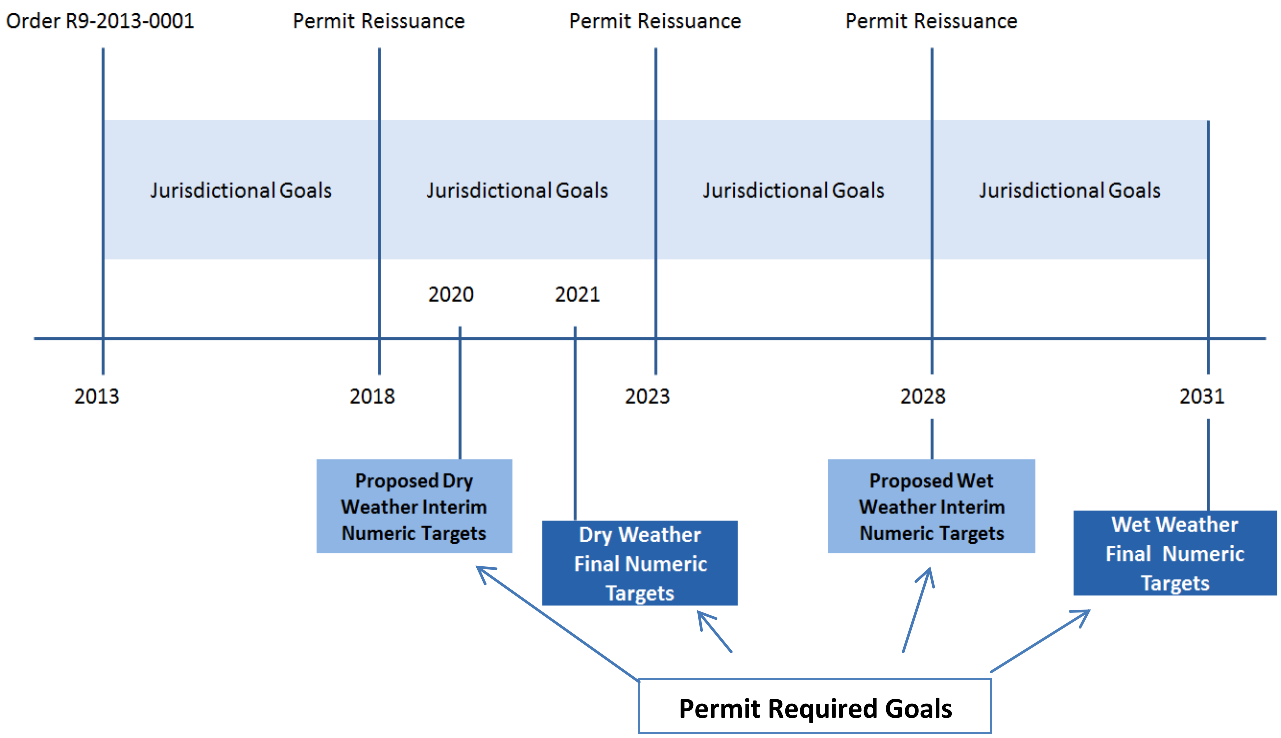


Figure 3-2. Timelines and Relationships between Bacteria TMDL Numeric Targets[a]

[a] Per the Permit, Participating Agencies may propose alternative TMDL interim milestones which differ from those presented in above in Figure ES-2.

3.1.1 *Compliance Pathways for Required Interim Goals*

Since each compliance pathway provides an independent option to demonstrate progress and ultimately compliance with the TMDL, any one of the following compliance pathways may be used for assessment purposes. That is, all pathways do not have to be assessed, but are options for use in the Plan. The compliance pathways to achieve interim required goals, summarized from Attachment E of the Permit, are presented in **Table 3-2.**

Table 3-2. Compliance Pathways to Achieve Required Interim TMDL Goals

Pathway	Title	Interim Target	Metric	Values to be met		
				Indicator	Dry[c]	Wet
1 OR	Meet bacteria allowable exceedance frequency of receiving water objectives	No exceedances of the interim receiving water limitations;	Exceedance frequencies as measured in receiving waters.	Total Coliform[a]	.28% AEF[d]	46% AEF
				Fecal Coliform	0% AEF	43% AEF
				Enterococcus	1.5% AEF	49%(creeks) 51% (Beaches) AEF
2 OR	No discharge from stormwater drain outfalls	No direct or indirect discharge from the Participating Agencies' storm drain outfalls to the receiving water;	Assessment of presence/absence of flow and connectivity with receiving water.	Flow observations or measurements		
3 OR	Reduce loads at storm drain outfalls	The pollutant load reductions for discharges from the Participating Agencies' outfalls are greater than the required load reduction;	Pollutant load reductions.	Total Coliform	37.02% reduction	19.07% reduction
				Fecal Coliform	34.72% reduction	26.61% reduction
				Enterococcus	46.98% reduction	21.37% reduction
4 OR	Show Exceedances are from natural sources	Demonstrate that exceedances of final receiving water limitations are due to loads from natural sources	Implement Natural Source Exclusion (NSE) Approach	Monitoring and assessment of receiving water and watershed which supports the NSE approach		
5 OR	No exceedances of final receiving water limitations	There are no exceedances of the final receiving water limitations in the receiving water at, or downstream of Participating Agencies' storm drain outfalls	Assessment of receiving water	Monitoring and assessment of receiving water indicating limitations have not been exceeded		
6	Implement Plan and use adaptive management	The Participating Agencies develop and implement an accepted Plan[b]	Implementation of jurisdictional strategies	Implementation of jurisdictional strategies as developed in accepted Plan and designed to meet interim goals 1, 2 and/or 3.		

a. Receiving water limitations for total coliform only apply to beaches.
b. The Plan must provide reasonable assurance that the interim TMDL compliance requirements in Attachment E of the Permit will be met via implementation, must be accepted by the Regional Board, and must be fully implemented by the Participating Agencies.
c. Dry weather measurements at beaches.
d. AEF - allowable exceedance frequency is the percent of samples that can exceed the single sample maximum of geometric mean and still be in compliance; the AEF is calculated based on the presence of bacteria loading from natural sources

In addition to the interim goals, achievement of any of the final goals will satisfy compliance with the interim TMDL requirements, as they are more stringent than the interim goals.

3.1.2 *Compliance Pathways for Required Final Goals*

Similar to the interim TMDL goals, the final TMDL goals include multiple pathways to demonstrate compliance. The final goal pathways, summarized from Attachment E of the Permit, are presented in **Table 3-3**.

Table 3-3. Pathways to Achieve Required Final TMDL Goals

Compliance Pathway	Final Target	Final Metric	Measurement					
			Indicator	Dry Weather			Wet Weather	
				SSM[a]	GM[b]	AEF[c]	SSM	AEF
1 OR	No exceedances of the final receiving water limitations in the receiving water;	Bacteria concentrations (MPN or CFU/100 ml) and exceedance frequencies in receiving waters are less than or equal to allowable values;	Total Coliform[d]	10,000	1,000	0%	10,000	22%
			Fecal Coliform	400	200	0%	400	22%
			Enterococcus (beaches)	104	35	0%	104	22%
			Enterococcus (creeks)	61	33		61	
2 OR	No direct or indirect discharge from the Participating Agencies' storm drain outfalls to the receiving water;	Assessment of presence/absence of flow and connectivity with receiving water;	Flow observations or measurements.					
3 OR	There are no exceedances of the final effluent limitations at the Participating Agencies' storm drain outfalls;	Bacteria concentrations (MPN or CFU/100 ml) and exceedance frequencies in discharges;		Dry			Wet	
				SSM	GM	AEF[e]	SSM	AEF[f]
			Total Coliform[g]	10,000	1,000	0%	10,000	22%
			Fecal Coliform	400	200	0%	400	22%
			Enterococcus (beaches)[h]	104	35	0%	104	22%
			Enterococcus (creeks)[i]	61	33		61	
4 OR	The pollutant load reductions for discharges from the Participating Agencies' storm drain outfalls are greater than or equal to the final load reductions;	Load reductions in discharges are greater than or equal to required load reductions. The calculation requires an understanding of the baseline load[j], which can be used to estimate a target load reduction;		Percent Reduction (Dry)			Percent Reduction (Wet)	
			Total Coliform	74.03%			34.7%	
			Fecal Coliform	69.44%			34.7%	
			Enterococcus	93.96%			34.7%	
5 OR	Exceedances of the final receiving water limitations in the receiving water are due to loads from natural sources and pollutant loads from the Participating Agencies' storm drain outfalls are not causing or contributing to the exceedances;	Microbial source tracking results as measured in the receiving water downstream of stormwater drain outfalls;	Microbial source tracking results show anthropogenic markers are below the limits of reporting in the receiving water at the time of the exceedance in most samples.					
6	The Participating Agencies develop and implement an adopted Water Quality Improvement Plan that includes a watershed model or other watershed analytical tool(s)	Implementation of jurisdictional strategies designed to meet goals. Use an adaptive management approach to improve implementation of jurisdictional strategies to reach goals.	Implementation of jurisdictional strategies as outlined in the Plan, and of the required monitoring and assessment program.					

a SSM = single sample maximum or the highest allowable concentration of bacteria contained in one discreet sample

b GM = geometric mean calculated based on multiple samples over a given time frame as defined by the Ocean Plan

c AEF = allowable exceedance frequency is the percent of samples that can exceed the single sample maximum of geometric mean and still be in compliance; the AEF is calculated based on the presence of bacteria loading from natural sources

d Receiving water limitations for total coliform only apply to beaches.

e For dry weather days, the dry weather bacteria densities must be consistent with the single sample maximum REC-1 water quality objectives in the Ocean Plan for discharges to beaches and the Basin Plan for discharges to creeks and creek mouths.

f The 22% single sample maximum allowable exceedance frequency only applies to wet weather days.

g Total coliform effluent limitations only apply to storm drain outfalls that discharge to the Pacific Ocean Shorelines and creek mouths listed in Table 6.0 of Attachment E of Order R9-2013-0001.

h This enterococcus effluent limitation applies to storm drain discharges to segments of areas of the Pacific Ocean Shoreline listed in Table 6.0 of Attachment E of Order R9-2013-0001.

i This enterococcus effluent limitation applies to storm drain discharges to segments of areas of the creeks or creek mouths listed in Table 6.0 of Attachment E of Order R9-2013-0001.

j The baseline loads for the lower watershed were determined through modeling, and are presented in Appendix 3C. Wet weather target load reductions (TLRs) for this Plan were taken from the City of San Diego Phase II Comprehensive Load Reduction Plan (Tetra Tech 2013). Fecal coliform was used to represent all bacteria for the purposes of this modeling.

3.1.3 *Jurisdictional Goals*

The Participating Agencies have each developed "jurisdictional goals" to demonstrate individual progress towards interim and final TMDL goals and to meet the overall purpose of the Permit: to protect the physical, chemical and biological integrity of waterbodies. The Permit does not require each jurisdiction to have numeric goals in every Permit term, only that one jurisdiction or the overall watershed has a numeric goal for each Permit term. The implementation of goals depends upon approval of funding in future annual budgets.

Each jurisdiction has developed its own goals that will result in a positive, measureable impact on water quality in the watershed. Wet and dry weather jurisdictional goals are proposed for each 5-year permitting cycle, through the implementation period of the Bacteria TMDL (2021 for dry weather and 2031 for wet weather). Jurisdictional goals for each participating agency are summarized below and in **Table 3-4** through **Table 3-13**.

3.1.3.1 Jurisdictional Goals for City of El Cajon

The City of El Cajon has established a dry weather goal for the 2013-2018 Permit term involving the reduction of controllable dry weather persistent flows. Specifically, El Cajon's goal is to reduce the volume of dry weather flows or the number of storm drains with dry weather flows by 10%. The City of El Cajon will establish a baseline for volume reduction in 2015. Following the establishment of the baseline and initial reduction, El Cajon will maintain a 10% reduction in flows or the number of storm drains with dry weather flows and expand reduction based on program effectiveness and funding availability.

Table 3-4. City of El Cajon Dry Weather Jurisdictional Numeric Goals

Title	Metric	Baseline	Outcome	1st Permit Term Numeric Goals 2013 - 2018	2nd Permit Term Numeric Goals 2018 - 2023	
					TMDL Interim Compliance Date April 4, 2020 (b)	TMDL Final Compliance Date April 4, 2021
Reduce controllable dry weather persistent flows	% reduction of flow volume or number of outfalls with flows mitigated from persistently flowing storm drain outfalls.	Baseline will be developed from previous dry weather monitoring data.	Effectively reduce controllable dry weather flow from storm drain outfalls to receiving water.	Reduce the volume of dry weather flows or the number of storm drains with dry weather flows by 10%.	Maintain 10% reduction in flows or the number of storm drains with dry weather flows and expand reduction based on results of previous actions and availability of funds.	Effectively reduce dry weather discharges from storm drain outfalls to the receiving water.
Transient encampment removal events	Increase the number of annual transient encampment removal events throughout the City's drainage channels.	Yearly average of five (5) removal events during R9-2007-0001 Permit cycle to help remove 25 cubic yards of trash and debris.	Increase annual transient encampment removal events to a minimum of eight (8) annual events to increase to 40 cubic yards of trash and debris to help reduce bacterial pollutant loads for total coliform fecal coliform and enterococcus.	Reduce gross pollutants that may contribute to bacteria loads by increasing the number of cubic yards of debris collected from drainage channels.	Continue to conduct a minimum of 8 transient encampment removal events per year and adjust the number of events accordingly to achieve compliance.	Continue to conduct a minimum of 8 transient encampment removal events per year and adjust the number of events accordingly and achieve compliance to achieve compliance with load reduction of 37.02% total coliform, 34.72% fecal coliform and 46.98% enterococcus respectively.

Table 3-5. City of El Cajon Wet Weather Jurisdictional Numeric Goals

Title	Metric	Baseline	Outcome	1st Permit Term 2013 - 2018	2nd Permit Term 2018 - 2023	3rd Permit Term 2023 - 2028	4th Permit Term 2028 - 2033
						Meet TMDL Interim Compliance Date April 4, 2028 (c) (d)	Meet TMDL Final Compliance Date April 4, 2031
Non-structural BMP (Creek Cleanup)	Reduce bacterial loads in Forrester Creek	5 cubic yards of solid waste (i.e. trash and debris) per cleanup event	Reduce trash and debris to help reduce bacteria loads.	Sponsor, coordinate with jurisdictions creek clean up events in 1 focused management area, bi-annually; segregate and quantify waste materials.	Sponsor, coordinate with jurisdictions creek clean up events in 1 focused management area, bi-annually; segregate and quantify waste materials.	Sponsor, coordinate with jurisdictions creek clean up events in 1 focused management area, bi-annually; segregate and quantify waste materials.	Reduce bacteria loads by an additional 14% (total 19 %) from the storm drain outfalls by continues implementation of programmatic Non-structural BMPs.
Non-structural BMP (Pet Waste Outreach)	Reduce bacterial loads in Forrester Creek	5 cubic yards of solid waste (i.e. trash and debris) per event	Reduce trash and debris to help reduce bacteria loads.	Expand pet waste management outreach to 1 focused management area; or to large properties owners (i.e. apartments, commercial facilities).	Expand pet waste management outreach to 1 focused management area; or to large properties owners (i.e. apartments, commercial facilities).	Expand pet waste management outreach to 1 focused management area; or to large properties owners (i.e. apartments, commercial facilities and educational institutions).	Reduce bacteria loads by an additional 14% (total 19 %) from the storm drain outfalls by continues implementation of programmatic Non-structural BMPs.

Title	Metric	Baseline	Outcome	1st Permit Term 2013 - 2018	2nd Permit Term 2018 - 2023	3rd Permit Term 2023 - 2028	4th Permit Term 2028 - 2033
						Meet TMDL Interim Compliance Date April 4, 2028 (c) (d)	Meet TMDL Final Compliance Date April 4, 2031
Structural BMPs feasibility study , adaptive management	Develop structural BMPs to help reduce bacterial load by 30%-40% to help meet wet weather TMDL allocations	Total Coliform 3,101 MPN/100mL (2004-2010 San Diego River outlet); Fecal Coliform Jurisdictional load (1993 Water year) 2,000x10^{12} MPN/yr; Enterococcus 252 MPN/100mL (2004-2010 San Diego River outlet)	Reduce total coliform, fecal coliform and enterococcus by 30-40%.	Develop feasibility study to assess dry/wet weather treatment control BMPs and draft environmental impact report for treatment control BMPs.	Complete EIR for treatment control BMPs (High Rate Media Filter - Gross Solids Filter).	Collaborate with other watershed jurisdictions for planning, conceptual design and full design for select BMPs engineering, siting, and environmental review as funding becomes available.	Operate and manage full scale BMPs (i.e. High Rate Media Filter), coordinate with the County of San Diego.
Implement Plan with focus on programmatic BMPs and use adaptive management to increase effectiveness	Percent Total Coliform bacterial load reduction	Total Coliform 3,101 MPN/100mL (2004-2010 San Diego River outlet)	Reduce total coliform bacterial load by 19.07% from storm drain outfalls to help meet TMDL load reduction.	Implement programmatic (non-structural) BMPs to help achieve source reduction of bacterial loads from storm drain outfalls.	Reduce bacterial loads by 1% from storm drain outfalls through continued implementation of programmatic BMPs and structural BMP utilizing an adaptive management.	Reduce bacteria loads by an additional 4 % (total of 5%) from the storm drain outfalls by continued implementation of programmatic BMPs and structural BMPs.	Reduce bacteria loads by an additional 14% (total 19 %) from the storm drain outfalls by continues implementation of programmatic BMPs and structural BMPs.

Title	Metric	Baseline	Outcome	1st Permit Term 2013 - 2018	2nd Permit Term 2018 - 2023	3rd Permit Term 2023 - 2028	4th Permit Term 2028 - 2033
						Meet TMDL Interim Compliance Date April 4, 2028 (c) (d)	Meet TMDL Final Compliance Date April 4, 2031
Implement Plan with focus on programmatic BMPs and use adaptive management to increase effectiveness	Percent Fecal Coliform bacterial load reduction	Fecal Coliform Jurisdictional load (1993 Water year) $2{,}000 \times 10^{12}$ MPN/yr	Reduce fecal coliform bacterial load by 26.61% from storm drain outfalls to help meet TMDL load reduction.	Implement programmatic (non-structural) BMPs to help achieve source reduction of bacterial loads from storm drain outfalls.	Reduce bacterial loads by 1% from storm drain outfalls through continued implementation of programmatic BMPs and structural BMP utilizing an adaptive management.	Reduce bacteria loads by an additional 4 % (total of 5%) from the storm drain outfalls by continued implementation of programmatic BMPs and structural BMPs.	Reduce fecal coliform bacterial load by 26.61% from the storm drain outfalls by continuing the implementation of programmatic BMPs and structural BMPs.
Implement Plan with focus on programmatic BMPs and use adaptive management to increase effectiveness	Percent Enterococcus bacterial load reduction	Enterococcus 252 MPN/100mL (2004-2010 San Diego River outlet)	Reduce enterococcus bacterial load by 21.37% from storm drain outfalls to help meet TMDL load reduction.	Implement programmatic (non-structural) BMPs to help achieve source reduction of bacterial loads from storm drain outfalls.	Reduce bacterial loads by 1% from storm drain outfalls through continued implementation of programmatic BMPs and structural BMP utilizing an adaptive management.	Reduce bacteria loads by an additional 4 % (total of 5%) from the storm drain outfalls by continued implementation of programmatic BMPs and structural BMPs.	Reduce enterococcus bacterial load by 21.37% from the storm drain outfalls by continuing the implementation of programmatic BMPs and structural BMPs.

3.1.3.2 Jurisdictional Goals for City of La Mesa

The City of La Mesa has established the dry and wet weather goal of performing a creek restoration project on Alvarado Creek, upstream of the box culvert at the SR-125 freeway. The restoration will involve 900 feet of restoration along the creek. Following the completion of the restoration project, the City of La Mesa will conduct the Alvarado Trunk Main Sewer Replacement Project. The project will replace approximately .75 miles of trunk sewer located under or in very close proximity to Alvarado Creek.

Table 3-6. City of La Mesa Dry Weather Jurisdictional Numeric Goals

Title	Metric	Baseline	Outcome	1st Permit Term Numeric Goals 2013 - 2018	2nd Permit Term Numeric Goals 2018 - 2023	
					TMDL Interim Compliance Date April 4, 2020 (b)	TMDL Final Compliance Date April 4, 2021
Creek Restoration Project	Linear Feet of Structural Projects	Existing Channel Conditions	Structural Project Completion	Perform 900 LF of Alvarado Creek restoration program.	Conduct Alvarado Trunk Main Sewer Replacement Project which will replace approx. 0.75 miles of trunk sewer located under or in very close proximity to Alvarado Creek.	Meet TMDL Final Compliance Requirements [Attachment E, 6.b(3)]

Table 3-7. City of La Mesa Wet Weather Jurisdictional Numeric Goals

Title	Metric	Baseline	Outcome	1st Permit Term 2013 - 2018	2nd Permit Term 2018 - 2023	3rd Permit Term 2023 - 2028	4th Permit Term 2028 - 2033
						Meet TMDL Interim Compliance Date April 4, 2028 (c) (d)	Meet TMDL Final Compliance Date April 4, 2031
Creek Restoration Project	Linear Feet of Structural Projects	Existing Channel Conditions	Structural Project Completion	Perform 900 Linear Feet of Alvarado Creek restoration program.	Conduct Alvarado Trunk Main Sewer Replacement Project which will replace .75 miles of trunk sewer.	Comply with any of the TMDL Interim Compliance Requirements [Attachment E, 6.c(3)]	Comply with any of the TMDL Final Compliance Requirements [Attachment E, 6.b(3)]

3.1.3.3 Jurisdictional Goals for City of Santee

Recognizing that urban runoff is generally a controllable source that contributes to the mobilization of bacteria, the City of Santee will primarily focus its efforts on addressing dry weather runoff. Based on cumulative monitoring studies conducted by various organizations such as the San Diego River Park Foundations State of the River Report and those referenced and summarized within the Comprehensive Load Reduction Plan, the known sources of bacteria include anthropogenic (human and pet contributions), high density areas and industry (multi-family housing, high use areas such as retail centers, and eateries), outdoor water use and urban runoff (over irrigation, pavement washing), and natural (wildlife) contributors. Based on historical data from the City of Santee's Monitoring Program, the primary areas of concern (where bacteria exceedances are consistently measured) are at the outfalls along the river between Cuyamaca Street and Carlton Hills Boulevard.

With the overall objective of reducing or stopping controllable (non-permitted) sources of urban runoff, the City of Santee has selected four actions/goals for dry weather compliance: 1) Implement a dry-weather inspection and investigation program (separate from the monitoring program component); 2) Implement a 'complete property' inspection program which focuses attention to high density or high-use areas including multi-family housing developments and industrial/commercial centers; 3) Implement a component to the existing inspection program which addresses housekeeping practices at eateries; and 4) Promote outdoor water use efficiency and conservation practices.

For the first goal, the City will develop and implement a plan for conducting dry weather flow inspections and investigations of those areas tributary to the channels that are commonly known to have dry weather flows (Woodglen Vista Creek and Sycamore Creek). By performing inspection and upstream investigations on a routine basis, the City hopes to attain a reduction of outfalls with persistent flows. With the second goal, the City will map its inventory of businesses and multifamily – high density housing developments in correlation to the known bacteria exceedance outfalls, to identify high-priority areas to target program efforts. The City will inspect these properties in their entirety, as opposed to business based (i.e., complete malls, retail centers). Inspections will focus toward dumpster / trash enclosure maintenance. For the third goal, the City will implement a targeted approach to address housekeeping practices at local eateries to include grease management, trash enclosures, and outdoor seating areas. Lastly, efforts will address outdoor water use through partnerships with both the Santee Unified School District and Padre Dam Municipal Water District. The City will enhance its efforts to encourage outdoor water efficiency and conservation to prevent runoff through outreach, education, and inspections.

For the wet weather goals, the City of Santee will address trash removal as a way to prevent the mobilization and regrowth of bacteria. Plans include partnering with other organizations on river and/or community clean-up events, improvements to the encampment inspection and removal program, and increasing the number of pet waste stations and trash bins in regional parks. Efforts will be focused on those geographical areas that are identified to be contributing to the highest bacteria levels (as described in the dry-weather goals). Following this effort, Santee plans to retrofit a total of 1.6 acres of drainage area. Planning and conceptual design for structural BMPs will be conducted as need and funding becomes available.

Success will be measured by routine monitoring – both visual and physical sampling. Therefore, the City will implement a complimentary monitoring program that will be able to demonstrate program effectiveness, and progress toward attaining goals. Through an iterative approach, the City will be able to refine efforts as needed to improve the progress toward achieving the Bacteria goals and to comply with the TMDL. Success will be determined based on the ability to achieve measurable reductions in average bacterial loads within the City's jurisdiction.

Table 3-8. City of Santee Dry Weather Jurisdictional Numeric Goals

Title	Metric	Baseline	Outcome	1st Permit Term Numeric Goals 2013 - 2018	2nd Permit Term Numeric Goals 2018 - 2023	
					TMDL Interim Compliance Date April 4, 2020 (b)	TMDL Final Compliance Date April 4, 2021
Dry Weather Investigations	Visual confirmation	Number of dry weather flows based on 2013-2014 monitoring records.	Achieve a 25% reduction in urban runoff / dry weather flows, as measured at outfalls.	Implement a dry-weather inspection and investigation program (separate from the monitoring program component). Dedicate 10% of compliance inspection hours to conduct dry weather investigations.	Reduce the number of storm drain outfalls with dry weather flows in areas tributary to Woodglen Vista Creek and Sycamore Creek by 10%.	Reduce the number of storm drain outfalls with dry weather flows in areas tributary to Woodglen Vista Creek and Sycamore Creek by an additional 15% (25% total).
'Complete Property' Inspection Program	Visual and physical confirmation; monitoring of targeted outfalls to be performed before and during implementation	Average loading (monitoring year 2012-2013)	Achieve 25% reduction of bacteria load levels at outfalls downstream of high priority areas.	Inspect 50% high priority, high-density use areas (residential & commercial/industrial). Focused inspections on pavement, landscape and trash enclosures.	Inspect remaining high priority, high-density use areas (residential & commercial/industrial). Focused inspections on pavement, landscape and trash enclosures.	Identify problem sites and implement escalating enforcement actions to achieve full compliance.
Eateries Inspection Program	Visual and physical confirmation; monitoring of targeted outfalls to be performed before and during implementation	Average loading (monitoring year 2012-2013)	Achieve measurable reduction of bacteria load levels at outfalls downstream of high priority areas.	Inspect 50% of high priority eateries. Focused inspections on grease storage, trash enclosures, outdoor seating areas	Inspect remaining high priority eateries. Focused inspections on grease storage, trash enclosures, outdoor seating areas	Identify problem sites and implement escalating enforcement actions to achieve full compliance.

Title	Metric	Baseline	Outcome	1st Permit Term Numeric Goals 2013 - 2018	2nd Permit Term Numeric Goals 2018 - 2023	
					TMDL Interim Compliance Date April 4, 2020 (b)	TMDL Final Compliance Date April 4, 2021
Outdoor Water Use Efficiency and Conservation	Pre & post surveys; reduction in water use.	Surveys; Average water use per capita; dry weather monitoring data	Achieve measurable reduction of average bacteria load levels at outfalls downstream from high priority areas.	Develop Residential Management Area (RMA) program. Distribute outreach materials addressing outdoor water use, water conservation, and water quality to all high-priority properties (areas). Partner with Santee School District to disseminate information and integrate efforts.	Review 50% of projects that require landscape and irrigation plans for compliance with the City's Landscape Ordinance. Participate and/or promote incentive programs.	Full implementation of RMA program. Review 100% of landscape and irrigation plans for compliance with the City's Landscape Ordinance.

Table 3-9. City of Santee Wet Weather Jurisdictional Numeric Goals

Title	Metric	Baseline	Outcome	1st Permit Term 2013 - 2018	2nd Permit Term 2018 - 2023	3rd Permit Term 2023 - 2028	4th Permit Term 2028 - 2033
						Meet TMDL Interim Compliance Date April 4, 2028 (c) (d)	Meet TMDL Final Compliance Date April 4, 2031
Retrofit projects	Acreage retrofitted	Existing retrofitted areas include Forester Creek and Woodglen Vista Creek	Retrofit a total of 2 acres of drainage area	Identify candidate locations for off-site compliance. Develop Water Quality Equivalencies (credit system).	Implement off-site (alternative) Compliance Program.	Develop and implement a plan for a Green Streets (i.e., Complete Streets Program). Develop minimum BMPs for all CIP projects.	Full implementation of Alternative Compliance Program and Complete Streets program.
Trash Management Program	Trash removal rates/quantities (Tonnage removed); visual surveys	Average number of encampments; trash removal rate/quantity	Reduce average number of river encampments; decreased presence of trash (reduced removal rate/quantities)	Bi-monthly river encampment sweeps with follow up trash removal. Increase efforts to provide referrals to local community services.	Increase accessibility to various waste disposal needs.	Secure funding or community investments to provide and maintain public sanitary facilities.	Obtain community involvement to implement regular disposal and cleanup events.

3.1.3.4 Jurisdictional Goals for City of San Diego

In addition to the numeric goals based on Attachment E of the Permit identified in **Table 3-2** and **Table 3-3**, which demonstrate sustained water quality improvement over longer periods of time, interim wet and dry weather performance-based goals have been established by the City of San Diego to measure short-term jurisdictional progress toward achieving the final goals during the current Permit cycle (**Table 3-10**).

The City of San Diego established a jurisdictional wet and dry weather interim numeric goal to develop and implement a policy that requires the inclusion of green infrastructure features on all suitable City projects, including non-SUSMP (Standard Urban Stormwater Management Plan) projects. This policy will be coordinated with ongoing efforts to update City design manuals and low-impact (LID) design standards for public LID BMPs. To guide implementation of the new policy, a green infrastructure program will be initiated in parallel. The program will begin with research and recommendations for ideal methods for green infrastructure project siting and prioritization within the City, but will ultimately result in the construction of additional green infrastructure projects. By FY 2018, the City will have implemented this policy, attained City Council approval, and constructed four green infrastructure BMPs within the watershed that will treat an estimated 58.4 acres of drainage area.

The City also established a jurisdictional dry weather interim numeric goal to implement a suite of runoff reduction programs that include more targeted education and outreach, enhanced business inspections, additional water conservation rebate programs, and increased enforcement. By FY 2018, the City anticipates a ten percent reduction in prohibited dry weather flow from its persistently flowing outfalls in the watershed during dry weather based on these efforts. Historical dry weather monitoring data will be used to establish baseline flows from persistency flowing outfalls.

Table 3-10. City of San Diego Dry Weather Jurisdictional Numeric Goals

Compliance Pathways		Baseline	Assessment Period and Fiscal Year		
			Current Permit Term	FY 16-20	FY 21-25
			FY18	FY19[a]	FY21[a]
Receiving Water % Days Exceeding WQO	Fecal coliform	12.6% Days Exceeding WQO (2002[b])	See performance measures	6.3%	0%
	Enterococcus	19% Days Exceeding WQO (2002[b])		9.5%	0%
OR					
Storm Drain Discharges % Days Exceeding WQO	Fecal coliform	Historic storm drain outfall dry weather data will be used to identify the baseline in the first annual report	See performance measures	0%	0%
	Enterococcus			0%	0%
OR					
Storm Drain Discharges % Load Reduction	Fecal coliform	0% Load Reduction (2002 TMDL Model)	See performance measures	49.4%	98.8%
	Enterococcus			49.9%	99.9%
OR					
Storm Drain Discharges Implement Accepted Water Quality Improvement Plan		Metric for compliance analysis is storm drain discharge % load reduction (above). Interim compliance is implementation of strategies and schedule based on analysis results (Appendix 3F). Final compliance is implementation of BMPs based on analysis results and demonstration of compliance with any of the compliance pathways through monitoring and assessment. See Section 3.2.3 and Appendix 3F for modeling discussion			
OR					
Storm Drain Discharges # of Direct or Indirect Storm Drain Discharges to Receiving Water		Number of persistently flowing major storm drain outfalls provided in the Monitoring and Assessment Program Section of this Plan	See performance measures	0	0

Compliance Pathways		Baseline	Assessment Period and Fiscal Year		
			Current Permit Term	FY 16-20	FY 21-25
			FY18	FY19[a]	FY21[a]
OR					
% of Exceedances of Final Receiving Water WQOs due to Natural Sources[c]	Fecal coliform	Not available	100%	100%	100%
	Enterococcus		100%	100%	100%
Performance Measures					
Suite of Strategies to Measure Performance during First Permit Term		Baseline	FY18		
Develop green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality during wet and dry weather		0 acres treated in 2002, the year used as baseline in the Bacteria TMDL	58.4 acres of drainage area treated through construction of 4 green infrastructure BMPs		
Implement runoff reduction programs, including targeted education and outreach, enhanced inspections, rebates [d], and increased enforcement		Historical dry weather monitoring data will be used to establish a baseline in the first annual report	10% reduction in prohibited [e] dry weather flow from baseline measured at persistently flowing outfalls in the watershed		

a. Denotes total maximum daily load (TMDL) interim and final water quality-based effluent limitation (WQBEL).

b. The existing exceedance frequency was calculated based on available monitoring data between 1996 and 2002 per Permit requirements and presented in more detail in Appendix 3C.

c. Demonstration of exceedances of final receiving water limitations due to natural sources includes demonstration that pollutant loads from the stormwater conveyance system are not causing or contributing to exceedances.

d. City of San Diego rebates include grass replacement, rainwater harvesting, downspout disconnect, and micro irrigation.

e. Does not include allowable discharges as defined in Provision A and Provision E.2.a of the Permit.

% = percent; FY = fiscal year; WQO = Water Quality Objective

Table 3-11. City of San Diego Wet Weather Jurisdictional Numeric Goals

Compliance Pathways		Baseline	Goals by Assessment Period and Fiscal Year				
			Current Permit Term (FY14 – FY18)	FY 16-20	FY 21-25	FY 26-30	FY 31-36
			FY18	FY19	FY24[a]	FY29	FY31[a]
Receiving Water % Days Exceeding WQO	Fecal coliform	72% Days Exceeding WQO (2002 TMDL Model)	See performance measures	72%[b]	43%	35%	22%
	Enterococcus – San Diego River	78% Days Exceeding WQO (2002 TMDL Model)		78%[b]	49%	36%	22%
	Enterococcus – Pacific Ocean Shoreline	81% Days Exceeding WQO (2002 TMDL Model)		81%	51%	37%	22%
OR							
Storm Drain Discharges % Days Exceeding WQO	Fecal coliform	Historic storm drain outfall wet weather data will be used to identify the baseline in the first annual report	See performance measures	22%	22%	22%	22%
	Enterococcus			22%	22%	22%	22%
OR							
Storm Drain Discharges % Load Reduction	Fecal coliform	0% Load Reduction (2002 TMDL Model)	See performance measures	5.2%	17.3%	23.9%	34.7%
	Enterococcus			4.2%	14.1%	19.5%	28.2%
OR							
Storm Drain Discharges Implement Accepted Water Quality Improvement Plan		Metric for compliance analysis is storm drain discharge % load reduction (above). Interim compliance is implementation of strategies and schedule based on analysis results (Appendix 3C). Final compliance is implementation of BMPs based on analysis results and demonstration of compliance with any of the compliance pathways through monitoring and assessment. See Section 3.2.4 and Appendix 3E for modeling results.					
OR							
Storm Drain Discharges # of Direct or Indirect Storm Drain Discharges to Receiving Water		Number of flowing major storm drain outfalls during wet weather monitoring (See Monitoring and Assessment Section of this Plan).	See performance measures	0	0	0	0

<table>
<tr><th colspan="2" rowspan="3">Compliance Pathways</th><th rowspan="3">Baseline</th><th colspan="5">Goals by Assessment Period and Fiscal Year</th></tr>
<tr><th>Current Permit Term (FY14 – FY18)</th><th>FY 16-20</th><th>FY 21-25</th><th>FY 26-30</th><th>FY 31-36</th></tr>
<tr><th>FY18</th><th>FY19</th><th>FY24[a]</th><th>FY29</th><th>FY31[a]</th></tr>
<tr><td colspan="8">OR</td></tr>
<tr><td rowspan="2">% Exceedances of Final Receiving Water WQOs due to Natural Sources [c]</td><td>Fecal coliform</td><td rowspan="2">Not available</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td></tr>
<tr><td>Enterococcus</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td></tr>
<tr><th colspan="8">Performance Measures</th></tr>
<tr><th colspan="2">Suite of Strategies to Measure Performance during First Permit Term</th><th>Baseline</th><th colspan="5">FY18</th></tr>
<tr><td colspan="2">Develop green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality during wet and dry weather</td><td>0 acres treated in 2002, the year used as baseline in the Bacteria TMDL</td><td colspan="5">58.4 acres of drainage area treated through construction of 4 green infrastructure BMPs</td></tr>
</table>

a. Denotes total maximum daily load (TMDL) interim and final water quality-based effluent limitation (WQBEL).

b. Denotes existing wet weather frequency as modeled in the Bacteria TMDL. With limited baseline monitoring data available, this goal reflects a reasonable estimate considering the difficulty in demonstrating progress within the receiving water during wet weather in a short amount of time. Furthermore, development and redevelopment of the urban environment has occurred since the Bacteria TMDL baseline loads were calculated in 2001. As such, this goal demonstrates that progress has been made by the Participating Agencies by maintaining the existing wet weather exceedance frequency.

c. Demonstration of exceedances of final receiving water limitations due to natural sources includes demonstration that pollutant loads from stormwater conveyance systems are not causing or contributing to exceedances.

3.1.3.5 Jurisdictional Goals for County of San Diego

The County of San Diego has established dry weather numeric goals for the highest priority water quality condition of bacteria in the watershed. To comply with the Permit's final TMDL compliance requirements, anthropogenic dry weather discharges from storm drain outfalls to the receiving water must be eliminated. Throughout implementation of the Plan, adaptive management will be used to evaluate reasonable progress toward the numeric goals and to consider changes to program design and project implementation, as needed to meet goals and as funding becomes available..

The dry weather goal was established to eliminate anthropogenic (excludes groundwater and other exempt or permitted non-stormwater flow) dry weather flow in storm drains to zero, in order to reduce pollutant loading to water bodies. This goal will be accomplished through the implementation of numerous JRMP strategies to mitigate dry weather flows from storm drain outfalls, as described in the County of San Diego JRMP. In particular, the County has shifted to a more active field program to better locate and abate dry weather flow. County Stormwater Staff spend a greater frequency of time present in unincorporated communities identifying nuisance anthropogenic flows and addressing them through appropriate education and enforcement strategies. All County staff members have been trained to identify and report illicit discharges and illicit connections during required annual stormwater training; this training has been updated to reflect recent Permit changes.

In addition to the increase in County staff field surveillance, staff is also implementing a focused program to reduce flow at targeted storm drain outfalls that have demonstrated persistent dry weather flow conditions. Using dry weather monitoring data collected from 2013 to 2015, the County has determined 19 priority outfalls in the watershed that will be monitored for dry weather flow regularly. If dry weather flows are detected, staff will initiate a field investigation to seek out and abate the source of flow.

Using the above strategies, The County will target to reduce the number of persistently flowing outfalls by 20% by 2018. Alternatively, the County may demonstrate a 20% decrease in the aggregate flow of the stormwater outfalls by 2018. A baseline volume of flow would be established during FY 2015-16 through special monitoring studies. Efforts will be adaptively managed to mitigate dry weather flows and consider designing small-scale structural controls as needed during the second Permit term. For the final TMDL compliance goal, scheduled for April 2021, the overall goal is no discharges from the County of San Diego's storm drain outfalls to the receiving water, as demonstrated through the storm drain outfall monitoring program.

The County has established several wet weather numeric goals for the highest priority water quality condition of bacteria in the watershed. One of the compliance options for the TMDL requires a 34.7% reduction of the bacteria load from storm drain outfalls by 2031. Half of the load reduction, 17.35%, is required by the interim TMDL target date. Programmatic approaches and structural BMPs are estimated to reduce bacteria loads by 10% and 24.7%, respectively. The County of San Diego is concerned that a long term funding source to construct and maintain structural BMPs has not been identified.

The programmatic approach involves reducing bacteria loads from storm drain outfalls. The metric established is the implementation of the stormwater program, resulting in an estimated 10%

reduction of the bacteria loads needed to meet compliance. The baseline established for the goal is to reduce the overall bacteria loads of 1,727x10^12 MPN/yr by 10%, demonstrated by the analytical spreadsheet approach. The load reduction is anticipated to take place incrementally by Permit term, with a 2% reduction during the second Permit term, a 4% reduction during the third Permit term, and a 4% reduction during the fourth Permit term. If the modeled reductions are not confirmed by monitoring, then program adjustments will be made according to the adaptive management process. This may require the incorporation of more effective strategies, changes in program design, or incorporation of additional structural BMPs if funding is available.

The County will implement distributed BMPs with the desired outcome of reducing bacteria loads from storm drain outfalls based on quantitative modeling estimates and bacteria loads reduced annually from storm drain outfalls. Retrofit projects implemented from 2003-2009 were used in the quantitative model to reduce the baseline loads. The percent reduction of baseline loads from drainage retrofitted was utilized as the metric for the retrofit goals. The first Permit term goal includes the retrofitting of 392 acres through redevelopment requirements (treatment control BMPs), which results in a reduction of the baseline loads. Further planning and design will be developed in future Permit terms as needed and as funding becomes available, with the goal of meeting the required reductions of the baseline load by the April 2031 final TMDL compliance, through construction of additional distributed structural BMPs for a reduction of up to 4% of bacteria loads.

The County also has a goal of developing a small-scale residential incentive program. This program is a public-private partnership program focused on residential participation. Opportunities to expand the program to include business community participation will also be explored. The outcome of the goal is the capture and use, or diversion of, bacteria loads from storm drain outfalls to landscaped areas. The metric for the goal is the percent reduction of baseline loads from construction of small-scale BMPs. An analytical spreadsheet was used to estimate the bacteria load reduction from rooftop stormwater runoff (Appendix 3D). The first Permit term will be utilized for planning and evaluation of the feasibility of a pilot residential incentive program to encourage rain water use through rain barrels, roof downspouts redirected to landscaped areas, rain gardens and other small scale infiltration BMPs. If feasible, the second through the forth Permit terms will include expansion of the program through incremental increases in the program scale (up to approximately 12% of single-family residences), and measured through reductions in the baseline bacteria loads of an estimated 2% for the second term, 5.5% for the third term, and a total of 9.8% by the forth term.

The County of San Diego also has established a multi-benefit goal of reducing bacteria in the stormwater conveyance system through implementation of structural BMPs. A partnership will be established with the Lakeside River Park Conservancy for potential structural BMP implementation. The baseline used for the goal includes quantitative modeling to estimate percent load reductions from structural BMPs, with the metric of a total bacteria load reduction of 10.6% of the baseline. The planning, full design, engineering, siting, and environmental review for select BMPs, will be conducted beginning in the second Permit term as needed and as funding becomes available. Planning will continue through the third Permit term. During the fourth Permit term, the structural BMP(s) will be constructed, if needed and if funding is available, to meet final compliance load reduction goals (as demonstrated through modeling). The following structural BMP or equivalent will result in 10.6% load reduction based on the quantitative modeling summarized in Section 3.2.4 and detailed in Appendix 3E.

- SDCO-R-01: Regional BMP - Wet Pond/Subsurface flow wetland (Partnership with Lakeside River Park Conservancy)
- Suite of distributed BMPs
    - retrofits such as permeable pavement of parking lots, non-traveled right of way, and other localized infiltration or bioretention BMPs

Water quality monitoring of structural BMPs will be used to determine compliance with the final Bacteria TMDL goal.

Because there is uncertainty inherent in some of the modeling parameters used to estimate load reduction benefits, optional strategies have been developed for consideration to achieve load reduction goals if necessary. These will be implemented as necessary based on the adaptive management model upon which this Plan is based. Implementation of the optional strategies is contingent on circumstances supported by the need for the additional effort, the cost and benefit as compared to other options and strategies, and the availability of funding.

Table 3-12. County of San Diego Dry Weather Jurisdictional Numeric Goals

Dry Weather Multi-Benefit Numeric Goals for Highest Priority Water Quality Condition - Bacteria[c]						
Title	Metric	Baseline	Outcome	1st Permit Term Numeric Goals 2013 - 2018	2nd Permit Term Numeric Goals 2018 - 2023	
					TMDL Interim Compliance Date April 4, 2020 [b]	TMDL Final Compliance Date April 4, 2021
Eliminate anthropogenic dry weather flows [a] from storm drain outfalls	% reduction of flow volume or number of outfalls with persistent flows	To be established FY 15-16 using dry weather flow measurements.	Effectively eliminate anthropogenic dry weather flow from storm drain outfalls to receiving water.	Reduce by 20 % the aggregate flow volume or the number of persistently flowing outfalls.	Reduce by 75 % the aggregate flow volume or the number of persistently flowing outfalls.	Effectively eliminate anthropogenic dry weather discharges from storm drain outfalls to the receiving water.

a. Here and throughout this table, the term "dry weather flows" excludes groundwater, other exempt or permitted non-stormwater flows, and sanitary sewer overflows.
b. Request moving Interim TMDL Compliance Date from April 4, 2017 (per Attachment E, 6.c(1)) to April 4, 2020 to allow adequate time to investigate and mitigate dry weather flows through the adaptive management process of the Plan.
c. The County of San Diego is concerned that a long-term funding source is not identified for constructing and maintaining structural BMPs, if structural BMPs are needed to meet compliance.

Table 3-13. County of San Diego Wet Weather Jurisdictional Numeric Goals

Wet Weather Multi-Benefit Numeric Goals for Highest Priority Water Quality Condition - Bacteria[c]							
Title	Metric	Baseline	Outcome	1st Permit Term 2013 - 2018	2nd Permit Term 2018 - 2023	3rd Permit Term 2023 - 2028 Meet TMDL Interim Compliance Date April 4, 2028 [a] [b]	4th Permit Term 2028 - 2033 Meet TMDL Final Compliance Date April 4, 2031
Implement Plan with focus on programmatic BMPs and use adaptive management to increase effectiveness	% bacterial load reduction	1,727 x 10^{12} MPN during Water Year 2003	Reduce baseline bacteria loads by 10 % from storm drain outfalls to meet TMDL required load reductions.	Implement programmatic (non-structural) BMPs to achieve source reduction of bacteria loads from the storm drain outfalls.	Reduce bacteria loads by 2 % from the storm drain outfalls through continued implementation of programmatic BMPs and, based on adaptive management, focus and enhance efforts where needed.	Reduce bacteria loads by an additional 4% (total 6%) from the storm drain outfalls by continued implementation of programmatic BMPs.	Reduce bacteria loads by an additional 4% (total 10 %) from the storm drain outfalls by continued implementation of programmatic BMPs.
Structural BMPs (as needed and as funding is available)	% bacterial load reduction based on quantitative model	1,727 x 10^{12} MPN during Water Year 2003	Reduce baseline bacteria loads by 24.7% from storm drain outfalls to receiving water to meet TMDL required load reductions.	Reduce by 1% the baseline bacteria loads from distributed BMPs constructed between 2003 and 2009 during redevelopment.	Reduce bacteria loads by an additional 2% (total 3%) through participation in the public private partnership program. Begin planning & design for additional long-term structural BMPs.	Reduce bacteria loads by an additional 8.8% (total 11.8%) through additional participation in the public private partnership program (5.5%) and reduction through BMPs required through redevelopment (3.3 %); Continue planning & permitting for long-term structural BMPs.	Reduce bacteria loads by 12.9% (total 24.7%) from constructed distributed and regional structural BMPs (10.6%), and participation in the public private partnership program (2.3%).

a. Request moving Interim TMDL Compliance Date from April 4, 2021 (per Attachment E, 6.c(1)) to April 4, 2028 to allow adequate time to monitor progress through the adaptive management process of the Plan

b. Progress toward final goals will be monitored and if implemented distributed BMPs are not enough then additional structural BMPs based on quantitative modeling conducted as part of the Plan will be considered. To prepare for this contingency additional design and planning work will be conducted during Permit 2 and are included in the optional jurisdictional strategies of the Chapter 3 Goals, Strategies and Schedule report. The County of San Diego is concerned that a funding source to construct, operate and maintain structural controls is not identified.

c. The County of San Diego is concerned that a long-term funding source is not identified for constructing and maintaining structural BMPs, if structural BMPs are needed to meet compliance.

3.2.3.6 Jurisdictional Goals for Caltrans

Caltrans storm water flows are not included in the Municipal Stormwater Permit; however, Caltrans is subject to similar requirements through its own stormwater permit (State Board, 2012b). Caltrans has voluntarily contributed to the Plan effort to provide a consistent and subwatershed-wide approach to meeting applicable TMDL requirements. The baseline strategies are continuously implemented and augmented as resources become available. Attachment IV to the Caltrans Stormwater Permit outlines a methodology for prioritizing stream segments included in TMDLs to which Caltrans is subject. The Permit establishes BMP implementation requirements, evaluated in terms of compliance units. Caltrans is expected to achieve 1,650 compliance units per year through the implementation of retrofit BMPs, cooperative implementation, and post-construction treatment beyond Permit requirements.

Impaired reaches throughout the state will be prioritized on the basis of several factors, including, but not limited to, percent reduction needed, Caltrans drainage area contributing to the reach, and proximity to receiving waters. Reaches with metals TMDLs will likely be prioritized. This prioritization list is currently under negotiation between Caltrans Head Quarter and State Board.

Caltrans' jurisdiction areas include roadways, land adjacent to roadways, and facilities. Caltrans' jurisdictional strategies specifically focus on BMP implementation to reduce known pollutants within these areas. Caltrans' strategies vary from those of other Participating Agencies (in both type and name) to best address freeway characterization discharges from its right-of-way. Strategies include programs developed by Caltrans Headquarters for statewide execution and District 11 implementation. Caltrans' implementation of strategies with the watershed is dependent on legislative approval. For Bacteria TMDLs, Caltrans is expected to eliminate dry weather flows by implementing control measures to ensure effective prohibition (Provision B.2 of the Stormwater Permit). For wet weather flows, Caltrans is expected to implement control measures or BMPs to prevent discharge of bacteria from the right-of-way; this can be source control and preemptive activities such as street sweeping, cleanup of illegal dumping, and public education on littering. Implementation of these controls is per the TMDL prioritization list currently under development.

3.1.4 *SCHEDULE FOR COMPLIANCE WITH INTERIM AND FINAL GOALS*

The proposed schedule below reflects the time necessary to implement the proposed strategies outlined in **Section 3.2** and detailed in **Appendices 3D, 3E,** and **3F**. Since there is an opportunity in 2016 to update the bacteria TMDL based on sound scientific studies, which may modify the current targets, the Participating Agencies propose an alternative schedule for interim TMDL compliance dates. The proposed schedule for achievement of final Bacteria TMDL (and the final jurisdictional goals) is consistent with final compliance schedules contained in the Permit. The proposed schedule for the interim and final goals is provided in **Table 3-14.**

Table 3-14. Proposed Compliance Dates for Goals

Condition	Compliance Date
Interim Dry weather	April 4, 2020 [a]
Final Dry weather	April 4, 2021
Interim Wet weather	April 4, 2028 [a]
Final Wet weather	April 4, 2031

[a] The interim schedules presented in the Permit are April 4, 2017 for dry weather and April 4, 2021 for wet weather; as allowed by the Permit, the Participating Agencies propose an alternative schedule for interim TMDL compliance dates.

As stated above, the Participating Agencies propose an alternative schedule for interim TMDL compliance dates. Key considerations to support moving the Dry Weather Bacteria Interim Goal from 2017 to 2020 include:

- Allow time to ramp up efforts and leverage strategies to comply with the Permit requirement to effectively prohibit discharge of dry weather flows from the storm drain outfalls to waterbodies; and
- Allow time to investigate the sources of discharges to the storm drain system that may include the following activities:
    - Ramp up efforts to address spray from over-irrigation and leverage efforts with the water conservation message from the water districts in response to the current drought conditions; and
    - Prioritize discharges from storm drain outfalls using, for example, visual observation, genetic test results, closed circuit television, or other methods, and characterize the source(s) of persistent dry weather flows.

Key considerations to support moving wet weather interim goal from 2021 to 2028 include:

- Allow time to build on the successes of the nonstructural approaches such as education and outreach to the public to pick up pet waste, increased usage of downspout disconnects and rain barrels, increased use of swales and other bioretention devices to treat rainfall close to the source.
- Allow time for the current processes on potential updates to the Bacteria TMDL from stakeholder studies and a statewide update to the bacteria standards to evolve as these efforts could affect the number and/or sizing of structural controls:
  - The Copermittees have the opportunity to revisit the Bacteria TMDL in 2016 and are in the process of conducting studies to provide the scientific basis for proposed changes to the Bacteria TMDL.
  - The State Board is conducting an effort to update the California bacterial standards for recreational activities to consider the United States Environmental Protection Agency's 2012 Recommended Recreational Guidelines. The scheduled adoption date is 2016.
- Assuming approximately seven years is required for a structural BMP to go from the planning phase through to construction, and if project planning began in 2017, the first complete structural BMP could be installed by 2024, if needed, to meet interim compliance goals. This exceeds the current interim deadline of 2021. Additional time is required to demonstrate the effectiveness of structural BMPs and to leverage lessons learned to cost effectively plan an implementation schedule for additional structural BMPs. For jurisdictions in multiple watersheds, an interim compliance date of 2028 provides the flexibility in having a staggered phasing plan for different watersheds.
- The County of San Diego is concerned that a long term funding source has not been identified to for the construction and ongoing operation and maintenance of the structural BMPS. An interim compliance date of 2028 allows additional time needed to pursue a long term funding source.

The goals will be achieved through implementation of the strategies summarized in **Section 3.2** and further detailed in **Appendices 3D, 3E,** and **3F**. The strategies are designed to attain the required and jurisdictional goals for the watershed and would be implemented at the jurisdictional scale.

3.2 WATER QUALITY IMPROVEMENT STRATEGIES

Multi-benefit Approach

Strategies were selected based on their ability to address multiple pollutants in addition to bacteria, and their potential to provide other benefits such as habitat, water resources, aesthetic, air quality, downstream stream integrity, and flood/drainage benefits.

Once the goals have been set, the Participating Agencies must develop strategies to meet the goals. As with the goals, each jurisdiction has developed its own strategies that will be implemented to work toward its goals. The Participating Agencies have also developed optional watershed strategies that, if needed, would be implemented through coordination amongst the Participating Agencies. The jurisdictional strategies for each participating agency are presented in the tables in **Appendix 3B**.

3.2.1 *DESCRIPTION OF STRATEGIES*

The Permit establishes that strategies should be identified based on their likelihood to "effectively prohibit non-stormwater discharges to the stormwater conveyance system, reduce pollutants in storm water discharges from the stormwater conveyance system to the maximum extent practicable, protect the beneficial uses of receiving water from storm drain discharges, and/or achieve the interim and final numeric goals identified under Provision B.3.a" (B.3.b).

Water quality improvement strategies selected for this Plan may be categorized as either non-structural, or structural BMPs (including both distributed and regional green BMPs). Non-structural BMPs can be municipal programmatic or regulatory measures, public education and outreach, financial incentives, or other management programs designed to effect behavioral changes. Distributed structural green BMPs include

Green BMPs (or Green Infrastructure) are defined as distributed or centralized/regional stormwater control measures that utilize natural treatment processes that emphasize infiltration, capture and use, and biofiltration, thereby addressing nearly all pollutants. Green BMPs may provide flood/drainage, habitat, water resources, aesthetic, air quality, and downstream stream integrity benefits. Typical types of Green BMPs include, but are not limited to bioretention and biofilters, green streets, rain gardens, infiltration trenches and swales, pocket parks and wetland systems.

features such as rainwater harvesting and Low Impact Development-type solutions. Regional structural BMPs include large-scale bioretention systems and treatment wetlands. Water quality improvement strategies, including non-structural and structural approaches, are identified in Appendix 3A.

The overall strategy of the Plan is to pursue aggressive non-structural BMPs as the initial method for achieving wet weather load reduction goals. Non-structural BMPs will also be utilized as the initial method for achieving dry weather load reduction goals. Distributed structural BMPs would be implemented as needed by the individual Participating Agencies. Determination of need will be based on modeling, the adaptive management process, and using the Report of Waste Discharge assessment process. As with distributed structural BMPs, regional structural BMPs will be implemented as needed and as funding is available by the individual Participating Agencies. Dry weather load reductions associated with the dry weather compliance goals are further discussed in **Appendix 3F**. Wet weather load reductions will be achieved through implementation of both non-structural and structural BMPs.

Within this larger framework, criteria for strategy selection include:

- BMP effectiveness for reduction of bacteria and priority water quality conditions;
- Potential for multiple benefits, including but not limited to habitat, recreation, economic, and water resources benefits; and
- The degree to which the strategy is sustainable, implementable, and cost-effective.

The following subsections describe the specific strategies that are being proposed for implementation.

3.2.1.1 Nonstructural Strategies and Pollutant Reduction

Nonstructural strategies reduce pollutant loading to the storm drain system by reducing pollutant generation at the source and/or by reducing mobilization of pollutants to the storm drain system, and ultimately to receiving waters or directly to receiving waters.

Irrigation runoff is a source of dry weather pollutant loading to the storm drain system – it picks up pollutants from the land it runs over and delivers them to the storm drain system, and adds water that supports bacteria growth in the storm drain system. Reducing irrigation runoff reduces pollutant delivery to the storm drain system and reduces bacteria regrowth in the storm drain system during dry weather conditions. Examples of nonstructural strategies to reduce irrigation runoff include outreach and education, and focused residential inspections.

Pet waste is a source of wet weather pollution that contains pathogens, such as bacteria, parasites and viruses. When pet waste is left on lawns, trails and sidewalks, stormwater picks up fragments as it flows to the storm drain system, or directly to a receiving water. Examples of strategies to reduce pet waste (and thereby reduce bacteria loading to the storm drain system and receiving waters) include installation of pet waste dispensers along trails, posting signs for trail, park and beach goers, pet waste management, and outreach.

3.2.1.2 Structural Strategies and Pollutant Reduction

During dry weather, pollutants from typical residential, recreational, civic, commercial and industrial activities can settle and accumulate on impervious surfaces (e.g., roofs, sidewalks, roads). Then, when it rains, these pollutants are mobilized and carried to the storm drain system and receiving waters. Structural strategies reduce pollutant loading to the storm drain system through reducing pollutants from stormwater before it enters the system or reducing the volume of stormwater delivered to the system. These structural strategies can be located strategically in the watershed to improve water quality by removing pollutants through different chemical, physical and biological processes.

Rain barrels are an example of small-scale structural strategies that collect the first flush of stormwater from rooftops and store it for later use on a pervious surface (e.g., flowerbeds, other planted areas) to keep a portion of accumulated pollutants from entering the storm drain system. Once discharged to the pervious surface, the captured rainwater infiltrates into the ground reducing the delivery of organics, sediment, pesticides, nutrients oil, and other pollutants to the storm drain system and receiving waters. An example strategy to promote rain barrel installations is a Public-Private Partnership program that offers incentives for connecting downspouts to rain barrels (i.e., disconnect downspout from direct discharge to storm drain system and install rain barrel to capture flow from downspout).

Infiltration trenches and basins are larger structural strategies that serve to capture and infiltrate stormwater from an impervious area or areas, from the size of a parking lot to a neighborhood, or an even larger area. Infiltration trenches and basins can be rock lined or earthen depressions that are designed to maximize infiltration, earthen varieties are often vegetated. They temporarily hold stormwater runoff to allow water to infiltrate into the underlying soil, evaporate into the atmosphere or be transpired by vegetation; these processes reduce pollutant loading to the storm drain system and receiving waters. These structures are designed to accommodate overflow and bypass during large storm events that exceed the structure's capacity. An example infiltration trench is constructions of a rock lined trench to collects stormwater from an adjacent parking lot to allow the water to infiltrate into subsurface soils.

3.2.1.3 Strategy Summary

The strategies described in this section are summarized in **Table 3-15** below. These strategies build upon the robust jurisdictional programs implemented to comply with previous and current Permits and the comprehensive load reduction plan developed to comply with the bacteria TMDLs in the watershed.

Table 3-15. Strategies Identified to address Bacteria in the San Diego River Watershed

Existing Baseline Strategies[a]	Nonstructural Strategies[b]	Structural Strategies[c]
• Development and Redevelopment Planning • Construction Management and Inspections • Existing Development Management • Illicit Discharge Detection and Elimination • Education of Municipal, Industrial, Commercial, and Residential audiences • Public Outreach and Participation • Stormwater conveyance cleaning • Street sweeping • Commercial/Industrial inspections • Municipal audits	• Identification and control of sewage discharge to the stormwater conveyance system • Pet waste programs • Trash cleanups • Onsite wastewater treatment source reduction • Commercial/industrial good housekeeping • Irrigation runoff reduction and good landscaping practices • Animal facilities management • Erosion Monitoring and Repair • Street and median sweeping • Stormwater conveyance system cleaning • Education and Outreach • Homelessness waste management • Property Based Inspections and Enforcement	• Infiltration BMPs (e.g., basins, bioretention, permeable pavement) • Rainwater harvesting • Biofiltration BMPs • Green Streets • Infrastructure improvements • Pretreatment BMPs • Strategic retrofits in areas of existing development; • Water course rehabilitation (e.g., stream restoration/ enhancements) • Advanced treatment and proprietary devices • Potential Public Private Partnership Program • Redevelopment and LID implementation

[a] Existing Jurisdictional Programs
[b] Potential shifts of current resources and/or enhance Existing Jurisdictional Programs to focus on areas/activities identified to be most effective at targeting reductions in bacteria
[c] The identification of potential improvement strategies is intended to create a list of activities that may or may not be implemented by each Participating Agency; and at this stage no commitment is made with regard to each strategy. The County of San Diego has concerns as funding sources for implementation of structural BMPs have not been identified. By reason of constraints in California law and the California constitution, Caltrans funds are subject to legislative appropriation and availability of funds.

3.2.2 *Jurisdictional Strategies*

The Participating Agencies have identified jurisdictional strategies that will be implemented as part of their Jurisdictional Runoff Management Programs (JRMP) that are designed to effectively prohibit non-stormwater discharges to the stormwater conveyance system, reduce pollutants in stormwater, and protect beneficial uses of receiving waters. Achievement of these outcomes will ultimately be measured against the interim and final numeric goals as discussed in **Section 3.1**. The jurisdictional strategies are detailed further in **Appendix 3B**.

The jurisdictional strategies can be categorized into three types:

- Strategies building on the required JRMP elements in Provision E of the Permit. These include the JRMP requirements as well as modifications and enhancements within the program elements to provide a more focused approach specifically addressing bacteria;
- Optional jurisdictional strategies that may be implemented to achieve the interim and final goals; and
- Coordinated strategies involving cooperation between multiple agencies working towards the common goals within the watershed.

3.2.2.1 Jurisdictional Runoff Management Plan (JRMP) Approach

Under the Permit, four primary jurisdictional programs are required to be included in each participating agency's JRMP. Each program is required to have its own inventory of sources. The four primary programs are:

- Illicit Discharge Detection and Elimination (stormwater outfall inventory) [D.2];
- Development Planning (Priority Development Project and BMP inventory) [E.3];
- Construction Management (Construction site inventory) [E.4]; and
- Existing Development Management (Industrial, Commercial, Municipal, Residential inventories) [E.5].

The Participating Agencies have identified known and suspected sources contributing to bacteria loading and BMPs to address the sources of bacteria in **Chapter 2**. These known and suspected sources include storm drain outfalls with persistent (non-stormwater or dry weather) flow and certain land use activities. The number of outfalls in each participating agency's jurisdiction with persistent flow is included in **Table 3-16**. The numbers of pollutant generating facilities, areas, and activities associated with the construction and existing development inventories for each jurisdiction are presented in **Table 3-17**.

Table 3-16. Number of Copermittee Stormwater Outfalls with Persistent Non-Stormwater Flow

Jurisdiction	Persistent Outfalls[a]
City of El Cajon	3
City of La Mesa	8
City of Santee	13
City of San Diego	86
County of San Diego	9

[a] Persistent flow is defined in the Permit as: "the presence of flowing, pooled, or ponded water more than 72 hours after a measureable rainfall event of 0.1 inch or greater during three consecutive monitoring and/or inspection events. All other flowing, pooled, or ponded water is considered transient."

Table 3-17. Pollutant Generating Facilities, Areas, and/or Activities

<table>
<tr><th>Land Use</th><th>County of San Diego</th><th>City of San Diego</th><th>City of Santee</th><th>City of La Mesa</th><th>City of El Cajon</th></tr>
<tr><td>Construction Sites</td><td>288</td><td>247</td><td>14</td><td>28</td><td>12</td></tr>
<tr><td>Commercial Sites</td><td>493</td><td rowspan="2">3,703</td><td>540</td><td>342</td><td>700</td></tr>
<tr><td>Industrial Sites</td><td>79</td><td>N/A</td><td>17</td><td>104</td></tr>
<tr><td>Municipal Sites</td><td>40</td><td>57</td><td>17</td><td>49</td><td>34</td></tr>
<tr><td>Parks/Recreational Areas</td><td>25</td><td>67</td><td>279 acres</td><td>--</td><td>78 acres</td></tr>
</table>

Nonstructural BMPs that will be implemented to address bacteria include those required by Provision E of the Permit. Some of these programs are new, required under the most recent Permit, while others are existing programs that have been implemented by the participating agencies for many years. Additional strategies and BMPs have been developed to complement the existing Permit requirements for JRMPs. The Participating Agencies have also included suggestions received by the public at workshops.

The following subsections and tables describe the potential sources of bacteria and the strategies and BMPs that the Participating Agencies will employ through their JRMP to address bacteria and other pollutants and associated sources within the watershed. Each jurisdiction will take specific actions to implement the strategies. These actions, included in **Appendix 3B**, provide a bridge from the planning level strategies developed in the Plan to each jurisdiction's JRMP. For a full description of the non-structural BMPs, including specific policies and procedures, the reader is referred to the JRMP documents for each jurisdiction that were concurrently being developed with this Plan.

Caltrans' jurisdiction areas include roadways, land adjacent to roadways, and facilities; Caltrans' jurisdictional strategies specifically focus on BMP implementation to reduce known pollutants within these areas. Caltrans is not a party to the Permit; however, Caltrans is subject to TMDL requirements through its statewide Permit (SWRCB, 2013). Caltrans' strategies vary from those of other Participating Agencies (in both type and name) to best address typical discharges from its jurisdictional areas. Strategies include programs being implemented by both Caltrans Headquarters for statewide execution and District 11 for local implementation; implementation of these strategies within the watershed is dependent on state funding. Caltrans has voluntarily contributed to the Plan effort to provide a consistent approach to meeting applicable Draft Sediment TMDL and Bacteria TMDL requirements. The strategies developed will be implemented as resources are available.

For Bacteria TMDLs, Caltrans is expected to eliminate dry weather flows by implementing control measures to ensure effective prohibition (Provision B.2 of the Permit). For wet weather flows, Caltrans is expected to implement control measures/BMPs to prevent discharge of bacteria from its ROW; this can be source control and preemptive activities such as street sweeping, clean-up of illegal dumping and public education on littering. Implementation of these controls is per their

TMDL prioritization list. For more information related to the Caltrans stormwater program, the reader should refer to their Stormwater Management Plan (July 2012).

3.2.2.2 Illicit Discharge Detection and Elimination

Strategies to address bacteria loading developed by the Participating Agencies related to the Illicit Discharge Detection and Elimination (IDDE) Program are described in **Table 3-18**. While the focus is on bacteria, these strategies address multiple pollutant sources and constituents. For each strategy, the table identifies the agencies that will implement associated programs and what sources and pollutants will be addressed. Details on the jurisdictional programs that the agencies will implement to support these watershed strategies, including the schedules for implementation and the frequencies in which these programs will be implemented, are included in **Appendix 3B**.

Table 3-18. Jurisdictional Strategies Related to the Illicit Discharge Detection and Elimination Program

San Diego River Watershed Illicit Discharge Detection and Elimination Program Strategies	Agency						Pollutant Sources					Highest Priority Water Quality Condition	Priority Water Quality Conditions			
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans	Residential	Municipal	Commercial	Industrial	Construction	Bacteria	Nutrients	Eutrophic Conditions	Total Dissolved Solids	Index of Biotic Integrity
1. Engage the public, jurisdictional staff, and other agency staff to proactively identify and report illicit discharges.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
2. Develop and implement approaches to address the impacts of septic systems within the watershed.	•	•			•											
3. Develop and implement approaches to address the impacts of homeless activities within the watershed.	•	•										•	•	•		
4. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
5. Implement monitoring programs to provide new information to refine the prioritization of drainage areas.	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•
6. Actively educate public on prohibitions related to illicit discharges and connections.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

3.2.2.3 Development Planning

> **Priority Development Projects (PDPs)** are new development and redevelopment projects that create, add, or replace large areas of impervious surfaces and are subject to stormwater retention and hydromodification requirements, in addition to the source control and treatment control requirements for all projects.

Previous Permits in 2001 and in 2007 designated specific types of new development and redevelopment projects as "priority development projects" or PDPs, requiring specific site design, source control, and structural treatment control BMPs to be implemented for qualifying projects. The 2007 Permit also required certain PDPs to implement controls to mitigate increases in peak flow and volumes of stormwater. With the 2013 Permit, these requirements were further intensified with the new requirement for full on-site retention of the 24-hour 85th percentile storm volume. With limited exceptions, new development and redevelopment projects are required to *retain* stormwater and its associated pollutants (including bacteria) on-site, to reduce the impacts on receiving waters during storm events. In most cases, the post-construction BMPs are also designed to intercept and infiltrate dry weather flows, providing significant pollutant reduction, and often full elimination under ambient conditions.

Projects that meet the following conditions are classified as PDPs:

- Residential development: new development creating 10,000 square feet of impervious surfaces or redevelopment creating/replacing 5,000 square feet or more;
- Commercial developments: new development creating 10,000 square feet of impervious surfaces or redevelopment creating/replacing 5,000 square feet or more;
- Parking lots with 5,000 square feet or more of impervious surface; and
- Streets, roads, highways, and freeways with 5,000 square feet or more of impervious surface.

The implementation of baseline Permit requirements for new development and redevelopment projects will mitigate pollutants (including bacteria and other priority water quality conditions) and ensure that these projects do not cause degraded water quality conditions downstream of the project site.

Participating Agencies will implement Permit requirements, aligned outreach and training programs, and are considering the potential for an alternative compliance program (further discussed in **Section 3.4**). These elements make up the strategies for the Development Planning element of the programs. The strategies developed to implement the Development Planning Program, focusing on bacteria where applicable, are included in **Table 3-19**. The table includes the strategies to be implemented by the Participating Agencies and the sources and pollutants that will be addressed. Details describing the programs that the agencies will implement to support these watershed strategies, including the schedules for implementation and the frequencies that these programs will be implemented, are included in **Appendix 3B**.

Table 3-19. Jurisdictional Strategies Related to the Development Planning Program

San Diego River Watershed Development Planning Program Strategies	Agency						Pollutant Sources					Highest Priority Water Quality Condition	Priority Water Quality Conditions			
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans	Residential	Municipal	Commercial	Industrial	Construction	Bacteria	Nutrients	Eutrophic Conditions	Total Dissolved Solids	Index of Biotic Integrity
1. Provide updated materials, enhanced outreach, and training to convey land development requirements.	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•
2. Develop and implement LID programs to complement standard Permit requirements.	•		•	•			•	•	•	•		•	•	•		
3. Implement a Watershed Management Area Analysis to develop watershed specific requirements for structural BMP implementation and identify a list of candidate projects that could be used as alternative compliance options for Priority Development Projects.	•	•	•	•	•		•	•	•	•		•	•	•	•	•
4. Consider development of an alternative compliance program for Priority Development Projects.	•	•	•	•	•		•	•	•	•		•	•	•	•	•
5. Implement a post construction BMP program for development projects to ensure proper construction and maintenance.	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•
6. Enforce post construction requirements related to new and redevelopment.	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•

3.2.2.4 Construction Management

Based on the evaluations performed in the Long Term Effectiveness Assessment[3], construction sites are unlikely to be a significant source of bacteria loading. However, there are particular sources and/or activities on construction sites that have the potential to general bacteria including vehicle equipment, maintenance, and repair, portable toilets, and waste storage/handling (i.e., trash).

The participating agencies have been implementing construction stormwater programs for several Permit terms. Over this time, agency staff and the construction community have become well trained in construction stormwater management. Additional oversight is required per the State Construction General Permit (Order 2009-0009-DWQ) for sites greater than one acre. With this amount of focus, the limited sources of bacteria related to construction are well addressed via the existing Permit requirements. For this reason, the Participating Agencies will focus on the baseline programs as required under the 2013 Permit.

Table 3-20 summarizes the various strategies developed to implement the Construction Program, focusing on bacteria where possible. The table includes the strategies to be implemented by the Participating Agencies and the sources and pollutants that will be addressed. Details describing the programs that the agencies will implement to support these watershed strategies, including the schedules for implementation and the frequencies in which these programs will be implemented, are included in **Appendix 3B**.

[3] The San Diego Stormwater Copermittees, Urban Runoff Management Programs, "2011 Long-Term Effectiveness Assessment", available on the Project Clean Water website: http://www.projectcleanwater.org/index.php?option=com_content&view=article&id=184%3Along-term-effectiveness-assessment&catid=16&Itemid=91

Table 3-20. Jurisdictional Strategies Related to the Construction Management Program

San Diego River Watershed Construction Management Program Strategies	Agency						Pollutant Sources					Highest Priority Water Quality Condition	Priority Water Quality Conditions			
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans	Residential	Municipal	Commercial	Industrial	Construction	Bacteria	Nutrients	Eutrophic Conditions	Total Dissolved Solids	Index of Biotic Integrity
1. Ensure that minimum BMPs are designated and required for construction projects.	•	•	•	•	•	•					•	•	•	•		
2. Provide enhanced outreach and coordination to convey construction requirements.	•	•	•	•	•	•					•	•	•	•		

3.2.2.5 Existing Development Management

The Existing Development Management Program addresses a variety of sources including commercial/industrial, residential, and municipal areas and activities. The distribution of baseline bacteria loads within the lower watershed by Participating Agency is illustrated in **Figure 3-3**. A majority of the land uses within the lower watershed are regulated under the Existing Development Management Program. For the purposes of the baseline loading analysis, as well as subsequent BMP implementation analyses, land use loads attributable to federal and tribal land ownership are not considered part of the Participating Agencies' load since the Participating Agencies do not have jurisdiction over these lands. Similarly, loading from agricultural land uses is not considered part of the Participating Agencies' load because the TMDL identifies Conditional Waivers of Waste Discharge Requirements as the mechanism to address discharges from controllable non-point sources (SDRWQCB 2010, p. A47). Open space loading is also shown as a separate category here, consistent with the TMDL. However, it should be noted that this general land use category includes parks and other undeveloped areas that are located within the Participating Agencies' jurisdictional areas and that drain to or through the stormwater conveyance system.

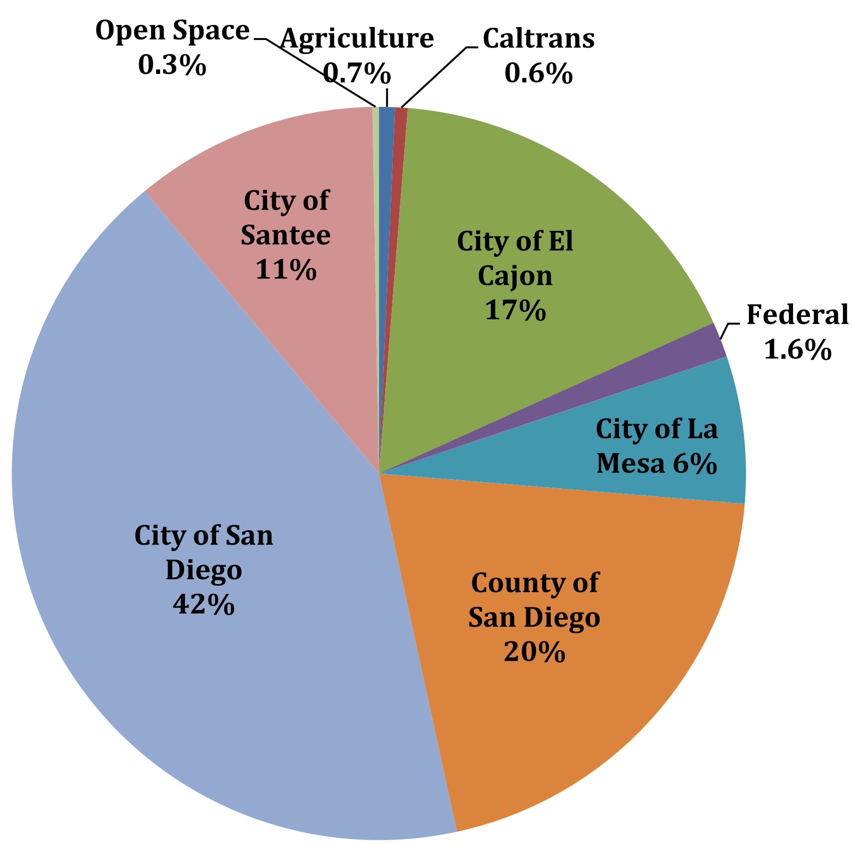


Figure 3-3. Wet Weather Fecal Coliform Modeled Loads in the San Diego River Watershed by Land Use/ Jurisdictional Category, Water Year 2003

Using experience gained through the implementation of the Existing Development Management Program, Participating Agencies identified strategies which will address bacteria within their jurisdictions. These strategies build on existing programs established during previous Permit cycles.

Table 3-21 summarizes the various strategies to be implemented within the Existing Development Management Program to focus on bacteria. The table includes the strategies to be implemented by the Participating Agencies and the sources and pollutants that will be addressed. Details describing the programs that the agencies will implement to support these watershed strategies, including the schedules for implementation and the frequencies that these programs will be implemented, are included in **Appendix 3B.**

Table 3-21. Jurisdictional Strategies Related to the Existing Development Management Program

San Diego River Watershed Existing Development Management Program Strategies	Agency						Pollutant Sources					Highest Priority Water Quality Condition	Priority Water Quality Conditions			
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans	Residential	Municipal	Commercial	Industrial	Construction	Bacteria	Nutrients	Eutrophic Conditions	Total Dissolved Solids	Index of Biotic Integrity
1. Maintain and improve data tracking methods for existing development inventories where necessary.	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•
2. Develop and implement approaches to address the impacts of improper water use and irrigation runoff.	•	•	•	•	•		•	•	•	•		•	•	•	•	
3. Improve and/or continue existing pet waste programs.	•	•	•	•	•		•	•				•	•	•		
4. Improve trash management strategies within the watershed.	•	•	•	•	•	•	•	•	•	•		•				
5. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.	•	•	•	•	•		•	•	•	•		•	•	•		
6. Improve and implement existing outreach programs to target key sources and pollutants.	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•
7. Enhance existing Stormwater maintenance programs.	•			•		•		•	•			•				
8. Develop and implement targeted programs to address issues in residential areas.	•	•	•	•	•		•					•	•	•	•	
9. Improve existing inspection programs to more efficiently target key sources.	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•

San Diego River Watershed Existing Development Management Program Strategies	Agency						Pollutant Sources					Highest Priority Water Quality Condition	Priority Water Quality Conditions			
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans	Residential	Municipal	Commercial	Industrial	Construction	Bacteria	Nutrients	Eutrophic Conditions	Total Dissolved Solids	Index of Biotic Integrity
10. Actively enforce stormwater and urban runoff requirements for existing development.	•	•	•	•	•		•	•	•	•		•	•	•	•	•
11. Identify and facilitate retrofit opportunities in areas of existing development.	•	•	•	•	•	•	•	•	•			•	•	•	•	
12. Perform strategic monitoring to improve understanding of sources and water quality within the watershed.					•		•	•	•	•		•	•	•	•	•
13. Improve coordination between agencies.	•	•	•	•	•		•	•				•	•	•		

3.2.2.6 Optional Jurisdictional Strategies

Optional jurisdictional strategies include those that agencies may implement if specific considerations are met to achieve interim and final numeric goals as defined by the Plan. Implementation of the optional strategies is contingent on circumstances supported by the need for the additional effort, the cost/benefit as compared to other options and strategies, and the availability of funding. Some optional strategies that may be implemented are included in **Table 3-22**.

Table 3-22. Optional Jurisdictional Strategies

Optional Strategy and Program	Participating Agency						Consideration(s) for Implementation	Funding
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans		
Support workgroup to provide sanitation and trash management for persons experiencing homelessness and determine if the program is suitable and appropriate for jurisdictional needs to meet goals. (IDDE)			•	•			The triggers the City must have to participate in this optional strategy include: 1) interim goals are not met, 2) funding to address storm drain discharges is identified and secured, 3) staff resources are identified and secured, 4) partners have been identified and formal MOUs have been developed, and 5) consensus and community support has been achieved.	Funding needs have not been determined at this time.
Identify strategy, resources, and funding to support mapping and assessment of agricultural operations. (Existing Development)				•			Where progress towards interim or final goals is not significant and source investigations indicate that agricultural operations are a source of bacteria causing receiving water exceedances.	Funding needs have not been determined at this time.
Improve database and mapping capabilities for management of existing development. (Existing Development)				•			As funding sources for project are available.	Funding needs have not been determined at this time.
Coordinate with County of San Diego and identify resources and funding to implement a program to target on-site wastewater treatment (septic) systems. May include mapping and risk assessment, inspection, or maintenance practices. (Existing Development)							Where progress towards interim or final goals is not significant and source investigations indicate that on-site wastewater treatment systems are a source of bacteria causing receiving water exceedances.	Funding needs have not been determined at this time.

Optional Strategy and Program	Participating Agency						Consideration(s) for Implementation	Funding
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans		
Conduct an assessment to determine if implementation an urban tree canopy (UTC) program would benefit water quality and other City goals. (Existing Development)			•				This strategy may be triggered as 1) interim goals are not met, 2) funding to address storm drain discharges is identified and secured, 3) staff resources are identified and secured, 4) partners have been identified and formal MOUs have been developed, and 5) consensus and community support has been achieved.	Funding needs have not been determined at this time.
Conduct a feasibility study to test Permeable Friction Course (PFC), porous asphalt that overlays impermeable asphalt. (Development Planning, Existing Development)			•				This strategy may be triggered as 1) interim goals are not met, 2) funding to address storm drain discharges is identified and secured, and 3) staff resources are identified and secured.	Funding needs have not been determined at this time.

Optional Strategy and Program	Participating Agency						Consideration(s) for Implementation	Funding
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans		
As opportunities arise and funding sources are identified, protect areas that are functioning naturally by avoiding impervious development and degradation on unpaved open space areas, creating permanent open space protections on undeveloped city-owned land, and accepting privately-owned undeveloped open areas. (Development Planning, Existing Development)			•				This strategy may be implemented if there is interest in participation by the public or private entity with current control of the land. Conditions to be met also include 1) identification of partners, if needed (public, private, non-profit), 2) identification of costs and potential sources of funding, 3) final agreement by public or private entity with current control of the land, 4) final agreement by all other participating partners, and 5) funding in place.	Variable depending on need.

Optional Strategy and Program	Participating Agency						Consideration(s) for Implementation	Funding
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans		
Conduct a Sustainable Return on Investment (SROI) analysis to estimate strategies' co-benefits and impacts to the public and private sector on a common scale.			•				Perform a feasibility study to determine if implementing an UTC program would be beneficial to the City's goals. UTC intercepts rainfall through increased coverage of leaves, branches, and stems and reduces runoff from the storm drainage system. Benefits associated with enhancing an UTC include reducing heat island effects and air pollution in addition to aesthetics and community benefits. Where feasible, native trees will be utilized to prevent invasive trees from migrating to open spaces and to conserve water. This strategy may be triggered as 1) interim goals are not met, 2) funding to address storm drain discharges is identified and secured, and 3) staff resources are identified and secured.	Funding needs have not been determined at this time.
Create a fund that allows habitat acquisition, protection enhancement, and restoration in conjunction with other cooperating entities including community groups, academic institutions, state county, and federal agencies, etc.			•				This strategy may be triggered as 1) interim goals are not met, 2) funding to address storm drain discharges is identified and secured, 3) staff resources are identified and secured, 4) partners have been identified and formal MOUs have been developed, and 5) consensus and community support has been achieved.	Funding needs have not been determined at this time.

Optional Strategy and Program	Participating Agency						Consideration(s) for Implementation	Funding
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans		
Participate in a watershed council or group if one is established.			•				This strategy may be triggered as 1) partners have been identified and formal MOUs have been developed and 2) consensus and community support has been achieved.	Funding needs have not been determined at this time.
Implement additional trash segregation projects. (Existing Development)			•				Where progress towards interim or final goals is not significant and it is determined that additional strategies will be necessary to meet final goals.	Variable depending on type of project.
Increase collaboration between watershed stakeholders, regulators, managers, and researchers. (Development Planning)	•		•	•	•		Dependent on the results of the Watershed Management Area Analysis, feasibility of implementation, and availability of funding.	Costs are depending on results of WMAA; funding sources have not been identified at this time.
Consider Alternative Compliance Program for Land Development – potential to address retrofits and rehabilitation (Development Planning)	•		•	•	•		Dependent on the results of the Watershed Management Area Analysis, feasibility of implementation, and availability of funding.	Costs have not been quantified but would include costs for program development, administration, and transactions. A source of funding has not been identified.

Optional Strategy and Program	Participating Agency: City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans	Consideration(s) for Implementation	Funding
Consider Green Street Retrofits or other small-scale retention or infiltration controls (Existing Development)	•	•	•	•	•	•	Where progress towards interim or final goals is not significant and watershed analysis indicates the need for distributed BMPs to attain the final goals, green streets will be considered where funding is available.	Project Dependent and contingent on need and adequate funding.
Investigate opportunities for restoration on Forester Creek, Wood Glen Vista Creek, Sycamore Creek, and the Stadium Wetland Mitigation Project				•	•		Where progress towards final goals is not significant and watershed analysis indicates the need for additional structural BMPs to attain the final goals, structural options will be considered where funding is available.	
Consider distributed and/or Regional Structural BMPs (e.g., detention basins, treatment systems)	•	•	•	•	•	•	Where progress towards final goals is not significant and watershed analysis indicates the need for additional structural BMPs to attain the final goals, structural options will be considered where funding is available.	Project Dependent and contingent on need and adequate funding.
Consider dry Weather Flow Diversions	•	•	•	•	•	•	Where progress towards interim or final dry weather goals is not significant and watershed analysis indicates the need for additional BMPs to attain the final goals, dry weather diversions may be considered where funding is available.	Project Dependent and contingent on need and adequate funding.

Optional Strategy and Program	Participating Agency						Consideration(s) for Implementation	Funding
	City of El Cajon	City of La Mesa	City of San Diego	City of Santee	County of San Diego	Caltrans		
Consider retrofit projects in areas of existing development	•	•	•	•	•	•	Dependent on the results of the Watershed Management Area Analysis, feasibility of implementation, and availability of funding.	Project Dependent and contingent on need and adequate funding.
Consider stream, channel, and/or habitat rehabilitation projects	•	•	•	•	•	•	Dependent on the results of the Watershed Management Area Analysis, feasibility of implementation, and availability of funding.	Project Dependent and contingent on need and adequate funding.
Consider groundwater characterization study		•					Where results of stormwater outfall monitoring indicated that groundwater is a contributing source of persistent flows and funding is available.	Project Dependent and contingent on need and adequate funding.
Investigate public-private partnership incentives program to encourage installation of structural BMPs on existing development					•		Dependent on the availability of opportunities for retrofits	Seek grant support and collaborations with non-government and other agencies

The decision to implement one or more optional strategies will be determined though the adaptive management process. As part of the adaptive management process, progress towards interim and final goals will be assessed annually, and once every five years, as part of the Report of Waste Discharge; the Report of Waste Discharge assessment process will consider:

- progress towards interim and final goals,
- implementation status of the strategies and BMPs,
- the appropriateness of the numeric goal(s), and
- the proximity (i.e., timeframe) of the final goal(s).

The Report of Waste Discharge assessment will aid the adaptive management process. Where the assessments indicate that the goals are appropriate and significant progress has not been achieved by the strategies and BMPs implemented, the Participating Agencies will update the watershed analysis with the most recent information available to determine whether the final goal can be met through continued implementation of the Plan as it is. If the results are affirmative, the Participating Agencies will continue implementing as planned. Where significant progress has not been achieved, the final goal has been determined appropriate, and is within the near term (e.g., 5-10 years), the Participating Agencies will move forward to implement select optional strategies based on available funding as necessary to meet the goal. The flexibility of the adaptive management process will allow each jurisdiction to adjust implementation to maximize their ability to achieve the goals.

3.2.2.7 Optional Watershed Strategies

Agencies have identified multiple coordinated efforts to be implemented within the watershed. Several of these are included in the jurisdictional programs supporting the watershed strategies, while others are included as optional strategies. These coordinated efforts are summarized in **Table 3-23**.

Table 3-23. Optional Watershed Strategies

Strategy and Program	Lead Agency	Cooperating Agencies	Optional Strategy	Implementation Timeframe
Increase collaboration between watershed stakeholders, regulators, managers, and researchers	None designated	City of Santee	Yes	To be determined; dependent on outcomes of WMAA
Regional workgroup to provide sanitation and trash management for persons experiencing homelessness and determine if the program is suitable and appropriate for jurisdictional needs to meet goals.	None designated	City of San Diego, City of Santee	Yes	To be determined; dependent on establishment of workgroup.
Coordinate with County of San Diego and identify resources and funding to implement a program to target on-site wastewater treatment (septic) systems. May include mapping and risk assessment, inspection, or maintenance practices.	None designated	County of San Diego	Yes	To be determined; dependent on assessments, investigations, and available funding.

3.2.3 *Quantification of Dry Weather Strategies*

Dry weather load reductions were calculated using a tiered approach to demonstrate reasonable assurance that the strategies will achieve compliance. First, the quantifiable nonstructural BMP load reductions were estimated then the gap between these aggressive source control programs and the TMDL required reduction level was filled using dry weather structural solutions when necessary.

The dry weather load reduction quantification approach involves similar steps for the suite of dry weather nonstructural BMPs (including irrigation runoff reduction and commercial/industrial good housekeeping). The first step was to calculate the load generated by the targeted pollutant source that the BMP will address, by using a percentage of the total Participating Agency pollutant baseline load[4] which was taken from source tracking studies. Once the targeted pollutant source load was calculated, the potential load reduction benefit was calculated using the estimated effectiveness of the selected BMP. These values were based on literature when available, and if not, on best professional judgment. In both cases, predicted levels of uncertainty are high. The following sections provide a brief description of the specific quantification approach for each dry weather nonstructural BMP, along with relevant assumptions and assumption explanations.

Additionally, some dry weather structural controls may also be implemented to achieve the TMDL required reduction levels. Dry weather structural BMPs may include but are not limited to: low flow diversions to sewers, storm drain lining, catch basin dry wells, street gutter permeable pavement, bioretention swales, and regional BMPs.

For the City of San Diego for dry weather, the methodology used in Phase II Comprehensive Load Reduction Plan development to quantify load reductions was applied. Irrigation runoff reduction practices were estimated using quantitative methods. In addition to irrigation runoff, the Phase I Comprehensive Load Reduction Plan identified a number of additional nonstructural BMPs that, although they have the potential for significant pollutant reduction, lack the data necessary for model representation (Geosyntec Consultants, 2012).

With the number of non-modeled, nonstructural BMPs included in the Phase I Comprehensive Load Reduction Plan, some pollutant load reductions are expected. For the purposes of benefit analyses and justification of funding for these BMPs, the collective load reduction for all non-modeled, nonstructural BMPs are assumed to be 10 percent, for both wet and dry conditions across the entire watershed. This assumption represents a conservative estimate that is comparable to the load reductions associated with non-structural BMPs that can be modeled. This assumption will be assessed in the future as BMPs are implemented and focused monitoring studies are performed to attempt to evaluate performance. As the Plan is updated in the future throughout the

[4] The baseline load was assumed to be proportional to the flow (i.e. if x% of the flow was from irrigation runoff than, x% of the load was from irrigation runoff).

implementation period, the modeling system can be updated over time as data become available for quantifying the effectiveness of additional nonstructural BMPs.

Structural solutions implemented by the City of San Diego watershed included centralized and distributed BMPs on public land, green streets, and centralized BMPs on acquired public land (if necessary to meet the required load reduction). Although centralized BMPs on public land and green streets are expected to provide dry weather load reductions, nonstructural BMPs provided 100% load reduction during dry weather so no additional benefits for structural BMPs were quantified.

The City also currently operates five low flow diversion facilities within the watershed. These were included in the baseline model of existing conditions and are therefore not included within the flow and pollutant load estimates for dry weather. Based on review of information on these diversions and communications with City staff, a cumulative diverted flow rate of 2.8 cubic feet per second (cfs) was assumed in the model for these facilities, with individual facility locations and diversion rates represented appropriately.

Dry weather goals are discussed further in **Section 3.2.6**.

3.2.4 *Wet Weather Structural Strategies*

Provision 6.b.(3).(f).(ii) of Attachment E of the Permit references an analysis that utilizes a watershed model or other analytical tools to demonstrate that the implementation of the Plan would meet the established goals. This analysis, which is required for this compliance demonstration, is referred to herein as the BMP benefits quantification. This section describes the methodology used to conduct the BMP benefits quantification. It presents the results of the analysis, which demonstrate that the proposed jurisdictional strategies and watershed strategies meet the goals of the Plan. Not only does this analysis show compliance with the Permit, and it also offers the following:

1) It gives the Participating Agencies a defensible basis for the number, type, size, location, and phasing of the strategies/BMPs identified.
2) It gives the Regional Board confidence in the strategies that the Participating Agencies have proposed (increasing likelihood of Plan acceptance).
3) It is a flexible tool that can accommodate future adaptive management processes – i.e., models can be improved with future monitoring data, and the list of strategies/BMPs can be updated accordingly as a result.
4) If desired, alternative regulatory scenarios can be evaluated using the models – for example, how implementation costs change as a result of a potential TMDL reopener outcome.

The overall approach is to prioritize early implementation of non-structural BMPs. The structural BMP controls are designed to address wet weather flows. As required in the Attachment E of the Permit, the proposed structural BMPs are equivalent to the suite of BMPs proposed in the Comprehensive Load Reduction Plan.

As with other optional strategies, structural BMPs would be implemented as needed and as funding is available by the individual entities, organizations, or Participating Agencies. The Plan does not oblige the Participating agencies to construct the measures but identifies those that may be effective in attenuating pollutant loading to meet final numeric goals.

Outside the City of San Diego, locations for proposed distributed and regional structural BMPs were identified using the U.S. Environmental Protection Agency model SWMM-based, Structural BMP Prioritization and Analysis Tool (SBPAT). The SBPAT was used to prioritize catchments within the watershed based on their potential to generate the highest pollutant loads during wet weather events. This allows identification of locations within the watershed that offer the greatest potential benefits in terms of load reductions through implementation of BMPs. Consistent with the objective of prioritizing strategies with a multi-pollutant benefit, this catchment prioritization analysis was conducted to consider nitrogen and phosphorus in addition to bacteria, the HPWQC.

Within the City of San Diego a similar process was used to identify and prioritize locations for distributed and regional BMPs; however, the City of San Diego used the System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN) during the assessment process.

Appendix 3C provides a detailed description of how the wet weather baseline loads were determined, and Appendix 3E provides a description of wet weather structural BMP load reduction calculations and methods.

3.2.4.1 Implemented Distributed Structural BMPs

Baseline loads included loads from development that occurred between the TMDL year (2003) and 2009, since the Plan baseline load was developed using 2009 land use data. As such, structural BMPs that were implemented between the TMDL year (2003) and 2009 as mitigation to this anticipated development were considered as part of the overall pollutant load reduction to be achieved by Plan implementation. **Appendix 3E** presents a list of these projects and a map with their locations is shown in **Figure 3-4** and the load reductions are summarized in **Table 3-24**.

No credit is given for BMPs to be implemented as mitigation to new development after 2009 as it is assumed that the loads mitigated by the BMPs will offset the additional loads generated by new development (i.e. no net decrease in pollutant load). Refer to Appendix 3C for a discussion of the role of implemented structural BMPs in the baseline load calculations. No credit was taken for implemented projects within City of San Diego jurisdiction as the LSPC model developed for the City implicitly accounts for benefits achieved from the implemented distributed BMPs.

Table 3-24. Estimated Load Reductions from Implemented Distributed BMPs

Distributed BMPs	Bacteria (Fecal Coliform) Load Reduction (% of Average Municipal Land Use Load)
Implemented Distributed Projects[a]	1.1% [0.6 – 1.3%]

[a] Load reductions are for the County of San Diego, and Cities of El Cajon, Santee, and La Mesa.

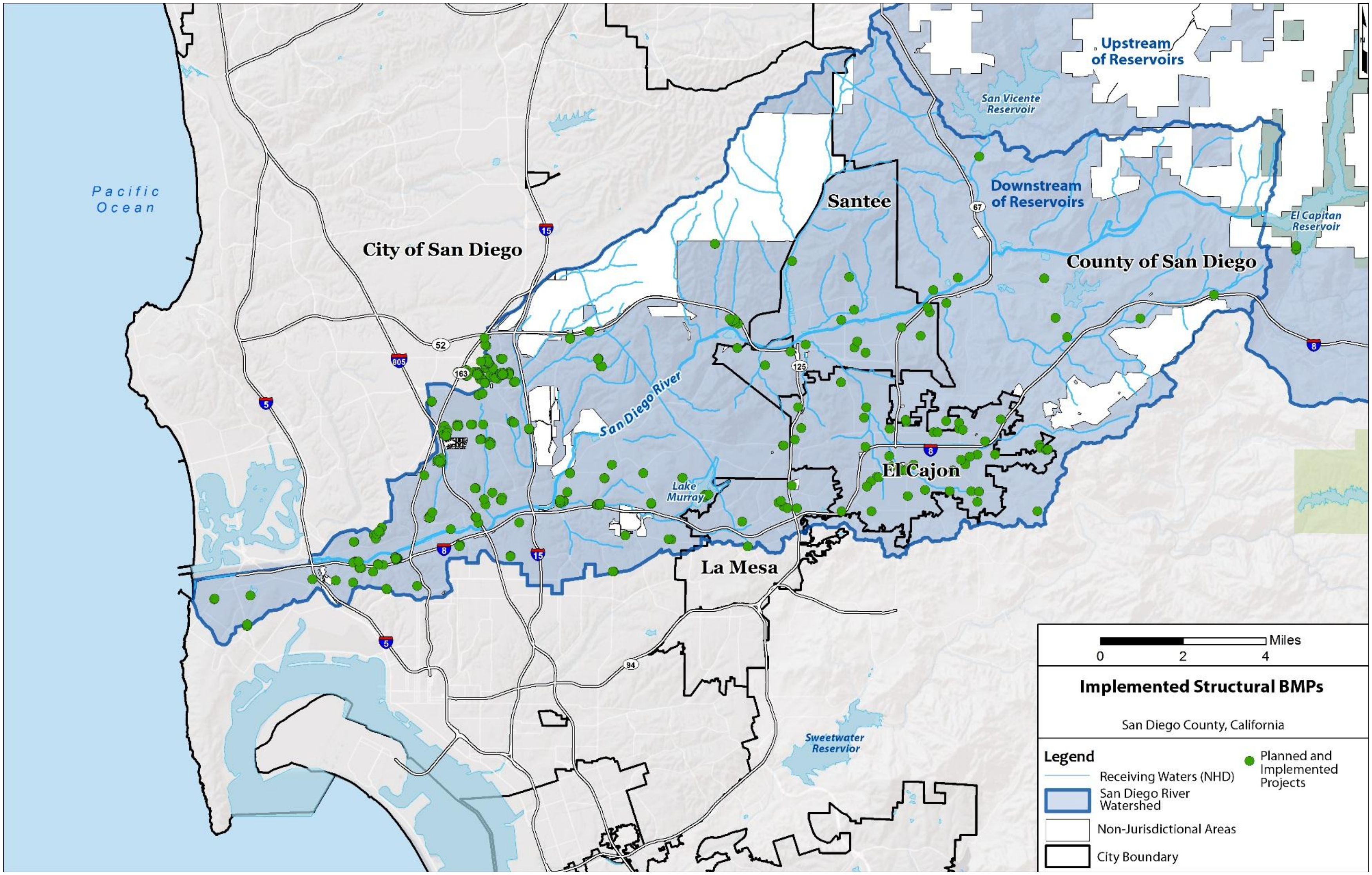


Figure 3-4. San Diego River Watershed Implemented Structural BMPs

3.2.4.2 Proposed Distributed Structural BMPs

Distributed structural BMPs would be implemented as needed by the individual Participating Agencies. Determination of need will be based on modeling and the adaptive management process described above and using the Report of Waste Discharge assessment process.

To determine appropriate locations for distributed structural BMPs, the watershed catchments were analyzed to determine their potential to contribute to pollutant loads, and those with the greatest potential were selected to focus BMP efforts. These focused catchments were further screened for potential distributed BMP opportunities. The catchments where implementation of proposed distributed BMPs would offer the greatest load-reduction are shown in **Figure 3-5**. **Table 3-25** details proposed water quality benefits from proposed distributed structural BMPs and the methodology for selection of BMP types and locations is detailed in **Appendix 3E**.

Table 3-25. Water Quality Benefits from Proposed Distributed Structural BMPs

BMP Type	Bacteria Load Reduction (Fecal Coliform) (% of Average Municipal Land Use Load)
	Average [Low-High]
Potential Public Private Partnership Program [a]	8.5% [1.6% - 15%]
Redevelopment through Permit-Required LID Implementation [a]	4.3% [3.4% - 5.1%]
Implemented Projects [a]	1.1% [0.6% - 1.3%]
Future Projects [a]	8.6% [4.6% - 10%]
Distributed on Public [b]	8.29%
Green Streets [b]	13.28%

[a] Load reductions are for the County of San Diego, and Cities of El Cajon, Santee, and La Mesa.
[b] Load reductions are for the City of San Diego.

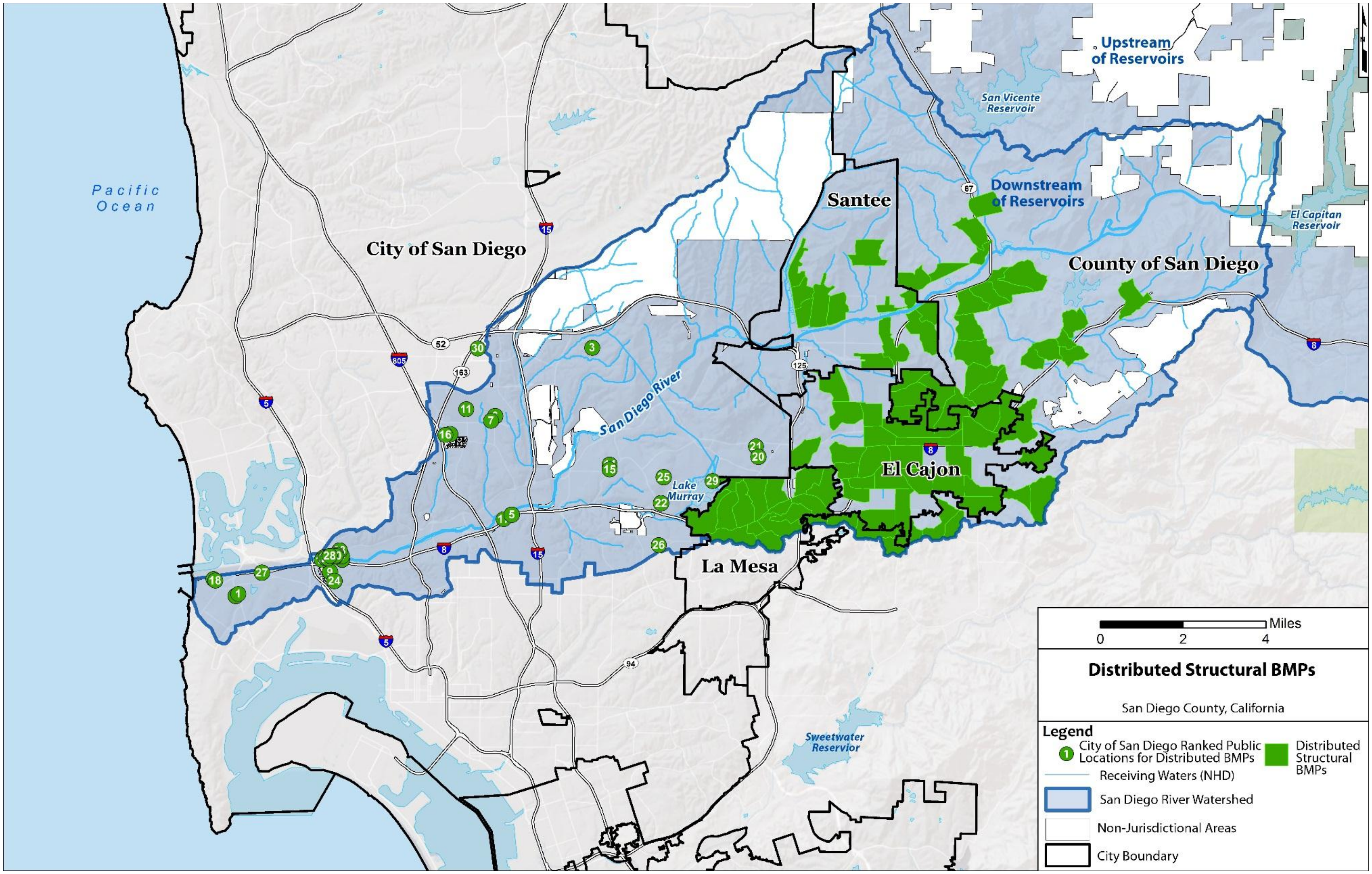


Figure 3-5. Proposed Catchments for Implementation of Distributed Structural BMPs

3.2.4.3 Proposed Regional Structural BMPs

As with distributed structural BMPs, regional structural BMPs would be implemented as needed and as funding is available by the individual Participating Agencies. The determination of need will be based on the adaptive management process and using the Report of Waste Discharge assessment process. The Plan does not oblige the Participating agencies to construct the measures but identifies those that may be effective in attenuating pollutant loading to meet target objectives.

Using SBPAT and LSPC/Sustain, potential locations for regional structural BMPs were determined by identifying catchments located downstream of multiple, hydrologically linked catchments that have high pollutant loads. Within these catchments, appropriate sites were selected and, based on each site's physical characteristics, site specific BMPs were selected. The locations of proposed regional BMPs are shown in **Figure 3-6** and summarized below in **Table 3-26**.

Table 3-26. Estimated Load Reductions from Regional BMPs

Location/Name	Bacteria (Fecal Coliform) Load Reduction (% of Average Municipal Land Use Load)
	WY 2003 [Low - High]
Potential Regional [a]	9.2% [5.3 – 11%]
Centralized on Public [b]	2.76%

[a] Load reductions are for the County of San Diego, and Cities of El Cajon, Santee, and La Mesa.
[b] Load reductions are for the City of San Diego

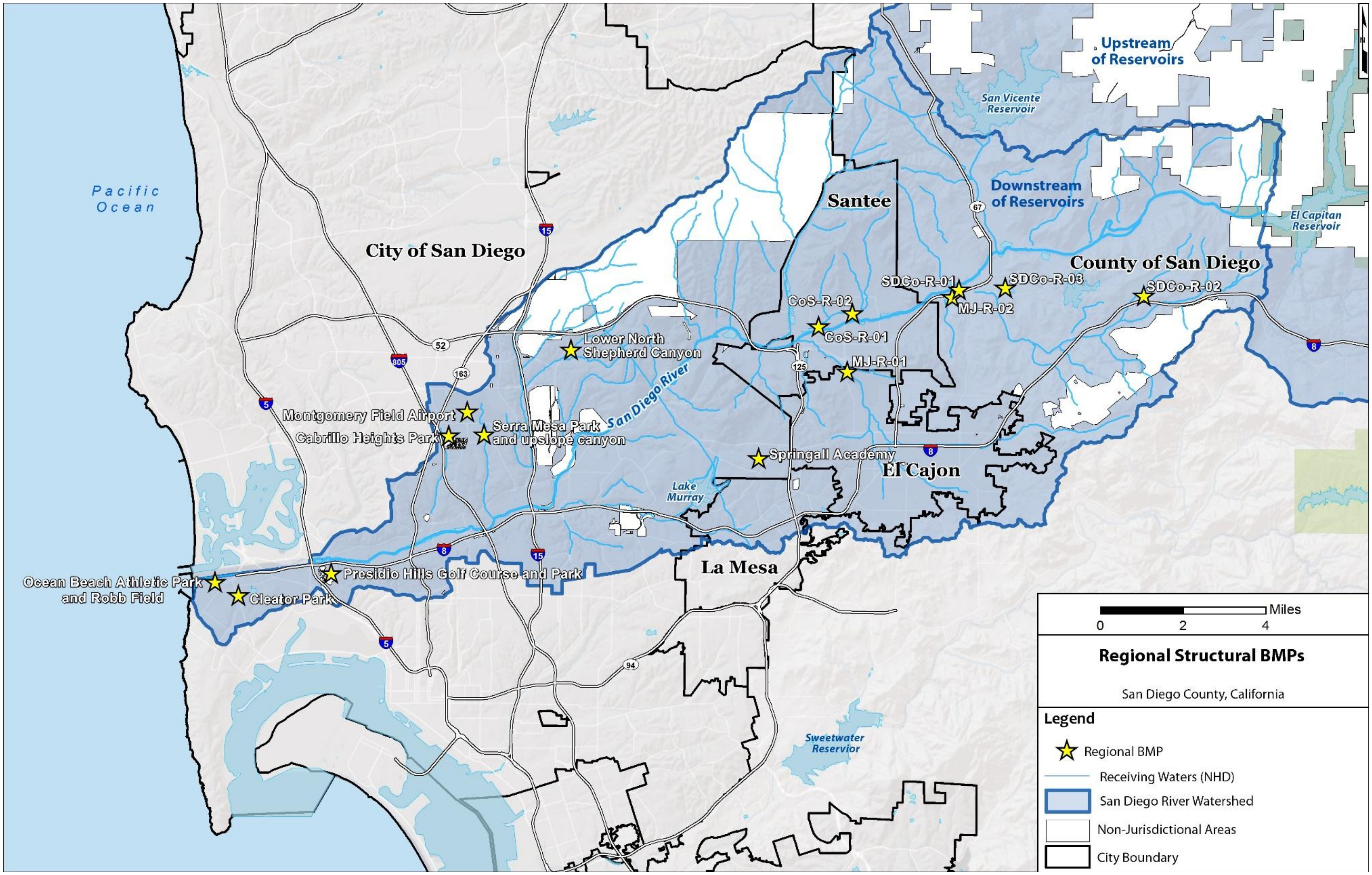


Figure 3-6. Locations of Proposed Regional Structural BMPs

3.2.4.4 Stream Restoration/Enhancement Projects

Stream restoration/enhancement projects that were implemented after 2003 to add or replace impacted habitat with habitat having similar functions of equal or greater ecological value within the watershed were given load reduction credit as these projects treat stormwater that comes in contact with enhanced and/or created vegetation.

Stream Restoration/Enhancement projects include the following:

- Forester Creek
- Woodglen Vista Creek
- Las Colinas Channel (future proposed project)
- Alvarado Channel Restoration (future proposed project)

Locations of stream restoration projects are shown in **Figure 3-7**, load reductions summarized in **Table 3-27**, and discussed further in **Appendix 3E**.

Table 3-27. Estimated Load Reductions from Stream Enhancement/Restoration Projects

Location/Name	Bacteria (Fecal Coliform) Load Reduction (% of Average Municipal Land Use Load)[a]
Forester Creek	55 [13 - 96]
Woodglen Vista Creek	4 [1 - 6]
Las Colinas Channel	2 [0 - 3]
Alvarado Channel Restoration	6 [2 - 11]
Totals	**67** **[16 - 117]**

[a] Load reductions are for the County of San Diego and Cities of El Cajon, Santee, and La Mesa. The City of San Diego is not taking credit for stream enhancement projects at this time.

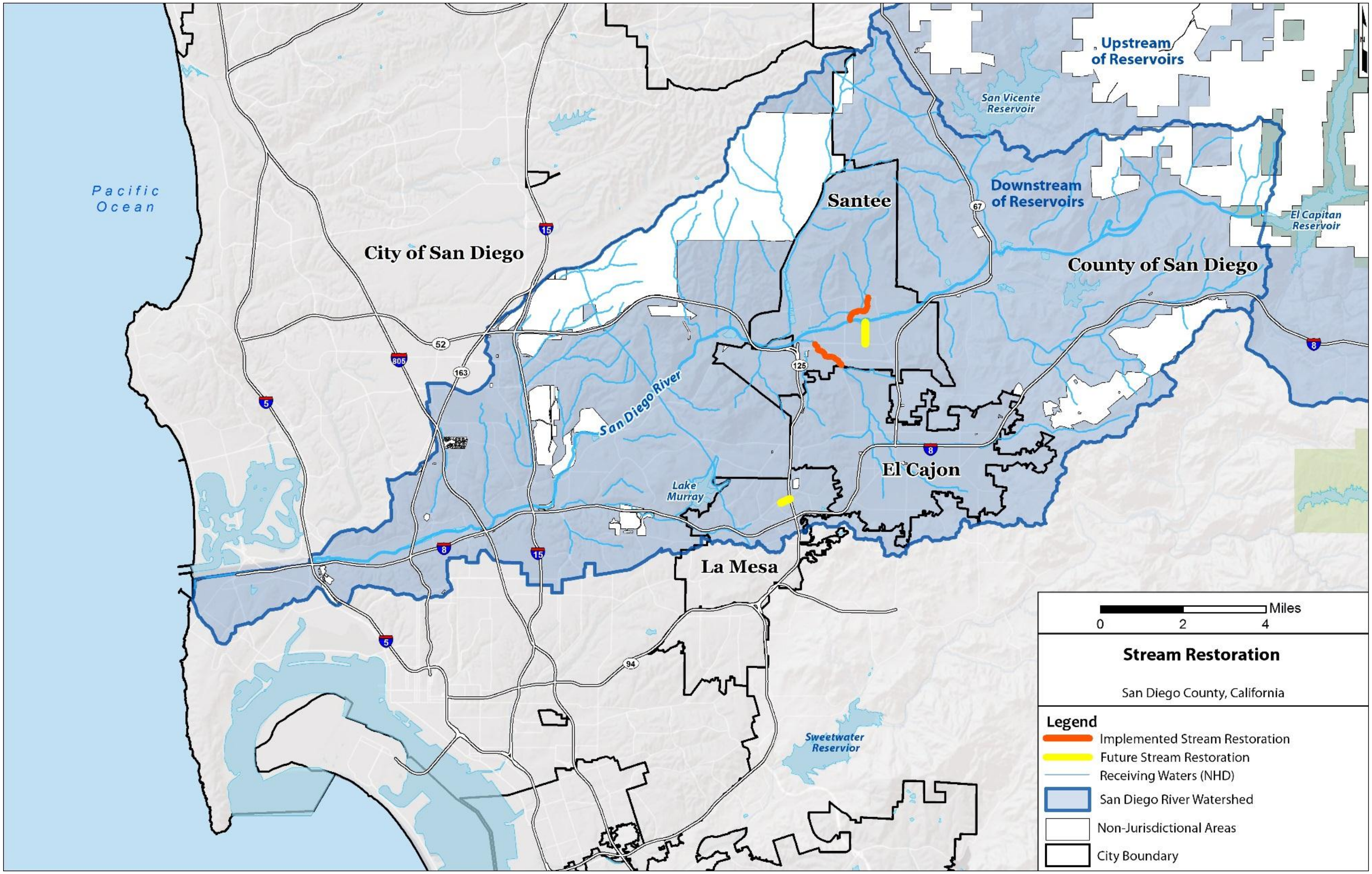


Figure 3-7. Stream Restoration Projects for San Diego River Watershed

3.2.5 *BMP BENEFITS QUANTIFICATION METHODOLOGY*

In order to assess the ability of the proposed jurisdictional strategies (**Section 3.2.2**), watershed strategies (**Section 3.2.2**), and structural strategies (**Section 3.2.4**) to achieve numeric goals, load reductions expected to result from the implementation of these strategies were estimated for wet weather and dry weather. The processes by which load reductions were estimated for wet weather BMPs (public-private partnership programs only), structural wet weather BMPs, and dry weather non-structural and structural BMPS are described in **Appendices 3D, 3E,** and **3F**, respectively.

3.2.5.1 Wet Weather Non-Structural BMPs

A distinction must be made between those with sufficient available data to be modeled (the public-private partnership programs) and those that cannot be modeled due to limited data. The methodology used to quantify the benefits achieved by public-private partnership programs (i.e., LID incentive programs, redevelopment and LID implementation) was as follows:

1) Identify the source(s) addressed by the BMP;
2) Calculate the source(s) area that are addressed by the BMP;
3) Estimate the effectiveness of the BMP at reducing the load generated by the source(s); and
4) Calculate the BMP pollutant load reduction benefit from the information obtained in Step 2 and Step 3.

Due to limited data quantifying their effectiveness, wet weather bacteria load reductions of potential BMPs identified in **Chapter 2** are not as readily modeled, including:

- Identification and control of sewage discharge to Copermittee stormwater systems,
- Trash cleanups,
- Onsite wastewater treatment source reduction,
- Commercial/industrial good housekeeping,
- Pet waste controls,
- Animal facilities management,
- Erosion monitoring and repair, and
- Education and outreach.

To account for the expected pollutant load reduction from these other non-modeled, non-structural BMPs, an additional ten percent reduction is initially included in the quantification. The inclusion of these other non-structural BMPs or programmatic BMPs and their assumed ten percent load reduction could be evaluated and updated throughout the implementation period as pollutant loading and BMP performance data is collected.

The City of San Diego was able to model several non-structural wet weather BMPs using SUSTAIN. The San Diego River Phase II Comprehensive Load Reduction Plan modeled: 1) street sweeping, 2) catch basin cleaning, 3) rain barrels, 4) downspout disconnects, and 5) irrigation runoff reduction. This process is described in **Appendix 3E**.

The quantification of the load reduction for non-structural BMPs currently being implemented by Caltrans followed a similar approach and is included in **Appendix 3E**.

3.2.5.2 Wet Weather Structural BMPs

To identify a program of activities capable of achieving TMDL-required bacteria load reductions, the Participating Agencies used robust computer models with the ability to simulate hydrologic and pollutant loadings and to evaluate various BMP implementation scenarios. The water quality model was used to estimate the bacteria load reductions predicted to achieve compliance under various BMP implementation scenarios.

The Plan identifies a suite of potential non-structural and structural BMPs. The Plan does not oblige the Participating Agencies to construct the measures, but identifies those that may be effective in reducing pollutant loading to reach final numeric goals. BMPs were identified based on their cost and potential effectiveness in reducing pollutant loading in the watershed, with the goal of achieving estimated target load reductions for wet and dry weather. For the proposed structural BMPs, load reductions during wet weather were calculated using SBPAT or SUSTAIN as described in Appendix 3E. In general, design criteria for each selected BMP were first defined considering site constraints (in particular, acreage available for each BMP footprint), BMP performance data, and local regulations. Once a BMP was identified and design criteria defined for each feasible BMP opportunity site, the impact of implementing this suite of BMPs on water quality in the region was evaluated.

> One of the key multiple benefits of these strategies is the removal of nutrients in addition to bacteria.
>
> The predicted wet weather load reductions for nitrate and phosphorus equal 79,100 and 14,200 lbs. /year, respectively.

3.2.5.3 Dry Weather BMP Water Quality Benefit Estimation

Appendix 3F describes dry weather load reduction quantification values, results, assumptions, and methods for the potential nonstructural and structural BMPs. The quantitative assessment of nonstructural BMP (including irrigation runoff reduction and commercial/industrial inspections) dry weather effectiveness follows a similar, but slightly different approach to the assessment of wet weather Public-Private Partnership Programs (see **Section 3.2.5**), including:

1) Identify the source(s) addressed by the non-structural BMP;
2) Calculate the load generated by the source(s) addressed by the non-structural BMP;
3) Estimate the effectiveness of the non-structural BMP at reducing the load generated by the source(s); and
4) Calculate the non-structural BMP pollutant load reduction benefit from the information obtained in Step 2 and Step 3.

Additional dry weather non-structural BMPs that the Participating Agencies may implement include:

- Identification and control of sewage discharge to Participating Agency stormwater systems,
- Water waste/conservation ordinances,
- Car washing runoff ordinances,
- Water conservation outreach and education, and
- Other non-storm water flow reduction strategies as needed.

Furthermore, some dry weather structural controls may also be implemented to achieve the TMDL required fecal coliform reduction levels. These dry weather structural BMPs may include but are not limited to: low flow diversions to sewers, storm drain lining, catch basin dry wells, street gutter permeable pavement, bioretention swales, regional BMPs, etc. **Table 3-28** provides a summary of the dry weather quantification results and corresponding assumptions and references.

Table 3-28. Summary of Dry Weather Quantification Results

Quantification Item	Quantitative Result[a]	Assumptions/References
Average Annual storm drain outfall bacteria dry weather load in the watershed	33.6 x 10^12 MPN/year	The baseline storm drain load was calculate by the model developed for the TMDL
Required bacteria load reduction	69.4% of the baseline stormwater load	Permit Attachment E, Table 6.6
Expected load reduction from quantifiable dry weather nonstructural BMPs (Smart controller and turf grass replacement rebates, and Commercial/industrial site inspections/audit)	8.2 to 38% of the baseline stormwater load	See following sections and Appendix 3F for assumptions and references. Additional benefits are expected from dry weather BMPs that were not quantified and these benefits constitute an additional level of conservatism.
Expected load reduction from all dry weather structural BMPs	31 to 61% of baseline stormwater load	To ensure that the required bacteria load reduction is achieved, structural BMPs may be implemented to this level.
Average stormwater total load reduction	69.4% of the baseline stormwater load	

a. The average annual baseline load and expected load reductions do not include contributions from the City of San Diego.

For the City of San Diego for dry weather, the methodology used in the development of the Phase II Comprehensive Load Reduction Plan to quantify load reductions was applied. Although structural BMPs are expected to provide dry weather load reductions, nonstructural BMPs provided 100% load reduction during dry weather so no additional benefits were quantified in the modeling process.

Table 3-29. Summary of Dry Weather Load Reductions for the City of San Diego

Condition	Non-structural (not modeled)	Non-structural (modeled)	Centralized on Public	Distributed on Public	Green Streets	Centralized on Acquired Private Land	Total[b]
Dry[a] weather	10.0%	90.0%	-	-	-	N/A	**100.%**

[a] Dry weather flow and load reductions reflect only runoff in urban sub-watershed.
[b] The load reduction analysis and scheduling of BMPs was performed for final targets only. Interim targets and associated schedules will be further evaluated through an adaptive process as BMPs are implemented and their effectiveness is assessed.

3.2.5.4 Wet Weather BMP Water Quality Benefit Estimation

Wet weather bacteria load reductions for each BMP type proposed for implementation by 2031 are provided in **Table 3-30**. The table presents the average, low, and high estimates for load reduction – the low and high estimates reflect variability in baseline pollutant loading (based on land uses) and variability in BMP effectiveness, and represent the 25th and 75th percentile of the modeled predictions.

Table 3-30. Summary of Modeled Wet Weather Load Reductions

BMP Category	FC Load Reduction (% of Average Municipal Land Use Load) 2003 WY Load [Low-High Range][a]
Programmatic BMPs	10%[b] [9.2%-11%]
Potential Public Private Partnership Program	8.5% [1.6%-15%]
Redevelopment through Permit-Required LID Implementation	4.3% [3.4% - 5.1%]
Implemented Distributed	1.1% [0.6%-1.3%]
Stream Restoration BMPs	1.4% [0.3% - 2.5%]
Potential Distributed	8.6% [4.6%-10%]
Potential Regional	9.2% [5.3%-11%]
Load Reduction Adjustment	-4.0% [-1.6% - -5.8%]
Load Reduction Sum	39% [24% - 50%]
Target Load Reduction	**34.7%**

[a] Load reductions are for the County of San Diego, and Cities of El Cajon, Santee, and La Mesa.
[b] HDR, 2014.

This analysis is applicable to the County of San Diego, City of El Cajon, City of Santee, City of La Mesa and Caltrans. Load reduction benefits for the City of San Diego were taken from the Phase II Comprehensive Load Reduction Plan and **Table 3-31** provides a summary of those load reductions.

Table 3-31 summarizes load reduction percentages estimated in the Phase II Comprehensive Load Reduction Plan for the suite of BMPs proposed for implementation in the City of San Diego's jurisdiction. As shown in the table, these BMPs are expected to result in a load reduction percentage that meets the TLR percentage. For all jurisdictions except the City of San Diego, a summary of the predicted wet weather load reductions from each BMP type proposed for implementation within the watershed, as well as the variability in potential BMP type performance, is included in Appendix 3E. In addition to the reductions in loading of the HPWQC and nutrients, the proposed strategies are expected to provide a number of other water resource benefits, including mitigation of physical and biological impairments. These benefits are also presented in further detail in Appendices 3E and 3F.

Table 3-31. Summary of Wet Weather Load Reductions for the City of San Diego

Condition	Non-structural (not modeled)	Non-structural (modeled)	Centralized on Public	Distributed on Public	Green Streets	Centralized on Acquired Private Land	Total[a]
Wet weather	10.00%	0.37%	2.76%	8.29%	13.28%	N/A	**34.70%**

[a] The load reduction analysis and scheduling of BMPs was performed for final targets only. Interim targets and associated schedules will be further evaluated through an adaptive process as BMPs are implemented and their effectiveness is assessed.

3.2.6 *Link between Goals and Strategies*

The strategies are generally broad in nature and include suites of programmatic (i.e., non-structural) and structural BMPs that are expected to improve conditions within the watershed. The majority of the strategies selected are multi-benefit in nature, addressing multiple pollutants, beyond bacteria. As an example, a goal may call for reduction of bacteria loads at storm drain outfalls in order to meet the interim, and then the final TMDL requirements. Strategies that could be implemented to achieve this goal may include programs for illicit discharge identification, reporting and enforcement; approaches to address impacts of septic systems and sanitary sewers; designating and requiring BMPs for construction projects; addressing impacts of irrigation runoff; implementing or improving pet waste and trash management programs. Additionally, targeting key issues in residential areas could include homeowner's association collaborations, outreach tasks and materials consisting of mailing lists, door-to-door handouts and promoting water conservation rebates. While each of these example strategies would help reduce multiple pollutants, they would all reduce bacteria loading to the storm water conveyance system and thereby improve conditions within the watershed. **Sections 3.2.3** and **3.2.4** provides quantification of these strategies and compares them to the target load reduction needed to meet Permit requirements.

3.2.7 *City of El Cajon Example Strategies*

The City of El Cajon identified administrative policies, urban development management programs, and innovative pilot projects, and is investing in research for site locations for green infrastructure and other treatment BMPs throughout its jurisdiction in the watershed. Strategies such as education and outreach that target irrigation runoff, rebate and incentive opportunities for rain barrels and downspout disconnection, pilot green infrastructure projects, and multiuse treatment areas are considered across the City's jurisdiction.

The following strategies are examples of those selected by the City of El Cajon and planned for implementation. A complete list of strategies planned for implementation and a description of each strategy is provided in Appendix 3B. The strategies and schedules are subject to change and are contingent upon annual budget approvals and funding availability. They will be modified through the adaptive management process as needed.

Development Planning

The City of El Cajon is currently updating BMP design manual procedures to specify stormwater requirements. Additionally, El Cajon is working on the development and implementation of LID programs involving downspout disconnection, proprietary BMPs, and rainwater harvesting in appropriate areas and for applicable projects. El Cajon is also implementing source control, low-impact development, and on-site structural controls for priority development projects.

Existing Development

The City of El Cajon plans to maintain and update their watershed-based inventory of existing development. El Cajon also has plans for outreach to homeowners associations in a targeted manner. Further targeted outreach by way of printed materials to residential areas is planned, along with focused inspections, to target key sources of pollutants. Strategies will be developed to identify opportunities for retrofit projects along with stream, channel, and habitat rehabilitation projects in areas of existing development. The Forrester Creek Bacteria Management Plan implementation is scheduled for FY15-16.

Public Education and Participation

A key City strategy to enhance watershed stewardship and awareness of water quality is through public education and participation in the City of El Cajon.

3.2.8 *City of La Mesa Example Strategies*

The City of La Mesa identified administrative policies, innovative pilot projects, urban development management programs, and is investing in research for site locations for green infrastructure and other treatment BMPs throughout its jurisdiction in the watershed. Strategies such as education and outreach that target irrigation runoff, rebate and incentive opportunities, pilot green infrastructure projects, and multiuse treatment areas are considered across the City's jurisdiction.

The following strategies are examples of those selected by the City of La Mesa and planned for implementation. A complete list of strategies planned for implementation and a description of each strategy is provided in **Appendix 3B**. The strategies and schedules are subject to change and are contingent upon annual budget approvals and funding availability. They will be modified through the adaptive management process as needed.

Development Planning

The City of La Mesa is currently updating BMP design manual procedures to specify stormwater requirements. Additionally, La Mesa is implementing source control, low-impact development, and on-site structural controls for priority development projects.

Existing Development

The City of La Mesa continues to maintain and update their watershed-based inventory of existing development. La Mesa also coordinates with I Love a Clean San Diego on installation of cigarette ashcans throughout the downtown area to manage trash. La Mesa plans to explore options for coordination with Helix Water District concerning water conservation programs.

Structural Strategies – Green Infrastructure

The City of La Mesa is carrying out a restoration project at Alvarado Creek involving 900 feet of channel restoration to enhance the ecological value of the creek.

Public Education and Participation

A key City strategy to enhance watershed stewardship and awareness of water quality is through public education and participation in the City of La Mesa.

3.2.9 *CITY OF SANTEE EXAMPLE STRATEGIES*

The City of Santee identified administrative policies, urban development management programs, and innovative pilot projects, and is investing in research for site locations for green infrastructure and other treatment BMPs throughout its jurisdiction in the watershed. Strategies such as education and outreach that target irrigation runoff, rebate and incentive opportunities for rain barrels and downspout disconnection, pilot green infrastructure projects, and multiuse treatment areas are considered across the City's jurisdiction.

The following strategies are examples of those selected by the City of Santee and planned for implementation. A complete list of strategies planned for implementation and a description of each strategy is provided in **Appendix 3B**. The strategies and schedules are subject to change and are contingent upon annual budget approvals and funding availability. They will be modified through the adaptive management process as needed.

Development Planning

The City of Santee is currently updating BMP design manual procedures to specify stormwater requirements. Additionally, Santee is also implementing source control, low-impact development, and on-site structural controls for priority development projects.

Existing Development

The City of Santee plans to maintain and update their watershed-based inventory of existing development. Santee also has plans for outreach to homeowners associations in a targeted manner. Santee will coordinate with the Padre Dam Municipal Water District on outreach, enforcement, and incentive programs to address impacts of improper water use and irrigation runoff. The City of Santee plans to develop a demonstration project for drought tolerant and native landscaping, permeable surfaces, and other low-impact development in coordination with the San Diego River Trail Expansion. Santee also has plans for outreach to homeowners associations in a targeted manner. Further targeted outreach by way of printed materials to residential areas is planned, along with focused inspections, to target key sources of pollutants. Strategies will be developed to identify opportunities for retrofit projects in areas of existing development.

Public Education and Participation

A key strategy for the City of Santee to enhance watershed stewardship and awareness of water quality is through public education and participation.

3.2.10 City of San Diego Example Strategies

The City of San Diego has identified administrative policies, urban development management programs, and innovative pilot projects, and is investing in research for site locations for green infrastructure and other treatment BMPs throughout its jurisdiction in multiple watersheds. These water quality improvement strategies are expected to provide the greatest benefits to the watershed and its residents, businesses, and communities within the City's jurisdictional boundaries. Furthermore, the City is currently developing a framework to evaluate other[5] potential additional benefits that the recommended strategies may provide beyond improved water quality. These other benefits may be financial, environmental, or societal. The recommended strategies will be evaluated on the basis of the number of other benefits they may provide, and could guide future updates to the Plan.

The following strategies are examples of those selected by the City of San Diego and planned for implementation. A complete list of strategies planned for implementation and a description of each strategy is provided in **Appendix 3B**. An analysis using a watershed model was conducted to identify the strategies required to be implemented to meet interim and final goals. The strategies and implementation schedules identified in Appendix 3B provide reasonable assurance that numeric goals will be met based on that analysis. The adaptive management process provides the framework to evaluate progress toward meeting the goals and allows for modification of strategies, if necessary. Furthermore, the strategies and schedules are subject to change and are contingent upon annual budget approvals and funding availability. However, if strategies are modified, the analysis will be updated as needed to provide assurance that numeric goals will be met.

These strategies will be implemented by the City of San Diego; they are not intended to be implemented by private entities (e.g., development, business, industry, etc.); however, some of the City's strategies, such as development planning, may have implications for private entities.

The City of San Diego will address discharges of bacteria and other pollutants through activities on public land across its jurisdiction in the watershed. The following example strategies provide multiple benefits by addressing bacteria, and also other water quality pollutants such as trash and sediment.

---

[5] Other benefits refer to outcomes of a strategy beyond water quality improvements. Other benefits can include reduced air pollution, increased water conservation, aesthetics-induced property value increases, and increased business investments.

Development Planning – Development and Implementation of a Green Infrastructure Policy and Program

In FY 2016 the City of San Diego will begin developing a policy that will require the inclusion of green infrastructure features on all suitable City projects, including non-SUSMP projects. This policy will be coordinated with ongoing efforts to update City design manuals and low-impact (LID) design standards for public LID BMPs. The program will begin with research and recommendations for ideal methods for green infrastructure project siting and prioritization within the City. By FY 2018, the City will complete construction of green infrastructure and/or green streets projects as detailed in the corresponding structural strategies.

Existing Development – Enhanced Property-Based Inspection Program

In FY 2016, the City plans to administer, as part of their existing development program, an enhanced property-based inspection program. The enhanced property-based inspection program is intended to increase the number of discharges prevented through property-based inspections and increased minimum BMP implementation. The City conducted an extensive multi-year pilot study of its business inspection program and found that more discharges were discovered and abated by inspecting large properties rather than individual businesses. For example, instead of inspecting one restaurant in a strip-mall, the entire strip-mall would be inspected as one property. Enhanced property-based inspections will be conducted at appropriate frequencies and using appropriate methods such as property- or area-based inspections, as specified in the Permit (Provision E.5). The program will also require implementation of minimum BMPs for existing development (commercial, industrial, municipal, and residential) that are specific to the facility, area types, and pollutant-generating activities (PGAs).

Existing Development – Increased Enforcement

The City intends to enhance enforcement responses by increasing the number of Code Compliance staff. Between FY 2016 and FY 2019, the City is planning to gradually hire additional Code Compliance Officers and support staff to increase compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management, and existing development as detailed in the City's Enforcement Response Plan. This effort will target increased enforcement of irrigation runoff and water-using mobile businesses.

Source Reduction Initiatives

The City of San Diego will continue to implement source reduction initiatives, where feasible. Bans or progressive phase-outs to be considered include pesticides and herbicides on landscapes, leaf blowers, plastic bags, and architectural copper (generally a legacy issue). The City will also consider legislative mandate and cooperative implementation of copper-free brake pads on city-owned vehicles to reduce pollutant deposition.

The City also plans expansion of programs to target irrigation runoff and other dry weather pollutant sources. These strategies primarily target meeting dry weather goals, but may also have wet weather benefits. Because dry weather strategies tend to target the elimination of dry weather flows, they provide load reduction benefits to most water quality pollutants.

Existing Development – Residential and Commercial Rebate Programs Targeting Water Quality

The City plans to continue and expand its landscape-based rebate program to target water quality impacts from residential and commercial areas in FY 2016 and beyond. Expansion of this program may occur by providing for additional rebates and/or distribution of promotional and information material and brochures to community groups, libraries, and recreational centers. Educational material would emphasize watershed stewardship and encourage the implementation of designated BMPs through rebates for rain barrel BMPs in residential areas and grass replacement BMPs, downspout disconnection BMPs, and micro-irrigation BMPs in residential and commercial areas.

Increased Public Education and Participation

The City of San Diego conducts an extensive public education and outreach program through its Think Blue program. Examples include the following:

- The City will continue and expand several of its current outreach programs. Outreach programs would be widely implemented but targeted to HOAs, BOAs, maintenance districts, various community groups through organized community trash cleanup events, and water-using mobile businesses.
- Workshops will be held, community events will be organized, and informational material and brochures will be disbursed to reach community members and advise them of incentives, regulations, and training, and provide general information they need for implementation of good watershed stewardship practices or BMPs.

Cost of Service Study

The City plans to conduct a Cost of Service Study starting in FY 2015. This study will examine the full cost of flood control and storm water strategies needed to comply with storm water regulations for the City of San Diego. The City of San Diego's Watershed Asset Management Plan will be used as the basis for the study.

Alternative BMP Implementation Scenario for Refinement of Water Quality Regulations

The pollutant loads from Non-Phase I MS4s (Non-MS4s) can be differentiated from Phase I MS4s' (MS4s) loads to more accurately and fairly assess load reduction responsibilities within the watershed. Load reduction responsibilities are assigned to responsible dischargers in a TMDL and are enforceable when adopted in a NPDES Permit. The Bacteria TMDL (R9-2010-0001) only assigns load reduction responsibility to the MS4s within the San Diego River watershed, although Non-MS4 areas are present within the watershed and contribute to bacteria loads. It is worth noting that pollutant loads from Non-MS4 areas may discharge directly to a receiving water body or enter a MS4 before ultimately discharging to a receiving water body.

Given these inconsistencies and the lack of clarity on how responsible dischargers are identified in the TMDL, the primary scenario included in this Plan currently does not differentiate between MS4 loads and Non-MS4 loads. To separate Non-MS4 loads from MS4 loads, a preliminary alternative modeling analysis was performed and is presented in this section. The purpose of this analysis is to foster future discussions about accurate and fair apportionment of pollutant reduction responsibilities in the watershed to ensure that Non-MS4 discharges are regulated before they enter a MS4 to improve water quality in the watershed. It is important to note that under the Alternative Scenario the MS4s would continue to implement programs to inspect and provide oversight of industrial discharges and detect illicit discharges.

The first step of the analysis was to update the watershed model to remove areas associated with the following Non-MS4s from within the City of San Diego's jurisdiction: registered industrial permits, Phase II permits, Federal and State lands (and Indian lands, if present), and agricultural lands. Federal/State/Indian lands and agricultural lands were removed because these areas are also subject to separate regulatory requirements. Land areas involving pollutant loading from construction activities and groundwater extraction were not considered because of the limited timeframe associated with construction permits and groundwater extraction impacts were assumed to be negligible. The second step was to optimize the proposed structural strategies in the remaining MS4 areas to achieve the required MS4 load reductions to meet the Water Quality Improvement Plan numeric goals while maintaining cost efficiencies. The methodology for completing the BMP implementation Scenario is included as **Appendix 3I**.

The overall watershed load reduction goal would be met through reductions by both the MS4s and Non-MS4s, thereby maintaining equity among all dischargers. Estimated load reductions were based on the relative loading from each responsible discharger in the watershed.

Table 3-32 summarizes the City's current Plan load reduction requirements (primary scenario) and the alternative scenario results which separate MS4 and Non-MS4 loads. The Alternative Scenario allows cost efficiencies to be achieved while still meeting the watershed's overall load reduction goal. Although the MS4 load reduction difference between the primary and alternative scenarios is small, the total cost savings to the MS4 are significant. This is due to structural BMP optimization within MS4 areas and a greater proportion of the required load reduction would be addressed by nonstructural programs which are less costly. Note that BMP optimization refers to the modeling analysis that was conducted to identify the "optimal" structural BMP opportunities (considering BMP size, type, and location in the watershed) that would achieve the load reduction with the lowest cost. BMP optimization was conducted for both scenarios; however, additional cost savings are provided in the alternative scenario because only MS4 areas are considered. Results of this analysis are shown for the City of San Diego in Table 3-33 as an example.

Table 3-32. Summary of Alternative Scenario Results

Primary Scenario (MS4 + Non-MS4 Areas Combined)		Alternative Scenario (Separate MS4 and Non-MS4 Areas)			
		MS4 Allocation		Non-MS4 Allocation	
Fecal Coliform Load Reduction		Fecal Coliform Load Reduction		Fecal Coliform Load Reduction	
%	10^9 MPN/mL	%	10^9 MPN/mL	%	10^9 MPN/mL
34.7%	543,673	34.7%	501,039	34.7%	42,634

Table 3-33. Example Cost and Load Reduction Summary for the City of San Diego

Cost Comparison between Primary and Alternative Scenario	Primary Scenario (MS4 + Non-MS4 Areas Combined[1]; $Million)	Alternative Scenario (MS4 Only[2]; $Million)	Cost Savings from Primary Scenario ($Million)
	$263.367	$203.265	$60 (22.8%)
MS4 Load Reduction Summary for Alternative Scenario	**MS4 Existing Load for Fecal Coliform (# x 10^9)**	**Load Reduction Target for Fecal Coliform (%)**	**Load Reduction Target for Fecal Coliform (# x 10^9)**
	1,443,915	34.7%	501,039

1. MS4 treats loads from other regulated sources
2. MS4 treats loads within its jurisdiction

The MS4s assert that the Regional Board is ultimately responsible for regulating storm water discharges from Non-MS4s to more accurately and fairly assign pollutant reduction responsibilities in the watershed. The MS4s support this regulatory approach as an effective tool for improving water quality, and are committed to participating in efforts to incorporate non-MS4s into current water quality regulations. To that end, the MS4s will continue to refine and update the alternative scenario analysis, and engage stakeholders in a dialogue about how all the responsible parties within the watershed can work together to achieve the numeric goals in the Plan. For example, the current list of Industrial General Permit (IGP) non-filers could be added to the analysis to more accurately estimate load reduction responsibilities for industrial dischargers within the watershed.

In addition, the Regional Board should work with the MS4s to identify potential updates to TMDLs, the MS4 Permit, and other responsible parties' NPDES permits, as appropriate, to more accurately and fairly assign load responsibilities among all the responsible parties in the watershed. The MS4s will provide the Regional Board with additional analysis and information necessary to facilitate future determinations by the Regional Board on load reduction responsibilities within the watershed. The Plan may be revised in a future update to remove the Non-MS4 loads.

3.2.11 *COUNTY OF SAN DIEGO EXAMPLE STRATEGIES*

The County of San Diego reviewed various implementation approaches, programmatic policies, opportunities for innovative potential projects, and is researching the viability of green infrastructure as well as potential structural and distributed BMPs throughout the unincorporated areas. Much of the County of San Diego's jurisdiction within the watershed consists of unincorporated and predominantly undeveloped land, open space, and low-density residential areas. The jurisdictional strategies reflect the need to address these types of land uses and associated stormwater issues. As such, the County has outlined strategies to enhance current programs, identify prospective opportunities, and develop innovative approaches to stormwater program management.

Strategies including education and outreach that target irrigation runoff, rebate and incentive opportunities, pilot green infrastructure projects, and multiuse treatment areas will be considered across the County's jurisdictional area.

The following strategies represent several examples selected by the County of San Diego. A complete list of strategies and a description of each strategy is provided in **Appendix 3B.** The strategies and schedules are subject to change, and are contingent upon programmatic need and funding availability. They will be modified through the adaptive management process as needed.

Stormwater Discharges – Wet Weather Bacteria Reduction through Implementation of Residential Large Property Pet Waste Management Program

The County currently implements pet waste management in county parks and will continue to do so, with plans to expand the program to an additional focused management area. The County plans to continue targeting parks and other public areas to reduce negative impacts to habitat, wildlife, and water quality.

Stormwater Discharges – Wet Weather Bacteria Reduction through Implementation of Public Education and Participation Programs

An important approach to heighten watershed stewardship and mindfulness of water quality is through public education and participation. The County will continue its public education and participation programs. The County develops, improves, and distributes outreach materials; performs outreach presentations in schools; provides outreach to large residential properties; performs an over-irrigation outreach pilot; and provides educational workshops. The County also plans to implement a Sustainable Landscapes Program and a pilot Homeowners Association Outreach and Coordination project. Furthermore, the County sponsors numerous trash collection events in targeted areas of the watershed.

Stormwater Discharges – Wet Weather Bacteria Reduction through Implementation of Structural and Distributed BMPs

The County of San Diego will continue to investigate opportunities for green infrastructure implementation on public parcels. The County will develop a strategy to identify candidate areas of existing development that are appropriate for retrofit projects. The County plans to evaluate the feasibility of a pilot residential incentive program. The program could encourage rain water use through installation of rain barrels, roof downspouts redirected to landscaped areas, rain gardens & other small scale bioretention/ infiltration BMPs.

The County will continue to consider green infrastructure or small scale structural BMPs to capture dry weather flows as needed.

Residential Programs

The County proposes promoting and encouraging implementation of designated BMPs in residential areas in the near future, including residential irrigation runoff reduction programs. These programs will be developed to address the impacts of improper water use and excessive irrigation runoff. A residential inspections tracking program will also begin by FY16.

3.2.12 *Schedules for Implementing Strategies*

The following sections detail the proposed schedules for phasing in the strategies discussed above. As noted earlier, the overall strategy of the Plan is to pursue aggressive non-structural controls as the primary method for achieving wet weather load reduction goals and the sole method for achieving dry weather load reduction goals. The benefits calculations summarized in **Section 3.2.5** and **Appendices 3E, 3F,** and **3G** support the viability of this strategy.

However, there is uncertainty inherent in some of the parameters used to estimate these load reduction benefits. Therefore, structural control options have also been selected to achieve load reduction goals if necessary. These will be implemented as necessary based on the adaptive management model as discussed in **Chapter 5**.

3.3 Permit Compliance

Load reduction modeling for the structural and non-structural BMPs as detailed in **Appendices 3C – 3F** was performed to provide a reasonable assurance that the load reduction target for the watershed can be achieved through implementation of the Plan.

From Provision 6.b.(3)(f) of the Permit, responsible jurisdictions must:

(i) Incorporate the BMPs required under Provision 6.b.(2)(c)[6] as part of the Water Quality Improvement Plan,

(ii) Include an analysis in the Water Quality Improvement Plan, utilizing a watershed model or other watershed analytical tools, to demonstrate that the implementation of the BMPs

[6] The Water Quality Improvement Plans for the applicable Watershed Management Areas in Table 6.0 must incorporate the Comprehensive Load Reduction Plans required to be developed pursuant to Resolution No. R9-2010-0001.

required under Provision 6.b.(2)(c) achieves compliance with Provisions 6.b.(3)(a), 6.b.(3)(b), 6.b.(3)(c), 6.b.(3)(d), and/or 6.b.(3)(e).

Load reduction modeling for the structural and programmatic (non-structural) BMPs as detailed in **Appendices 3C-3F** was performed to provide a reasonable assurance that the load reduction target for the watershed can be achieved through implementation of the Plan. Table 3-34 summarizes the total quantified benefits for the proposed suite of BMPs relative to the target load reduction for the HPQWC. As shown, the predicted wet weather load reduction is greater than the estimated target load reduction to meet the HPWQC final numeric goal.

Table 3-34. Watershed Load Reduction Summary

Load Reduction Category	Bacteria Load Reduction - Fecal Coliform (% of Load)
Target Load Reduction	34.7%
Predicted Wet Weather Load Reduction[a]	39% [24% - 50%]
Predicted Wet Weather Load Reduction for City of San Diego	34.7%
Watershed Load Reduction	**37%**

[a] Load reductions are for the County of San Diego, and Cities of El Cajon, Santee, and La Mesa

3.4 Optional Watershed Management Area Analysis

The Permit provides an innovative pathway for Participating Agencies to provide offsite alternative compliance options to their land development programs by performing watershed-specific analyses characterizing each watershed. In past Permit cycles, waivers from onsite structural BMPs were possible, but only on a site-by-site basis, without consideration of the overall needs of the watershed. In contrast, the current Permit provides an option for Participating Agencies to promote implementation of controls on a watershed-based scale established by a greater understanding of the watershed needs and priorities, with the intent of greater overall water quality benefit. As indicated in the Southern California Coastal Water Research Project (SCCWRP) report (2012) that forms the basis of this provision, the first step in achieving this goal is "…identification of existing opportunities and constraints in order to prioritize areas of greater concern, areas of restoration potential, infrastructure constraints, and pathways for potential cumulative effects." The Watershed Management Area Analysis (WMAA), as denoted in the Permit, is an optional task intended to characterize important processes and characteristics of each watershed through creation of GIS layers that include the following information:

- A description of dominant hydrologic processes, such as areas where infiltration or overland flow likely dominates;
- A description of existing streams in the watershed, including bed material and composition, and if they are perennial or intermittent;
- Current and anticipated future land uses;
- Potential coarse sediment yield areas; and
- Locations of existing flood control structures and channel structures, such as stream armoring, constrictions, grade control structures, and hydromodification or flood management basins.

The Participating Agencies may use the data generated from the characterization analyses indicated above for two purposes:

1) To identify candidate projects that could potentially be used as offsite alternative compliance options in lieu of satisfying full onsite retention, biofiltration, and hydromodification runoff requirements.
2) To identify and/or prioritize areas where it is appropriate to allow certain exemptions from onsite hydromodification management BMPs.

Understanding that development of a WMAA is on a watershed-by-watershed basis could be time and funding intensive, the Participating Agencies elected to perform the watershed characterization and hydromodification management exemption mapping on a regional scale under a separate but concurrent effort to development of this Plan. The geospatial data and technical documentation from this project has been packaged individually for each watershed, with the WMAA package in **Appendices 3G** and **3H**.

3.4.1 *Candidate Projects*

The Permit allows Participating Agencies to develop a program as part of their overall JRMP that potentially allows development projects to participate in offsite alternative compliance projects that yield greater overall water quality benefit to the watershed. These alternative compliance projects would be implemented in lieu of meeting full onsite pollutant retention and hydromodification management control requirements as is required for all Priority Development Projects. As such, the County of San Diego, the City of San Diego, the City of Santee, and the City of El Cajon have elected to identify a list of potential projects, using the Regional WMAA data, as indicated in the Candidate Project lists that appears in **Appendix 3G**. The effort to identify these projects is described in the associated WMAA data assessment that also appears in Appendix 3H. It should be noted that only the Candidate Project list is provided and the specific provisions and programmatic details of any potential Alternative Compliance programs that may be implemented by individual Participating Agencies is not part of the Plan.

3.4.2 *Hydromodification Management Exemptions*

Hydromodification, which is caused by both altered storm water flow and altered sediment flow regimes, is largely responsible for degradation of creeks, streams, and associated habitats in the San Diego Region. The purpose of the hydromodification management requirements in the Permit is to maintain or restore more natural hydrologic flow regimes to prevent accelerated, unnatural erosion in downstream receiving waters.

In some cases, priority development projects may be exempt from hydromodification management requirements if the project site discharges runoff to receiving waters that are not susceptible to erosion (e.g., a lake, bay, or the Pacific Ocean) either directly or via hardened systems including concrete-lined channels or existing underground storm drain systems.

The March 2011 Final Hydromodification Management Plan (HMP) identified certain exemptions from hydromodification management requirements by presenting "HMP applicability criteria." The Permit maintains some of these HMP applicability criteria. However, some of the applicability criteria are not included under the Permit unless the area or receiving water is mapped in the WMAA. Based on the results of the WMAA, the following exemptions from hydromodification management are proposed for the watershed:

Receiving waters that are **exempt** based on the Permit include:

- The Pacific Ocean
- Lakes and Reservoirs
- Existing underground storm drains or concrete-lined channels draining directly to the ocean

Receiving waters or conveyance systems that are **recommended to be exempt** in the watershed based on studies that were prepared as part of the Regional WMAA includes:

- San Diego River from Pacific Ocean to confluence with San Vicente Creek;
- Forester Creek stabilized reach from the confluence with the San Diego River to Prospect Avenue; and
- Existing underground storm drains or concrete-lined channels discharging directly to the above receiving waters. These systems were identified based on stormwater data provided by the Copermittees via the data call. These systems may not represent all discharges to the above receiving waters. Additional systems may be considered exempt if there is no evidence of erosion at the outfall of the conveyance system, and any other criteria determined by the local jurisdiction.

4 WATER QUALITY IMPROVEMENT PLAN MONITORING AND ASSESSMENT PROGRAM

This chapter of the Plan describes the Monitoring and Assessment Program for the San Diego River Watershed. The Participating Agencies in the watershed have developed an integrated Monitoring and Assessment Program to:

1) Measure the progress toward addressing the Highest Priority Water Quality Condition (HPWQC) established in **Chapter 2**;
2) Assess the progress toward achieving the goals, strategies, and schedules provided in **Chapter 3**; and
3) Evaluate each Participating Agency's overall efforts to implement the Plan.

The Permit supports an outcome-based approach through the Plan. Monitoring data collection and assessment provides the vehicle for determining whether intended outcomes are being realized or if adaptations of Participating Agencies' programs are necessary. Collection and assessment of monitoring data will guide future implementation of the Participating Agencies' management actions as part of the Plan process. Monitoring during wet and dry weather is conducted to collect observational and analytical data from storm drain outfalls and the receiving water. The data are utilized to help Participating Agencies determine whether discharges from storm drain outfalls are influencing receiving water quality, and if so, are storm drain discharges improving or degrading receiving water conditions over time. Participating Agencies assess the data in combination with their management actions to determine what actions are improving the quality of storm drain discharges and receiving water conditions and where additional actions are necessary.

This chapter provides an overview of the two main components: Monitoring and Assessment. As stated in Provision D of the Permit:

> *"The purpose of this provision is for the Participating Agency to monitor and assess the impact on the conditions of receiving waters caused by discharges from the Participating Agency's MS4s under wet weather and dry weather conditions. The goal of the Monitoring and Assessment Program is to inform the Participating Agency about the nexus between the health of receiving waters and the water quality condition of the discharges from their MS4s. This goal will be accomplished through monitoring and assessing the conditions of the receiving waters, discharges from the storm drains, pollutant sources, and/or stressors, and effectiveness of the water quality improvement strategies implemented as part of the Water Quality Improvement Plans."*

Monitoring includes sampling, inspection, and data collection at beaches, creeks, lakes, estuaries, and storm drain outfalls to observe conditions, improve understanding, and inform the management within the watershed to improve water quality conditions.

The Program incorporates monitoring to assess progress toward addressing the HPWQC per requirements of Permit Provision B.4. It also includes the compliance monitoring requirements of Permit Provision D, Illicit Discharge Detection and Elimination (IDDE) requirements of Permit Provision E.2, and Bacteria TMDL monitoring and assessment requirements in Permit Attachment E. Assessment under this program includes annual review of the monitoring data along with a comprehensive analysis of the data at the end of the Permit term.

4.1 WATER QUALITY IMPROVEMENT PLAN MONITORING PROGRAM

The Monitoring Program includes five major components:

1) Monitoring to assess goals and schedules;
2) Receiving water monitoring program that measures the long-term health of the watershed during dry and wet weather conditions;
3) Storm drain outfall monitoring program that investigates the elimination of illicit dry weather flows from storm drain outfalls and the improvement in quality of the discharges from storm drains during wet weather;
4) Special studies that look further into the HPWQC presented in **Chapter 2**, and
5) Complementary Illicit Discharge Detection and Elimination investigations and inspections of potential pollutant sources that are implemented under the Jurisdictional Runoff Management Programs.

Wet Weather is defined as a storm event of >0.1 inch of rainfall and the following 72 hours after the end of rainfall.

Dry Weather is defined as all days where the preceding 72 hours has been without measurable precipitation (>0.1 inch).

An overview of the planned monitoring activities for the watershed is presented in **Table 4-1**. The overview includes monitoring programs, conditions, monitoring elements, and the implementation schedule for each program during this Permit term. In **Chapter 2**, bacteria was identified as the HPWQC for the watershed. As reflected in **Table 4-1,** monitoring is being conducted to characterize bacteria levels in the discharges from storm drain outfalls, identify potential sources of bacteria, and assess the effectiveness of strategies designed to address bacteria. Additionally, these programs will generate data to track priority water quality conditions and general health and conditions within the watershed. This chapter provides an overview of each of the monitoring programs. Where required by the Permit, additional detail is included in the **Appendix 4A** and associated attachments.

Table 4-1. Elements of Water Quality Improvement Plan Monitoring

Monitoring Programs			Condition	Monitoring Element	Permit Schedule [a]				
					2013-2014[b]	2014-2015	2015-2016	2016-2017	2017-2018
Monitoring to Assess Goals and Schedules			Dry and Wet	Varies by goal and jurisdiction	–	–	●	●	●
Receiving Water Monitoring	Long-Term Receiving Water Monitoring		Dry	Conventionals, bacteria, nutrients, metals, pesticides, toxicity (chronic), possible TIE/TREs, visual observations, field measurements	●[b]	–	–	–	–
				Hydromodification (channel conditions, discharge points, habitat integrity, evidence and estimate of erosion and habitat impacts)	●[b]	–	–	–	–
				Bioassessment (BMI taxonomy, algae taxonomy, physical habitat characteristics)	●[b]	–	–	–	–
			Wet	Conventionals, bacteria, nutrients, metals, pesticides, toxicity (chronic), possible TIE/TREs, field measurements	●[b]	–	–	–	–
	Regional Monitoring Participation	Bight	Dry	Chemistry, toxicity, benthic infauna	●	●	–	–	●[c]
		SMC	Dry	Bioassessment	●	●	●	●	●
		2011 Hydromodification Monitoring Program (HMP)	Wet	Channel assessments; flow monitoring; sediment transport monitoring	●	●	●	–	–
	Sediment Quality Monitoring		Dry	Chemistry, toxicity, benthic infauna	●[c]	●[c]	–	–	–

Monitoring Programs			Condition	Monitoring Element	Permit Schedule [a]				
					2013-2014[b]	2014-2015	2015-2016	2016-2017	2017-2018
Receiving Water Monitoring	TMDL Monitoring	Bacteria TMDL for Forrester Creek, Lower San Diego River, and Dog Beach	Dry	Bacteria	•	•	•	•	•
			Wet	Bacteria	•	•	•	•	•
Storm Drain Monitoring	Storm Drain Field Screening		Dry	Visual: flow condition, presence and assessment of trash in and around the station, IC/IDs, descriptions	•	•	•	•	•
	Storm Drain Outfall		Dry	Field parameters, conventionals, bacteria, nutrients, metals	-	-	•	•	•
			Wet	Field parameters, conventionals, bacteria, nutrients, metals	•	•	•	•	•
Special Studies	San Diego Regional Reference Streams and Beaches		Dry	Field parameters, conventionals, bacteria instantaneous flow	2012-2014	•	–	–	–
				Streams only: nutrients, metals, bioassessment, including physical habitat and chlorophyll a	2012-2014	–	–	–	–
			Wet	Field parameters, conventionals, bacteria	2012-2014	•	–	–	–
				Streams only: nutrients, metals, toxicity, flow and precipitation (duration of storm)	2012-2014	•	–	–	–

Monitoring Programs		Condition	Monitoring Element	Permit Schedule [a]				
				2013-2014[b]	2014-2015	2015-2016	2016-2017	2017-2018
Special Studies	San Diego Wet Weather Epidemiology Study	Wet	Field parameters, bacteria, human genetic markers, viruses, human health data, flow and precipitation	•	•	•	–	–
IDDE Program	Illicit Discharge Detection and Elimination Program	Dry	Visual surveys, field parameter testing, analytical testing and follow-up investigations, if warranted	–	–	•	•	•

BMI=Benthic macroinvertebrates; IC/ID = illicit connection and/or illicit discharge; NA = not applicable; bacteria = fecal indicator; SMC = Southern California Stormwater Monitoring Coalition; Bight = Southern California Bight Regional Monitoring Program; TIE=Toxicity Identification Evaluation; TRE=Toxicity Reduction Evaluation

a. The Permit was adopted on May 8, 2013; the Permit became effective on June 27, 2013.

b. Completed under the Transitional Monitoring Program according to Permit Provisions D.1.a and D.2.a.

c. The 2018 Southern California Bight Regional Monitoring will occur during the summer of 2018 or 2019.

4.1.1 *Monitoring to Assess Progress Toward Achieving Goals and Schedules*

This section summarizes monitoring to assess progress toward achieving goals related to the HPWQC, which is bacteria for the watershed, as described in **Section 2.**3. As outlined in Section 3.1, goals are based on the multiple compliance pathways set forth for the Bacteria TMDL in Attachment E.6 of the Permit. Compliance with the TMDL may be demonstrated via one of the compliance pathways identified in the Permit. The proposed compliance dates for both the TMDL's interim goals and final goals are set outside of this Permit cycle, as presented in Chapter 3.

Table 4-2 presents the compliance options for the interim TMDL goals and the monitoring that may be used to track progress toward achieving these goals.

Each Participating Agency has established both wet and dry weather jurisdictional goals for bacteria, during this Permit term to demonstrate progress towards compliance with the TMDL requirements. Generally, Participating Agencies have identified near-term goals to address potential bacteria sources and/or to reduce anthropogenic dry weather flow in storm drain outfalls. Data collection or monitoring elements that go beyond the prescribed Permit activities are tailored to measure progress towards meeting each goal. These elements, which are further detailed in the following subsections, may include visual surveys, inspections, physical sampling or measurements, and development of new outreach and source control programs related to bacteria reduction.

Table 4-2. Monitoring Related to Interim Bacteria TMDL Goals [a]

Compliance Pathway		Interim TMDL Goal	Monitoring Elements
1 OR	Receiving Water Conditions	No exceedances of the interim Receiving Water Limitations (RWLs) in the receiving water	Bacteria data collected at compliance points as described in Section 4.1.1.3 Bacteria TMDL Monitoring Program
2 OR	Storm Drain Discharges	No direct or indirect discharge from the Participating Agencies' storm drain outfalls to the receiving water	Visual observation of flow from outfalls to receiving waters as described in Section 4.1.3 Storm Drain Monitoring Program.
3 OR	Storm Drain Discharges	Pollutant load reductions for discharges from the Participating Agencies' storm drain outfalls greater than or equal to the final load reductions	Bacteria and flow data collected at outfalls as described in as described in Section 4.1.3 Storm Drain Monitoring Program.
4 OR	Receiving Water Conditions	Exceedances of the final receiving water limitations in the receiving waters due to loads from natural sources	Data from Sections 4.1.1, 4.1.2, 4.1.4, and 4.1.5.
5 OR	Receiving Water Conditions	No exceedances of the final RWLs in the receiving water	Bacteria data collected at compliance points as described in Section 4.1.1.3 Bacteria TMDL Monitoring Program
6	Water Quality Improvement Plan	Implementation of Plan and use of adaptive management	Data from monitoring and Jurisdictional Runoff Management Programs

a. Participating Agencies may propose alternative TMDL interim milestones which differ from those included in Permit Attachment E.6.

4.1.1.1 *Dry Weather Bacteria Monitoring*

Participating Agencies have established dry weather goals for the 2013-2018 Permit term. **Table 4-3** summarizes the data that will be collected to assess these goals by jurisdiction.

Table 4-3. Dry Weather Monitoring Related to Jurisdictional Goals

Jurisdiction	First Permit Term Numeric Goals 2013-2018 (Chapter 3)	Assessment Metric	Monitoring Elements
City of El Cajon	Reduce controllable dry weather persistent flows by 10%	% reduction of flow volume or number of storm outfalls with flows mitigated from persistently flowing storm drain outfalls	Collect dry weather flow measurements
	Reduce gross pollutants that may contribute to bacteria loads by increasing the number of cubic yards of debris collected from drainage channels	Increased number of annual transient encampment removal events throughout the City's drainage channels	Quantify number of cubic yards of debris collected from drainage channels

Jurisdiction	First Permit Term Numeric Goals 2013-2018 (Chapter 3)	Assessment Metric	Monitoring Elements
City of La Mesa	Creek restoration – 900 linear feet of Alvarado Creek	Linear feet of creek restoration	Quantify linear feet of restoration completed in Alvarado Creek
City of Santee	Implement a dry weather inspection and investigation program. Dedicate 10 % of compliance inspection hours to dry weather inspections	Visual confirmation	Track visual inspections and investigations of dry weather flows
	'Complete Property' inspection program – Inspect 50% high priority, high-density use areas. Focused inspections on pavement, landscape, and trash enclosures	Visual and physical confirmation	Monitor targeted storm drain outfalls before and during implementation
	Eateries Inspection Program – Inspect 50% of high priority eateries. Focused inspections on grease storage, trash enclosures, and outdoor seating areas	Visual inspections on grease storage, trash enclosures, and outdoor seating areas	Monitor targeted storm drain outfalls before and during implementation
	Outdoor Water Use Efficiency and Conservation – Develop Residential Management Area program. Distribute outreach material	Pre and post surveys; reduction in water use	Perform pre- and post-surveys and quantify reduction in water use
City of San Diego	Develop green infrastructure policy, attain City Council approval, and construct green infrastructure best management practices (BMPs) to improve water quality	58 acres of drainage area treated through construction of 4 green infrastructure BMPs	Quantify total acres treated by constructed BMPs using information from final design drawings.
	Implement runoff reduction programs, including targeted education and outreach, enhanced inspections, rebates [a], and increased enforcement.	10% reduction in prohibited[b] dry weather flow from baseline measured at persistently flowing storm drain outfalls in the watershed	Collect flow measurements at persistently flowing storm drain outfalls
County of San Diego	Reduce by 20% the aggregate flow volume or the number of persistently flowing storm drain outfalls	% reduction of flow volume or number of storm drain outfalls with persistent flows	Conduct visual inspections and/or flow measurements at persistently flowing storm drain outfalls

[a] City of San Diego rebates include grass replacement, rainwater harvesting, downspout disconnect, and micro-irrigation.

[b] Does not include allowable discharges as defined in Provision A and Provision E.2.a of the Permit.

4.1.1.2 *WET WEATHER BACTERIA MONITORING*

Participating Agencies have established wet weather goals for the 2013-2018 Permit term. **Table 4-4** summarizes the data that will be collected to assess these goals by jurisdiction.

Table 4-4. Wet Weather Monitoring Related to Jurisdictional Goals

Jurisdiction	First Permit Term Numeric Goals 2013-2018 (Chapter 3)	Assessment Metric	Monitoring Elements
City of El Cajon	Non-structural BMP – Coordinate 1 Creek Cleanup	Reduce bacteria loads in Forrester Creek	Quantify waste material
	Non-structural BMP – Expand Pet Waste Outreach to 1 focused management area or to large property owners	Reduce bacteria loads in Forrester Creek	Quantify waste material
	Conduct a structural BMP feasibility study to assess dry weather treatment control BMPs and draft environmental impact report for treatment control BMPs	30-40% reduction in bacteria load by developing structural BMPs to help meet wet weather TMDL allocations	Monitor bacteria and flow from BMP input and output
	Implement programmatic BMPs to achieve source reduction of bacterial loads from storm drain outfalls	% bacterial load reductions for Total coliform, fecal coliform, and *Enterococcus*	Collect bacteria and flow data at storm drain outfalls
City of La Mesa	Creek restoration – 900 linear feet of Alvarado Creek	Linear feet of structural projects	Quantify linear feet of restoration in Alvarado Creek
City of Santee	Identify candidate locations for off-site compliance. Develop Water Quality Equivalencies (credit system)	Acreage retrofitted.	Quantify acreage
	Conduct bi-monthly river encampment sweeps with follow up trash removal. Increase efforts to provide referrals to local community services.	Trash removal rates/quantities (tonnage removed; visual surveys	Conduct visual trash surveys and quantify tonnage removed
City of San Diego	Develop green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality	58 acres of drainage area treated through construction of 4 green infrastructure BMPs	Quantify total acres treated by constructed BMPs using information from final design drawings.
County of San Diego	Reduce by 1% the baseline bacteria loads from distributed BMPs constructed between 2003 and 2009 during redevelopment.	% bacterial load reduction based on quantitative model	Confirm installation of treatment control BMPs

4.1.2 *Receiving Water Monitoring*

The purpose of the receiving water monitoring program is to characterize trends in the chemical, physical, and biological conditions of a receiving water to determine whether beneficial uses are protected, maintained, or enhanced. Additionally, the receiving water monitoring component helps inform the Participating Agencies of the nexus between the health of receiving waters and the quality of discharges from their storm drain outfall(s). This program is designed to meet the requirements set forth in Provision D.1 of the Permit. Long-term monitoring occurs during both wet and dry weather conditions for water quality, along with physical and biological integrity. Sediment quality monitoring, if appropriate, and participation in regional monitoring occurs as well. Attachment E of the Permit stipulates how TMDL monitoring requirements are to be incorporated into the receiving water monitoring program. Receiving water monitoring comprises the following programs:

- Long-term receiving water monitoring
- Regional monitoring participation
- Toxicity identification evaluation/toxicity reduction evaluation, if appropriate
- Sediment quality monitoring, if appropriate
- TMDL monitoring

The receiving water programs are designed to answer one or more of the following questions:

- Are conditions in the receiving water protective, or likely protective, of beneficial uses?
- What are the extent and magnitude of the current or potential receiving water problems?
- Are the conditions in the receiving water getting better or worse?

4.1.2.1 *Long-Term Receiving Water Monitoring*

Long-term receiving water monitoring will track the overall health of the receiving waters. Dry and wet weather monitoring will continue at the historical mass loading station (SDR-MLS) located on the San Diego River. Participating Agencies have monitored SDR-MLS since 2001 to meet the requirements of previous permits and this site is co-located with the United States Geological Survey (USGS) monitoring station. The land uses in the surrounding drainage area for SDR-MLS are primarily residential with some industrial, commercial, and open space. The mass loading station location is in **Table 4-5.**

Table 4-5. San Diego River Watershed Long-term Receiving Water Station

Station ID	Latitude	Longitude	Cross Street Description	Channel Type	Jurisdiction
SDR-MLS	32.765240	-117.168617	Directly south of the Fashion Valley Trolley Station at the footbridge across San Diego River	Modified Natural Channel	City of San Diego

Source: Transitional Receiving Water Monitoring Plan (Weston, 2014a)

Additional details of the monitoring requirements are in the Monitoring and Assessment Plan provided in Appendix 4A. Detailed proposed monitoring methods and procedures are presented in the Receiving Water Monitoring Plan as **Attachment 4A-1** to **Appendix 4A**. These methods and procedures may be modified based on site-specific environmental conditions and updated analytical methodologies.

4.1.2.2 Regional Monitoring Participation

Regional monitoring includes separate studies that will evaluate various aspects of receiving water health on a regional scale. Participating Agencies will participate in the following regional programs to meet the requirements of Permit Provision D.1.e (1).

Bight Regional Monitoring

The Bight regional monitoring program is a multi-agency collaborative effort to assess the ecological condition of the Southern California Bight from a regional perspective. The core program consists of monitoring of sediment chemistry, sediment toxicity, and benthic infauna. The goals of past Bight programs are to answer three primary questions:

- What are the extent and magnitude of direct impact from sediment contaminants?
- How do the extent and magnitude of the environmental impact vary by habitat?
- What is the trend in extent and magnitude of direct impacts from sediment contaminants?

Sediment quality monitoring was conducted during the summer of 2013 at a total of 22 sites in 9 estuaries and lagoons in the San Diego region including the San Diego River Estuary under the Southern California Bight 2013 Regional Monitoring Survey (Bight '13) (Weston, 2014c). As described in **Section 4.1.2.3**, sediment monitoring data from Bight '13 will be used to fulfill part or all of the sediment monitoring requirements of the Permit. During this Permit term, Participating Agencies will participate in planning Bight '18 monitoring programs.

Stormwater Monitoring Coalition (SMC) Regional Monitoring

Since 2001, Participating Agencies have partnered with regulated stormwater municipalities in southern California, the Regional Boards of Southern California and the Southern California Coastal Water Research Project (SCCWRP) to form the Southern California Stormwater Monitoring Coalition (SMC). The goals of the SMC are to standardize monitoring, improve understanding of stormwater mechanics, and identify receiving water impacts from stormwater (SCCWRP, 2002).

According to its 2014 Research Agenda, the SMC has identified 21 potential projects and is in the process of prioritizing projects on the basis of need and availability of funding (SMC, 2014). The Participating Agencies have elected to participate in the projects that are relevant to the watershed. The Participating Agencies will continue participation in the SMC Regional Freshwater Stream Bioassessment Monitoring Program (SMC Regional Bioassessment Program). Additional information is included in the Monitoring and Assessment Plan in Appendix 4A.

Hydromodification Regional Monitoring Program

Copermittees have developed a regional Hydromodification Management Plan (HMP) to address impacts to beneficial uses and stream habitat from increased erosive force potentially caused by a rise in runoff discharge rates and volume from Priority Development Projects (County of San Diego, 2011). The HMP was initially developed to meet the requirements of the 2007 MS4 permit. The Monitoring Plan is defined in Chapter 8 of the HMP, and was updated by the Copermittees and accepted by the Regional Board in February of 2014. The HMP requires monitoring with a final report due to the Regional Board in December of 2016. Monitoring consists of channel sediment transport assessments, and continuous flow monitoring of pre-project, post-project, and reference conditions per Permit Provisions D.1.a and D.1c(6). Additional monitoring is required per Provision D.1.a(2).

4.1.2.3 *Sediment Quality Monitoring*

Sediment quality monitoring is designed to assess compliance with the sediment quality receiving water limits applicable to enclosed bays and estuaries in accordance with the State Board's Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality (Sediment Control Plan) (State Board, 2009). Sediment quality monitoring will be performed in compliance with Permit Provision D.1.e.(2), which requires preparation of a Sediment Quality Monitoring Plan that satisfies the requirements of the Sediment Control Plan. The requirements of the sediment quality monitoring are:

1) The elements required under Sections VII.D and VII.E of the Sediment Control Plan
2) A Quality Assurance Project Plan
3) A schedule for completion of sample collection, analysis, and reporting.

The Participating Agencies propose to conduct one round of sediment sampling each permit term. The second required round of sampling will be satisfied by conducting additional follow-up sampling in the vicinity of possibly impacted sites identified in the first round. Additional details of the monitoring requirements are in the Monitoring and Assessment Plan provided in **Appendix 4A**. The Sediment Quality Monitoring Plan and Quality Assurance Project Plan (**Attachment 4A-2**) describe detailed proposed monitoring procedures and analytical methods that are illustrative and may change on the basis of site environmental conditions and updated methodologies.

4.1.2.4 *Toxicity Identification Evaluation/Toxicity Reduction Evaluation*

Provision D.1.c(4)(f) of the Permit requires that the Copermittees discuss the need for conducting a Toxicity Identification Evaluation (TIE)/Toxicity Reduction Evaluation (TRE) if chronic toxicity is detected in receiving waters. A TIE is a set of procedures to identify specific chemicals or conditions responsible for toxicity; a TRE is a study designed to identify causative agents of effluent or ambient toxicity, isolate its sources, evaluate effectiveness of toxicity control options, and confirm reduction of toxicity. A work plan that outlines the process to identify chronic toxicity and prioritize the need to implement a TIE/TRE based on the magnitude and persistence of chronic toxicity is included in **Appendix 4A-4**.

4.1.2.5 TMDL MONITORING

TMDL provisions, schedules, and monitoring requirements are provided in Attachment E of the Permit. The purpose of the monitoring program is to track progress toward achieving compliance with interim and final TMDL numeric targets. The Bacteria TMDL in Attachment E.6 is applicable to the watershed. Monitoring is designed to meet compliance with the monitoring requirements of the TMDL. Wet and dry weather sampling will be conducted each year at the compliance point located at the existing California Assembly Bill 411 (AB411) monitoring location along the Pacific Ocean shoreline (25 yards down current of where ocean currents meet river discharge in ankle to knee deep water) and four additional compliance points are located in the lower San Diego River and Forrester Creek. The data generated will be used to address the following questions:

- Are TMDL numeric targets for indicators being met at the compliance monitoring locations?
- Are levels of bacteria decreasing at the compliance monitoring locations?

Additional details of the monitoring requirements, per Permit Attachment E.6, are in the Monitoring and Assessment Plan provided in **Appendix 4A**. The proposed Bacteria TMDL Monitoring Plan and Quality Assurance Project Plan describe detailed monitoring procedures and analytical methods that are illustrative and may be revised based on site-specific environmental conditions and updated methodology. They are presented in **Attachment 4A-3**.

4.1.3 STORM DRAIN OUTFALL MONITORING

The purpose of the Storm Drain Outfall Monitoring Program is to evaluate the potential impact from storm drain discharges on the beneficial uses of the waterbody. This program is designed to meet requirements set forth in Provision D.2 of the Permit and seeks to answer the following question:

- Do non-stormwater or stormwater discharges from the storm drain outfalls contribute to receiving water quality problems?

The number of major outfalls to be monitored under each component of the Storm Drain Outfall Monitoring Program by each Participating Agency is provided in **Table 4-6**. Detailed proposed monitoring methods and procedures are presented in the Storm Drain Outfall Monitoring Plan (**Attachment 4A-5**). These methods and procedures may be modified on the basis of site-specific environmental conditions and updated analytical methodologies. Additionally, the number of major outfalls monitored per year as shown in **Table 4-6** are subject to change based on new information, updates to the Participating Agency's storm drain outfall inventories, changes in transient or persistent flow classifications, and/or changes or updates to the priority water quality conditions over the life of the Plan.

Table 4-6. Number of Major Storm Drain Outfalls per Jurisdiction

Jurisdiction	Number of Storm Drain Outfalls Monitored Per Year		
	Field Screening [a] (Provision D.2.b(1))	Dry Weather Monitoring (Provision D.2.b(2))	Wet Weather Monitoring (Provision D.2.c)
City of El Cajon	28 [a]	5	1
City of La Mesa	11 [a]	3	1
City of San Diego	67 [b]	5	1
City of Santee	46 [a]	5	1
County of San Diego	40 [a]	5	1

a. For Participating Agencies with fewer than 125 major storm drain outfalls in the watershed, 80% of major outfalls must be screened twice per year.

b. The City of San Diego has 502 outfalls within the City jurisdiction. The City of San Diego in accordance with MS4 Permit Section D.2.a(2).(a).(iv) is required to screen 500 sites City wide once per year. The City is not required to screen 500 sites within each watershed.

4.1.3.1 Storm Drain Outfall Dry Weather Monitoring

The purpose of the Storm Drain Outfall Dry Weather Monitoring Program is to evaluate the potential contribution from storm drain discharges on receiving water quality during dry weather conditions and to assess the ability of programs to effectively eliminate non-storm water discharges to waterbodies or waterways. Each Participating Agency has established a number of major storm drain outfalls that are prioritized based on non-stormwater flow status and threat to receiving water quality, and will be screened once or twice annually based on this prioritization. Additionally, the highest priority major storm drain outfalls have been selected for further water quality testing to facilitate source investigations of these outfalls with persistent dry weather flows.

4.1.3.2 Storm Drain Outfall Wet Weather Monitoring

The purpose of this program is to identify pollutants in stormwater discharges from the storm drain conveyance system, guide pollutant source identification efforts, and track progress in achieving the goals set forth in **Chapter 3**. The Participating Agencies' five monitoring locations for the wet weather storm drain outfall discharge monitoring component were chosen to be representative of the residential, commercial, industrial, and mixed-use land uses within the watershed pursuant to Provision D.2.c.

4.1.4 Special Studies

Special studies have been selected to further investigate the HPWQC to meet requirements of Provision D.3 of the Permit. Per Provision D.3, the purpose of the special studies is to "address pollutant and/or stressor data gaps and/or develop information necessary to more effectively address the pollutants and/or stressors that cause or contribute to Highest Priority Water Quality Conditions identified in the Water Quality Improvement Plan." The special studies will include a regional special study and a special study specific to the watershed. Both special studies selected for the watershed will provide additional information on the HPWQC selected by the watershed's Participating Agencies.

4.1.4.1 *San Diego Regional Reference Streams and Beaches Studies*

Participating Agencies have elected to participate in the San Diego Regional Reference Streams and Beaches Study currently being conducted by San Diego and Orange County stormwater permittees. These two regional studies fulfill the requirements for special studies per Provisions D.3.a(2) and D.3.a(3). The studies will measure levels of bacteria that account for "natural sources" to establish the concentrations or loads from streams or beaches minimally disturbed by anthropogenic activities or "reference" conditions. The Reference Stream Study also collected nutrients, metals, and toxicity data as secondary constituents. This study will provide a scientific basis for updating the reference conditions to be considered in evaluating appropriate compliance levels in the Bacteria TMDL. The results of this study will be used to support the forthcoming re-evaluation of the recently adopted Bacteria TMDL and to support numeric target development in future TMDLs or alternative regulatory approaches for nutrients and metals.

The San Diego Regional Stream Reference Study will address the following questions (SCCWRP, 2013) in streams minimally influenced by anthropogenic activities:

- How does the Water Quality Objective (WQO) exceedance frequency vary between summer dry weather, winter dry weather, and wet weather?
- How does the WQO exceedance frequency vary by hydrologic factors?
- How does the WQO exceedance frequency vary by input factors?
- How does the WQO exceedance frequency vary by biotic and abiotic factors?

The San Diego Regional Reference Beaches Study will address the following questions (SCCWRP, 2013) at beaches minimally influenced by anthropogenic activities.

- How does the WQO exceedance frequency vary between summer dry weather, winter dry weather, and wet weather?
- How does the WQO exceedance frequency vary by hydrologic factors, including:
    - Discharge flow rate (wet and dry weather)
    - Status of estuary mouth (open/closed; dry weather only)
- What are the wet and dry weather exceedance frequencies of bacteria in estuaries?

4.1.4.2 *Wet Weather Epidemiology Study and Quantitative Microbial Risk Assessment*

The special study specific to the watershed will examine the correlation between bacteria levels in stormwater discharges from the San Diego River and the health effects experienced by surfers at Ocean Beach, located near the mouth of the San Diego River. The study is being conducted by SCCWRP and the University of California at Berkeley, in collaboration with the Surfrider Foundation. It is primarily funded equally by the County of San Diego and City of San Diego with additional funding assistance from the remaining San Diego River Participating Agencies. The Wet Weather Epidemiology Study and Microbial Risk Assessment (Surfer Health Study) began in January 2014 and will continue through March of 2015. A final report is anticipated in June of 2016.

The Surfer Health Study will be conducted using a two-phased approach. Phase 1 consists of an epidemiological study involving recruitment of surfers for self-reported illness tracking and water quality sampling at the beaches. Phase 2 consists of a quantitative microbial risk assessment (QMRA), including source tracking through composite wet weather sampling of San Diego River and Tourmaline Creek, measurements and modeling of swimmer exposure, and modeling of illness response. The overall purpose of this study is to assess wet weather impacts on the water contact recreation (REC-1) beneficial use.

Specifically, the Surfer Health Study will address the following questions (SCCWRP, 2014):

- Is water contact associated with an increased risk of illness?
- Is illness risk greater following exposure to wet weather events as compared with dry weather?
- What is the association between levels of *Enterococcus* and illness following wet weather events?
- What level of *Enterococcus* corresponds to the same risk of illness as current water quality standards?

For details of the Surfer Health Study, refer to Attachment 4A-6.

4.1.5 Illicit Discharge Detection and Elimination Program

Each Participating Agency is required to develop an IDDE Program to address the potential contribution of pollutants from non-stormwater and stormwater discharges and to establish and enforce pollutant discharge prohibitions in compliance with Provision E.2 of the Permit. The outline of an IDDE Program is included in the Plan to establish a consistent framework for all JRMPs within the watershed and to describe the data that may be generated to support assessments described in **Section 4.2**. The IDDE Program will be designed to have the following goals:

- Control the contribution of pollutants to and the discharges from the storm drains within its jurisdiction.
- Effectively prohibit non-stormwater discharges to the storm drain.
- Reduce the discharge of pollutants in stormwater to the maximum extent practicable.

Additional details of the IDDE program are summarized in the Monitoring and Assessment Plan provided in Appendix 4A. Participating Agencies may choose to further enhance the program in their jurisdictions.

4.1.6 *REGIONAL CLEARINGHOUSE*

Participating Agencies will use existing data-sharing templates to facilitate compilation of watershed-wide datasets for assessment and reporting purposes. To support reporting under previous Permit cycles, regional data-sharing templates were developed for receiving water monitoring, storm drain outfall monitoring, field screening, and IC/ID reporting. Participating Agencies will make the following data and documentation available to the public on the Project Clean Water website:

- Water Quality Improvement Plan and all updated versions with date of update
- Annual Reports for the watershed
- Jurisdictional Runoff Management Program documents for each Participating Agency within the watershed and all updated versions with date of update
- BMP Design Manual for each Participating Agency within the watershed and all updated versions with date of update
- Reports from special studies conducted in the watershed
- Monitoring data uploaded to the California Environmental Data Exchange Network (CEDEN) with links to the uploaded data
- Geographic information system (GIS) data, layers, and/or shape files that are available for distribution and used to develop the maps to support the Plan, Annual Reports, and Jurisdictional Runoff Management Programs

> Project Clean Water is a web-based portal that functions as a regional clearinghouse for San Diego County watersheds. It is used as a centralized point of access to share educational materials, water quality information, and Permit-required reports with the public.
>
> www.projectcleanwater.org

4.2 WATER QUALITY IMPROVEMENT PLAN ASSESSMENT PROGRAM

The assessment portion of the Monitoring and Assessment Program will evaluate the data collected under the monitoring programs described in **Section 4.1**, and integrate the information collected as part of the JRMPs. The data collected from these two programs will be used to assess the progress toward achieving the numeric goals and schedules and to measure the progress toward addressing the HPQWC. **Figure 4-1** depicts how the watershed monitoring activities will support the assessments required by the Permit.

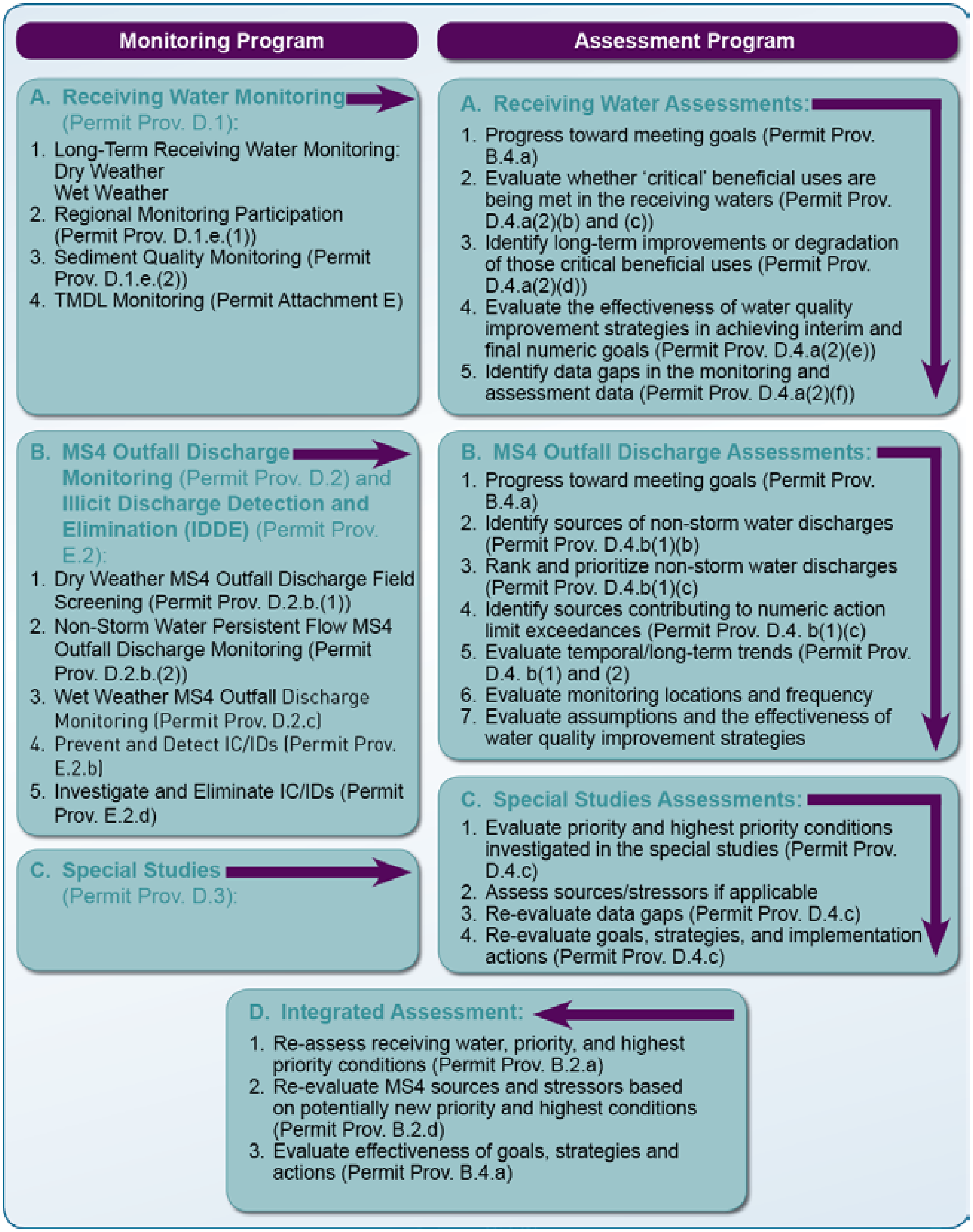


Figure 4-1. Monitoring and Assessment Program Components for the San Diego River Watershed

Table 4-7 summarizes the reporting and assessment requirements of the Permit. Some assessments will be reported annually, as part of the Annual Report, while others will be included in the Report of Waste Discharge that the Participating Agency must submit 180 days prior to the end of this Permit. Additional detail on the contents of the reports is presented in the Monitoring and Assessment Plan in **Appendix 4A**.

The Monitoring and Assessment Program will be evaluated and adapted in the context of the Annual Report and the Report of Waste Discharge. The re-evaluation will consider data gaps and the results of all monitoring program elements. Modifications may be made to the program, but the core elements required by the Permit and described in **Section 4.1** must be maintained. This limits the amount of adaptation that is possible. Potential changes could be to modify the frequency of sampling, add a new analyte of concern, or move a monitoring location.

Table 4-7. Water Quality Improvement Plan Annual Report Requirements

Assessment and Documentation	Detailed Data and Information
Summary of data collected, findings, interpretations, and conclusions from the assessments required per Permit Provisions F.b.(3)(a), (b), and (c)	· Receiving Water Assessments per Provision D.4.a. · Sediment Quality Assessments per Provision D.1.e(2) · TMDL Assessments per Provision E.6 · Storm Drain Discharge Assessments D.4.b · IDDE relevant information and findings · Special studies: findings and progress per Provision D.4.c · Re-evaluation of the Priority Water Quality Conditions, numeric goals, strategies, schedules, and/or monitoring and assessment, as needed per Provision D.4.d.[a]
Progress of implementing the Plan per Provision F.b.(3)(d)	· Progress towards interim and final numeric goals for the HPWQC for the watershed · Status of water quality improvement strategies by each Participating Agency · Proposed modifications to water quality improvement strategies and supporting rationale · Water quality improvement strategies planned for implementation during the next reporting period · Proposed modifications to the Plan and/or each Participating Agency's jurisdictional runoff management program document · Previous modifications or updates incorporated into the Plan and/or each Participating Agency's jurisdictional runoff management program document

Assessment and Documentation	Detailed Data and Information
A completed Jurisdictional Runoff Management Program Annual Report Form for each Participating Agency in the watershed, certified by a Principal Executive Officer, Ranking Elected Official, or Duly Authorized Representative per Provision F.b.(3)(e)	· City of El Cajon · City of La Mesa · City of San Diego · City of Santee · County of San Diego
Any data or documentation utilized in developing the Annual Report for each Participating Agency, upon request by the Regional Board. Monitoring data must be uploaded to the California Environmental Data Exchange Network (CEDEN) and available for access on the Regional Clearinghouse per Provision F.b.(3)(f)	· Receiving water and data collected per Provision D.1 · Storm drain discharge monitoring data collected per Provision D.2 · Special Study data · IC/ID investigation data

a. This re-evaluation is not required annually; at minimum, it must be completed as part of the Report of Waste Discharge.

5 ITERATIVE APPROACH AND ADAPTIVE MANAGEMENT PROCESS

Adaptive Management Highlights

Iterative approach is developed to facilitate the adaptive management process for the San Diego River Watershed.

Iterative approach re-evaluates the following based on the requirements of the Permit:

- Conditions and priorities
- Goals
- Strategies

Adaptive management process explains how the Water Quality Improvement Plan will be revised when:

- New priorities and/or highest priorities are developed
- Goals are adjusted or new goals are added
- Strategies are modified to meet the latest goals or to be more effective

This section presents the iterative approach that facilitates the adaptive management process for the San Diego River Watershed. The iterative approach re-evaluates the conditions and priorities, goals, and strategies based on the requirements of the Permit. The adaptive management process details how the Plan will be revised when new priorities and/or highest priorities are added, how goals will be adjusted or new goals are added, and how the strategies will be modified to meet the latest goals.

The Permit describes various triggers that may warrant program adaptation, including exceedances of water quality standards in receiving waters, new information, Regional Board recommendations, and public participation. Effectiveness assessments of JRMP programs and strategies may also trigger adaptations to the Plan.

Each trigger will result in specific adaptive management processes or actions within timeframes specified in the Permit. The timing of the adaptive management requirements is typically either annually or at the end of the Permit term. Other adaptations, especially those driven by TMDLs, will likely occur outside of the current Permit term.

The adaptive management process provides the framework to evaluate progress toward meeting the requirements in the compliance pathways of the Bacteria TMDL that are reflected in the goals presented in **Chapter 3**. The adaptive management process will be used in conjunction with the data collected as part of the Monitoring and Assessment Program to evaluate whether modifications to goals, schedules, and/or strategies are necessary to achieve compliance with the interim and final TMDL compliance options provided in Attachment E of the Permit. **Figure 5-1** provides an overview of the adaptive management process.

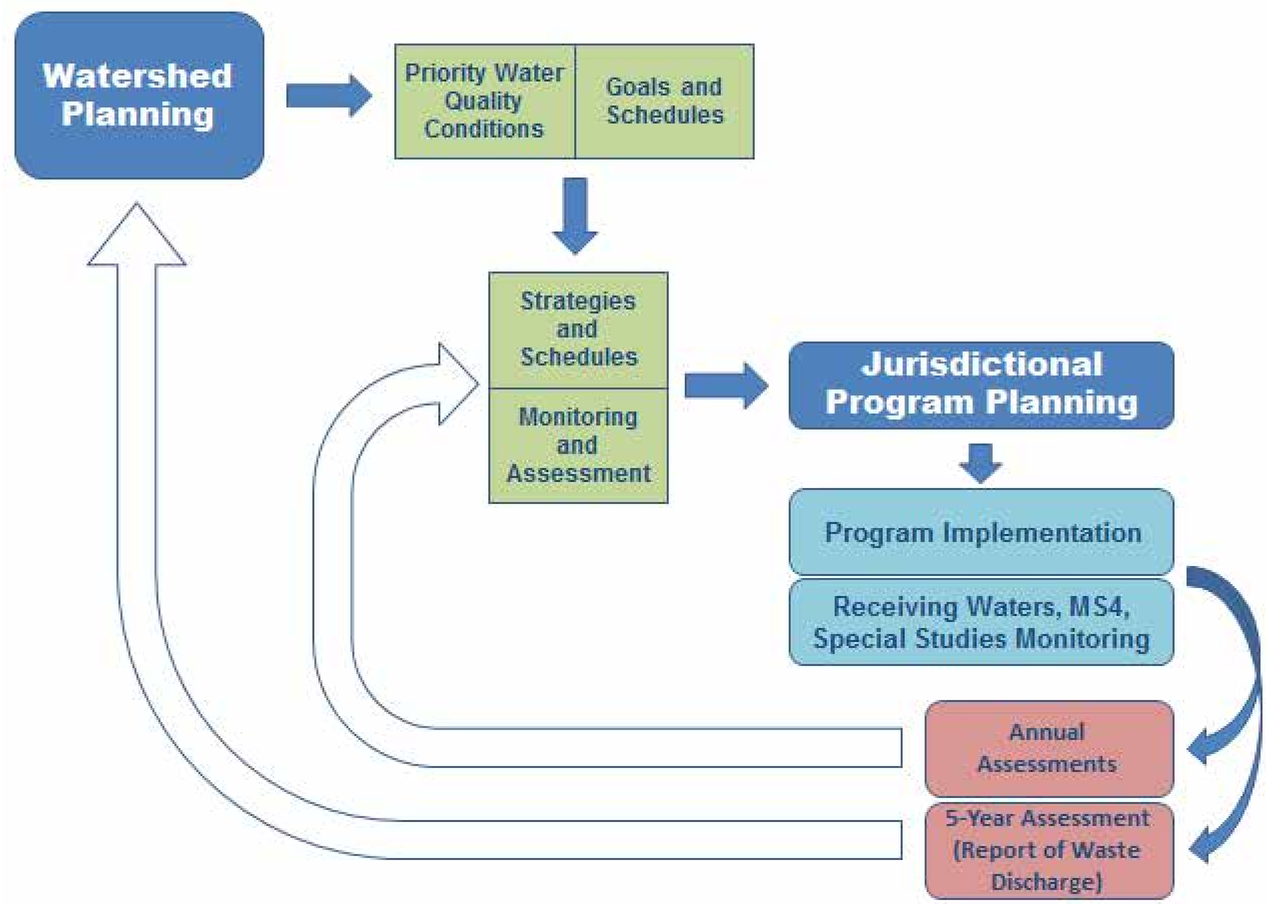


Figure 5-1. Water Quality Improvement Plan Assessment Adaptive Management Framework

5.1 Permit Requirements: Iterative Approach and Adaptive Management

The Permit includes the requirements for the adaptive management in multiple provisions. Provisions A.4, B.5, D.4.d, and F.2.c each contain requirements related to adaptive management.

Provision A.4 requires the Plan to be designed and adapted to ultimately achieve compliance with the discharge prohibitions (Provisions A.1.a and A.1.c) and receiving water limitations (Provision A.2.a) specified in the Permit. It addresses the adaptive management process that may be triggered when exceedances of water quality standards persist in receiving waters.

Provision B.5 contains specific considerations that must be included in the adaptive management process, whether performed as part of the Annual Report or as part of the Report of Waste Discharge. This includes the re-evaluation of priority water quality conditions; adaptation of goals, strategies, and schedules; and adaptation of the Monitoring and Assessment Program.

Provision D.4.d contains the processes for the assessments and adaptive management that must occur in the Report of Waste Discharge preparations.

Provision F.2.c describes the requirements for updates to the Plan that could result from implementation of the adaptive management requirements.

5.2 Re-evaluation of Priority Water Quality Conditions (B.5.a)

The process for selecting the highest priority water quality condition(s) is documented in **Chapter 2**. Given the relatively short duration of the remainder of this Permit term after expected approval of the Plan, the priority water quality conditions selected during the development of the Plan will remain for the duration of the term. They will be modified only on the basis of new information assessed as part of the Report of Waste Discharge. Data collected during the Permit term will be used to update the analysis of the priority water quality conditions on the basis of the methodology described in **Chapter 2**. **Table 5-1** lists the considerations that must be included when Participating Agencies re-evaluate the Priority Water Quality Conditions for the watershed.

Table 5-1. Re-evaluation of Priority Water Quality Conditions

Frequency	Trigger [a]	Considerations
Permit Term	Report of Waste Discharge (B.5.a, D.4.d.(1))	***Provision B.5.a Iterative Approach and Adaptive Management Considerations*** Achievement of the outcome of improved water quality through the implementation of strategies identified in the Plan. New information developed in the re-assessment of receiving water conditions, impacts from storm drain discharges, and subsequent re-evaluation of priorities. Spatial and temporal accuracy of monitoring data Availability of new information and data from sources outside the JRMP programs that inform the effectiveness of strategies Recommendations from the Regional Board and received through a public participation process ***Provision D.4.d(1) Integrated Assessment Considerations*** Re-evaluation of the receiving water conditions and the impacts of the storm drain discharges on receiving waters per the process developed in Chapter 2 of the Plan. This includes the identification of beneficial uses in receiving waters that are protected per the Monitoring and Assessment Program. Re-evaluation of sources and/or stressors if corresponding to elevation of a new highest priority condition.

a. Following approval of a TMDL with wasteload allocations by OAL and the USEPA, Participating Agencies must initiate an update of the Plan within six months.

5.3 Adaptation of Goals, Strategies, and Schedules (B.5.b)

The adaptation of goals, strategies, and schedules may occur on an annual basis under certain conditions, but will occur as part of the Report of Waste Discharge. Goals and schedules may be adapted annually based on new information generated in one of two circumstances: (1) where a new TMDL is approved by OAL and USEPA or (2) where annual evaluations of receiving water data provide new information impacting the goals. Strategies and their associated schedules may also be adapted annually based on new information generated in one of three circumstances: (1) where a new TMDL is approved by OAL and USEPA, (2) where annual evaluations of receiving water data provide new information impacting the schedules, or (3) where program effectiveness assessments provide information adequate to justify modification.

5.3.1 Adaptation of Goals and Schedules

As part of the preparation of the Report of Waste Discharge, the Participating Agencies will evaluate the progress toward achieving the interim and final numeric goals established in **Chapter 3**. This evaluation may be performed using programmatic or water quality data collected as Plan implementation matures. The Plan interim goals that will be assessed as part of the Report of Waste Discharge are provided in **Table 5-2** through **Table 5-6** along with the related assessment metric for each.

Assessment of the goals and compliance pathways will be performed using data collected per the Monitoring and Assessment Program and JRMP, along with the schedules developed in conjunction with each goal. Depending on the results of the assessment, it may be appropriate to adjust either or both the numeric goals and/or the schedules associated with each goal. The exception is where the interim and/or final numeric goals and schedules are based on approved Bacteria TMDL compliance schedules. In this case, interim schedules may be modified. However, numeric targets (interim and final) and final schedules cannot be modified without changes to the Bacteria TMDL. **Table 5-7** lists the considerations that will be included in the process of evaluating progress towards defined goals and schedules.

Table 5-2. City of El Cajon Jurisdictional Goals, FY16 – FY18

Title	Condition		Metric	Goal
	Dry	Wet		
Reduce controllable dry weather persistent flows	X		% reduction of flow volume or number of storm drain outfalls with flows mitigated from persistently flowing storm drain outfalls.	Reduce the volume of dry weather flows or the number of storm drains with dry weather flows by 10%.
Transient encampment removal events	X		Increase the number of annual transient encampment removal events throughout the City's drainage channels.	Reduce gross pollutants that may contribute to bacteria loads by increasing the number of cubic yards of debris collected from drainage channels.
Creek Cleanup		X	Reduce bacterial loads in Forrester Creek	Sponsor, coordinate with jurisdictions creek clean up events in 1 focused management area, bi-annually; segregate and quantify waste materials.
Pet Waste Outreach		X		Expand pet waste management outreach to 1 focused management area; or to large properties owners (i.e. apartments, commercial facilities).
Structural BMPs feasibility study, adaptive management		X	Develop structural BMPs to help reduce bacterial load by 30%-40% to help meet wet weather TMDL allocations	Develop feasibility study to assess dry/wet weather treatment control BMPs and draft environmental impact report for treatment control BMPs.
Implement Plan with focus on programmatic BMPs and use adaptive management to increase effectiveness		X	Percent Total Coliform bacteria load reduction	Reduce bacterial loads by 1% from storm drain outfalls through continued implementation of programmatic BMPs and structural BMP utilizing an adaptive management.
Implement Plan with focus on programmatic BMPs and use adaptive management to increase effectiveness		X	Percent Fecal Coliform bacteria load reduction	Reduce bacterial loads by 1% from storm drain outfalls through continued implementation of programmatic BMPs and structural BMP utilizing an adaptive management.
Implement Plan with focus on programmatic BMPs and use adaptive management to increase effectiveness		X	Percent Enterococcus bacteria load reduction	Reduce bacterial loads by 1% from storm drain outfalls through continued implementation of programmatic BMPs and structural BMP utilizing an adaptive management.

Table 5-3. City of La Mesa Jurisdictional Goals, FY16 – FY18

Title	Condition		Metric	Goal
	Dry	Wet		
Creek Restoration Project	X	X	Linear Feet of Structural Projects	Perform 900 LF of Alvarado Creek restoration program.

Table 5-4. City of Santee Jurisdictional Goals, FY16 – FY18

Title	Condition		Metric	Goal
	Dry	Wet		
Dry Weather Investigations	X		Visual confirmation	Implement a dry-weather inspection and investigation program (separate from the monitoring program component). Dedicate 10% of compliance inspection hours to conduct dry weather investigations.
'Complete Property' Inspection Program	X		Visual and physical confirmation; monitoring of targeted storm drain outfalls to be performed before and during implementation	Inspect 50% high priority, high-density use areas (residential & commercial/industrial). Focused inspections on pavement, landscape and trash enclosures.
Eateries Inspection Program	X		Visual and physical confirmation; monitoring of targeted storm drain outfalls to be performed before and during implementation	Inspect 50% of high priority eateries. Focused inspections on grease storage, trash enclosures, outdoor seating areas
Outdoor Water Use Efficiency and Conservation	X		Pre & post surveys; reduction in water use.	Develop Residential Management Area (RMA) program. Distribute outreach materials addressing outdoor water use, water conservation, and water quality to all high-priority properties (areas). Partner with Santee School District to disseminate information and integrate efforts.
Retrofit projects		X	Acreage retrofitted	Identify candidate locations for off-site compliance. Develop Water Quality Equivalencies (credit system).
Trash Management Program		X	Trash removal rates/quantities (Tonnage removed); visual surveys	Bi-monthly river encampment sweeps with follow up trash removal. Increase efforts to provide referrals to local community services.

Table 5-5. City of San Diego Jurisdictional Goals, FY16 – FY18

Title	Condition		Metric	Goal
	Dry	Wet		
Develop green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality during wet and dry weather	X	X	Acres of drainage area treated through construction of green infrastructure BMPs, using 2002 as a baseline	58.4 acres of drainage area treated through construction of 4 green infrastructure BMPs
Implement runoff reduction programs, including targeted education and outreach, enhanced inspections, rebates[a], and increased enforcement	X		Change in flow from baseline measured at persistently flowing storm drain outfalls in the watershed during dry weather	10% reduction in prohibited[b] dry weather flow from baseline measured at persistently flowing storm drain outfalls in the watershed during dry weather

a. City of San Diego rebates include grass replacement, rainwater harvesting, downspout disconnect, and micro-irrigation.

b. Does not include allowable discharges as defined in Provision A and Provision E.2.a of the Permit

Table 5-6. County of San Diego Jurisdictional Goals, FY16 – FY18

Title	Condition		Metric	Goal
	Dry	Wet		
Eliminate anthropogenic dry weather flows [a] from storm drain outfalls	X		% reduction of flow volume or number of storm drain outfalls with persistent flows	Reduce by 20 % the aggregate flow volume or the number of persistently flowing storm drain outfalls.
Implement Plan with focus on programmatic BMPs and use adaptive management to increase effectiveness		X	% bacterial load reduction	Implement programmatic (non-structural) BMPs to achieve source reduction of bacteria loads from the storm drain outfalls.
Structural BMPs (as needed and as funding is available)		X	% bacterial load reduction based on quantitative model	Reduce by 1% the baseline bacteria loads from distributed BMPs constructed between 2003 and 2009 during redevelopment.

a. Here and throughout this table, the term “dry weather flows” excludes groundwater, other exempt or permitted non-stormwater flows, and sanitary sewer overflows.

Table 5-7. Adaptation of Goals and Schedules for the HPWQC

Frequency	Trigger [a]	Considerations
Permit Term	Report of Waste Discharge (B.5.b, D.4.d.(1))	***Provision B.5.b Iterative Approach and Adaptive Management Considerations*** Modifications to the priority water quality conditions based Progress toward achieving numeric goals for the HPWQC Progress in meeting established schedules New policies or regulations that may affect goals Reductions of non-storm water discharges Reductions of pollutants in storm water discharges from storm drain outfalls to the MEP New information resulting from the re-evaluation of impacts from storm drain discharges and/or pollutants and stressors Efficiency in implementing the Plan Recommendations from the Regional Board Recommendations received through a public participation process ***Provision D.4.d(1) Integrated Assessment Considerations*** Evaluation of the progress toward achieving interim and final numeric goals for protecting impacted beneficial uses in receiving waters

a. Following approval of a TMDL with wasteload allocations by OAL and the USEPA, Participating Agencies must initiate an update of the Plan within six months.

5.3.2 *Adaptation of Strategies and Schedules*

The strategies and implementation schedules developed to address the highest priority water quality conditions in the watershed will be re-evaluated as part of the preparation of the Report of Waste Discharge. Ultimately, the effectiveness of the strategies will be based on the progress toward achieving the interim and final numeric goals. However, an evaluation of strategies based on the achievement of the interim and final numeric goals may take many years of implementation and monitoring to assess. To supplement the "goal-based" assessments, water quality and programmatic data collected over the Permit term will be incorporated into the assessment and adaptive process to modify strategies and implementation schedules as appropriate.

5.3.2.1 Water Quality Data Evaluation and Linkage to Strategies

Receiving water data will be assessed as described in **Section 5.5**. The assessment will indicate progress toward longer term goals and protection of beneficial uses. These data may be used to evaluate the collective effectiveness of the Plan strategies. This information will provide a "big picture" assessment of the success of the strategies over the long term. The data evaluation also has the potential to trigger mandatory updates to the Plan per Provision A.4 where exceedances of water quality standards persist in receiving waters. This part of the adaptive management process is described further in **Section 5.5** and detailed in **Figure 5-2**.

Storm drain outfall visual observations, water quality data, and special studies results may provide information that is more directly linked to the implementation of individual strategies. Where possible, this information will be used to modify, eliminate, and/or develop new strategies to address the highest priority water quality conditions in the watershed. Where appropriate, these assessments will include a comparison of the data with the NALs and SALs as required per Provision C of the Permit. These data will provide the foundation for the storm drain outfall discharge assessments described in **Chapter 4**, which will examine the results of Participating Agency Illicit Discharge Detection and Elimination Programs and Storm Drain Outfall Discharge Monitoring Programs. Where strategies can be linked to measurable or demonstrable reductions of non-storm water discharges or of pollutants in storm water, appropriate modifications will be made.

5.3.2.2 Program Assessments

Where available, the results of program effectiveness assessments performed at the jurisdictional or watershed scale may also factor into the adaptation of specific strategies. The level of information will vary by jurisdiction and by program, as these types of assessments are not explicitly required under the Permit. However, in many cases, the jurisdictions are performing programmatic assessments to ensure the most effective use of limited resources. These assessments have the potential to provide information to determine the effectiveness of specific strategies that is more relevant than water quality data collected at storm drain outfalls or in receiving waters and may be a key driver in adapting strategies. In some cases, modifications to strategies may also be the result of internal jurisdictional opportunities or constraints such as increases or decreases in available funding or staffing. Modifications to strategies based on program effectiveness assessment may occur annually or on a Permit term. **Table 5-8** lists the considerations that will be evaluated when adapting strategies and schedules, whether on an annual timeframe or the Permit term (i.e., Report of Waste Discharge).

Table 5-8. Adaptation of Water Quality Strategies and Schedules

Frequency	Trigger [a]	Considerations
Annual Report	Persistent Exceedances Not Addressed (A.4.a.(2))	***Provision A.4.a(2) Integrated Assessment Considerations (Summarized in Figure 5-2)*** [b] Water quality standard exceedances for pollutants that are addressed by the Plan; implementation of the accepted plan continues and is updated as necessary. If storm drain discharges are causing or contributing to a new exceedance of an applicable water quality standard for pollutants that are not addressed by the Plan, the plan will be updated as part of the Plan Annual Report (unless directed to update it earlier by the Regional Board). Following Regional Board approval of modifications to the Plan, the Participating Agencies must update their JRMPs accordingly.
Annual Report	New Information (B.5.b)	***Provision B.5.b Iterative Approach and Adaptive Management Considerations*** Modifications to the priority water quality conditions based Progress toward achieving numeric goals for the HPWQC Progress in meeting established schedules New policies or regulations that may affect goals Reductions of non-storm water discharges Reductions of pollutants in storm water discharges from storm drain outfalls to the MEP New information resulting from the re-evaluation of impacts from storm drain discharges and/or pollutants and stressors Efficiency in implementing the Plan Recommendations from the Regional Board Recommendations received through a public participation process
Permit Term	Report of Waste Discharge (D.4.d.(2))	***Provision D.4.d(2) Integrated Assessment Considerations*** Identification of the non-storm water and storm water pollutant loads from the storm drain outfalls per Provision D.4.b Identification of the non-storm water and storm water pollutant load reductions, or other improvements that are necessary to attain the interim and final numeric goals Identification of the non-storm water and storm water pollutant load reductions, or other improvements, that are necessary to demonstrate that non-storm water and storm water discharges are not causing or contributing to exceedances of receiving water limitations Evaluation of the progress of the strategies toward achieving interim and final numeric goals for protecting beneficial uses in receiving waters

a. Following approval of a TMDL with wasteload allocations by OAL and the USEPA, Participating Agencies must initiate an update of the Plan within six months.

b. The procedure does need not be repeated for continuing or recurring exceedances of the same water quality standard(s) once scheduled strategies are implemented unless directed to do so by the Regional Board.

5.4 Adaptation of Monitoring and Assessment Program

As part of the Report of Waste Discharge, the Participating Agencies will consider modifications to the Monitoring and Assessment Program, consistent with the requirements in Provision D.4.d.(3). During the Permit term, modifications must be consistent with the requirements of Provisions D.1, D.2, and D.3 (receiving water, storm drain outfall, and special study monitoring requirements, respectively), which limit the amount of adaptation that is possible. However, recommendations within the Report of Waste Discharge provide an opportunity to make more meaningful modifications to the Monitoring and Assessment Program. Examples of modifications to the Monitoring and Assessment Program include the following adjustments:

- Determine whether discharges from the stormwater conveyance system are linked to exceedances in the receiving water
- Address data gaps via re-assessment of monitoring locations and frequencies
- Address results of special studies

Table 5-9 lists considerations that will be evaluated when adapting the Monitoring and Assessment Program.

Table 5-9. Adaptation of Monitoring and Assessment Program

Frequency	Trigger [a]	Considerations
Annual Report	Persistent Exceedances Not Addressed (A.4.a.(2))	***Provision A.4.a(2) Integrated Assessment Considerations (Summarized in Figure 5-2)*** [b] Follow the process described in **Figure 5-2**. This may potentially include modifying the monitoring program to fill data gaps. Modifications could include moving monitoring locations, adding additional sample collection, or changing type of sample collected.
Annual Report	New Information (B.5.c)	***Provision B.5.c Iterative Approach and Adaptive Management Considerations*** Re-evaluation based on new information such as modified priority water quality conditions, goals, strategies, or schedules New information, including new regulations The Monitoring and Assessment Program must include the Permit required monitoring
Permit Term	Report of Waste Discharge (B.5.c)	***Provision B.5.c Iterative Approach and Adaptive Management Considerations*** Review of Monitoring and Assessment Programs based on the requirements in Provision D Adjustment of the monitoring program to determine whether discharges from the stormwater conveyance system are causing/contributing to exceedances in the receiving water when new exceedances persist; identification and addressing of data gaps via re-assessment of monitoring locations and frequencies; adjustment of monitoring program to address results of special studies.

a. Following approval of a TMDL with wasteload allocations by OAL and the USEPA, Participating Agencies must initiate an update of the Plan within six months.
b. The procedure does need not be repeated for continuing or recurring exceedances of the same water quality standard(s) once scheduled strategies are implemented unless directed to do so by the Regional Board.

5.5 Timing of Adaptive Management Requirements

Based on the Permit required evaluations described previously, adaptive management via the iterative process will be integral to the success of the Plan. However, the Participating Agencies will adapt different facets of the Plan at different rates, depending on a variety of factors. In most cases, annual modifications will consist of relatively minor updates to strategies or timelines, reflective of information gained through implementation. Significant updates to the Plan will be required as part of the Report of Waste Discharge, performed once per Permit term. For parts of the Plan (e.g., priority water quality conditions, goals) a longer timeline is appropriate for evaluation, as accurate and more robust information is necessary to change the course of the Plan. The following sections provide more insight and details related to the timing of the adaptive management process and the impacts on revisions to the Plan.

5.5.1 *Annual Assessments and Adaptive Management*

The Permit contains two conditions that may trigger adaptation annually:

1) Exceedances of water quality standards in receiving waters
2) New information

In either case, modifications may be appropriate for the water quality goals, strategies, schedules, and/or Monitoring and Assessment Program. The priority water quality conditions may be modified *as needed* during the Permit term, but would likely be modified only as a result of assessments conducted for the Report of Waste Discharge.

5.5.1.1 Receiving Waters Assessments

Evaluation of receiving water and storm drain outfall discharge data will be performed annually as part of the Annual Report and is described in **Chapter 4**. More comprehensive evaluations of receiving water data will be performed for the Transitional Monitoring and Assessment Program Report and for the Report of Waste Discharge (Provision D.4.a.(1)). These evaluations will summarize receiving water data collected within the watershed and provide information with the potential to trigger the adaptive management process to achieve compliance with Permit discharge prohibitions and receiving water limitations as required in Provision A.

Provision A.4 describes adaptive management procedures that the Participating Agencies must implement "if exceedance(s) of water quality standards persist in receiving waters." If the adaptive management process is triggered under this provision, the process will include the following assessments:

- Whether the stormwater conveyance system is a source of pollutants causing the exceedances to persist in the receiving waters
- Whether or not the exceedances are addressed by the Plan

If the receiving water exceedances are addressed under the Plan, the Participating Agencies will continue implementation of the Plan. If the receiving water exceedances are not addressed, the Participating Agencies will update the plan to address the exceedances as described in Provision A.4.a.(2) and submit the updates with the Annual Report. The updates will include, as applicable:

- A description of strategies that are currently being implemented, are effective, and will continue;
- A description of strategies that will be implemented to reduce or eliminate pollutants or conditions that are a source of the receiving water exceedances;
- Updates to the implementation schedules for existing, revised, or additional strategies;
- Updates to the Monitoring and Assessment Program to track progress toward achieving compliance with Provisions A.1.a, A.1.c, and A.2.a.

The adaptive management process as required under Provision A.4 is illustrated in **Figure 5-2**.

5.5.1.2 Annual Evaluation of New Information

The adaptive management process may also be triggered as new information becomes available as discussed in the following subsections. Where appropriate, modifications may be made to goals, strategies, schedules, and/or the Monitoring and Assessment Program and reported in the Annual Report.

5.5.1.2.1 Regulatory Drivers

Where new regulations or policies are adopted that impact watershed planning and implementation processes in the near term, modifications to the Plan goals, strategies, schedules, and/or Monitoring and Assessment Program may be warranted, and, in some cases, required. For example, an update to the Plan will be initiated no later than six months following approval of a TMDL Basin Plan Amendment by OAL and the USEPA. The trigger applies to TMDLs containing wasteload allocations assigned to Participating Agencies within the watershed during the term of the Order (Provision F.2.c.(2)). Other examples of regulatory drivers that may trigger modifications to the Plan include new state policies or plans (e.g., trash, toxicity, biological objectives, bacteria standards update) and changes resulting from modifications to existing Permit requirements (e.g., as a result of revising a TMDL).

5.5.1.2.2 Special Study Results

As part of the Monitoring and Assessment Program, Participating Agencies will perform special studies related to the highest priority water quality condition for the watershed. The special studies are designed to provide information related to sources of the highest priority water quality conditions within the watershed, will be implemented during the Permit term, and are typically performed over multiple years. As relevant data, conclusions, and lessons learned become available from these studies, the Plan may be modified. The study results may impact the goals, strategies, schedules, and the Monitoring and Assessment Program. Additionally, lessons learned and study results from outside the watershed, especially those related to the bacteria impairments, may also be incorporated into the Plan.

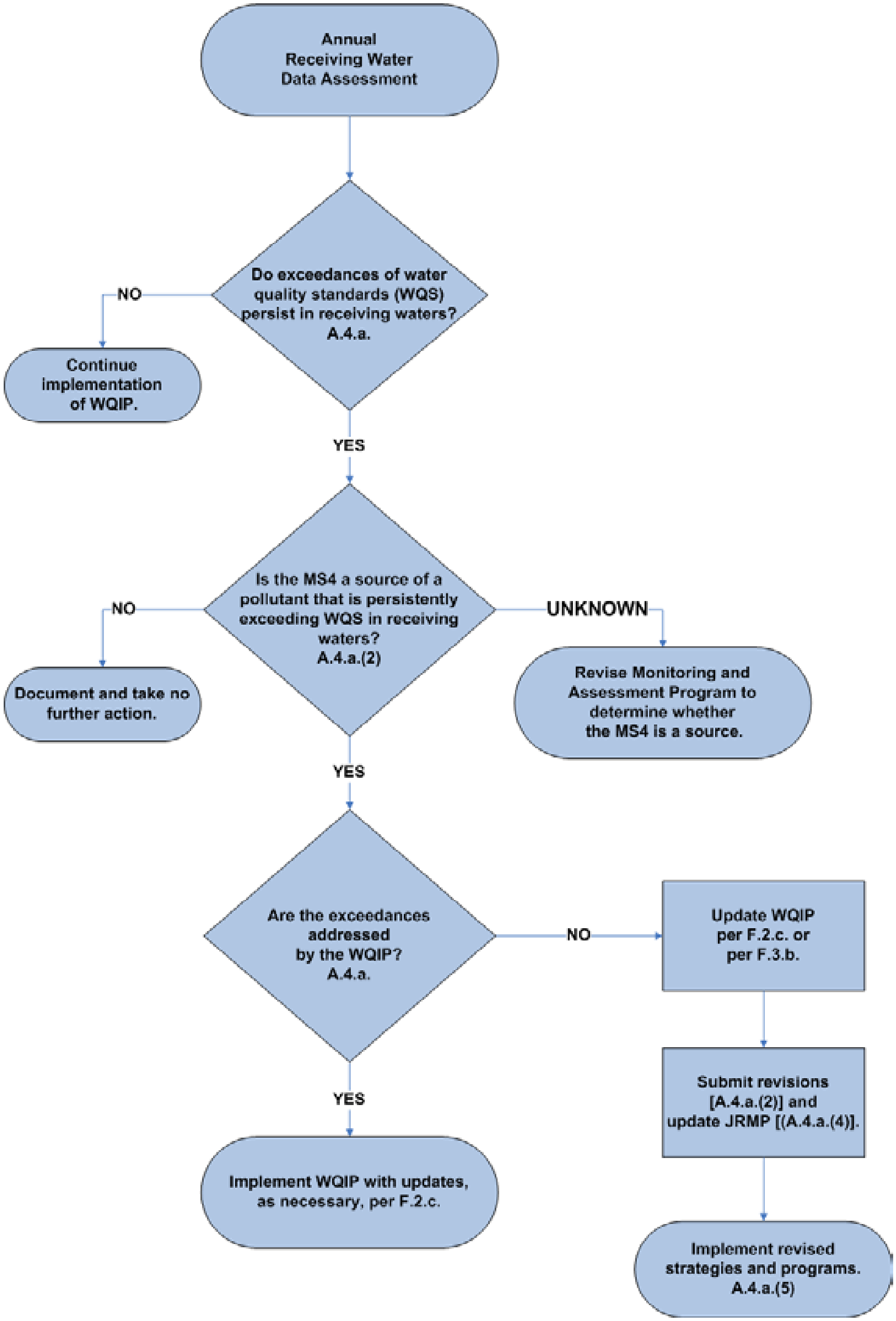


Figure 5-2. Receiving Water Exceedance Process

5.5.1.2.3 *Program Effectiveness Assessments*

Strategies developed within the Plan will be incorporated into individual Participating Agency programs through implementation of their respective JRMPs. Each Participating Agency is implementing programs that are focused on addressing the highest priority water quality conditions within the watershed. While implementation of these programs has been ongoing in many cases, refinements to the programs provide additional focus on the particular water quality issues identified in the Plan. Over time, Participating Agencies will utilize various assessment methods to determine which program refinements are effective and which are not. In some cases, the program effectiveness assessment results may provide useful information leading to adaption of elements of the Plan. Where new information is applicable, it may be used to modify goals, strategies, schedules, and the Monitoring and Assessment Program.

5.5.1.2.4 *Regional Board Recommendations*

Adaptation of the Plan may also be required on the basis of recommendations from the Regional Board. Recommendations may be a result of the public participation process, Consultation Panel, review of submitted reports, or other Regional Board interests.

5.5.2 *Permit Term Assessments and Adaptive Management*

The Permit also contains specific assessments to be performed during preparation of the Report of Waste Discharge. The assessments are longer term in nature, occurring only once during the Permit cycle. Because the updates to the Plan are required to undergo a full public participation process per Provision F.2.c, including reconvening the Consultation Panel, modifications will consider input from the public and the Regional Board. Adaptation of Plan elements will also consider new regulations or policies as appropriate. In the Report of Waste Discharge preparation, all elements of the Plan are eligible for modifications through the required adaptive management processes. Elements that will be evaluated include the water quality conditions (i.e., priorities), goals and accompanying schedules, strategies and accompanying schedules, and the Monitoring and Assessment Program.

5.6 Water Quality Improvement Plan Updates and Reporting

Updates to the Plan will include a public participation process as required by Provision F of the Permit. Annual updates will likely include a more abbreviated public process unless substantial modifications are envisioned. A full public process will be implemented as part of updates associated with the Report of Waste Discharge. Updates will include a process to obtain data from the public, participation by the Consultation Panel, and submittal for approval. As applicable, updates to the Plan will be initiated within six months following OAL and USEPA approval of any TMDLs with WLAs assigned to the Participating Agencies. Updates will be deemed appropriate for inclusion in the Plan 90 days following submission to the Regional Board unless otherwise directed by the Executive Officer. Updates to the Plan will also be made available to the public via the Regional Clearinghouse (i.e., Project Clean Water website) following acceptance by the Regional Board.

Figure 5-3 provides a tentative timeline for the adaptive management process, including implementation schedules for the Plan, JRMPs, and Monitoring and Assessment Programs. Key reporting dates are also included. The timeline assumes that the Plan will be approved by the Regional Board during fall 2015, with implementation beginning in October 2015. The first Annual Report is scheduled to be submitted by the Participating Agencies in January 2017. It will include an abbreviated monitoring and JRMP implementation period because the Monitoring and Assessment Program and JRMP will not be effective until after the approval of the Plan. The second Annual Report for current Permit cycle will be submitted in January 2018. This submittal will be after the submittal of the Report of Waste Discharge that is due to the Regional Board by December 2017.

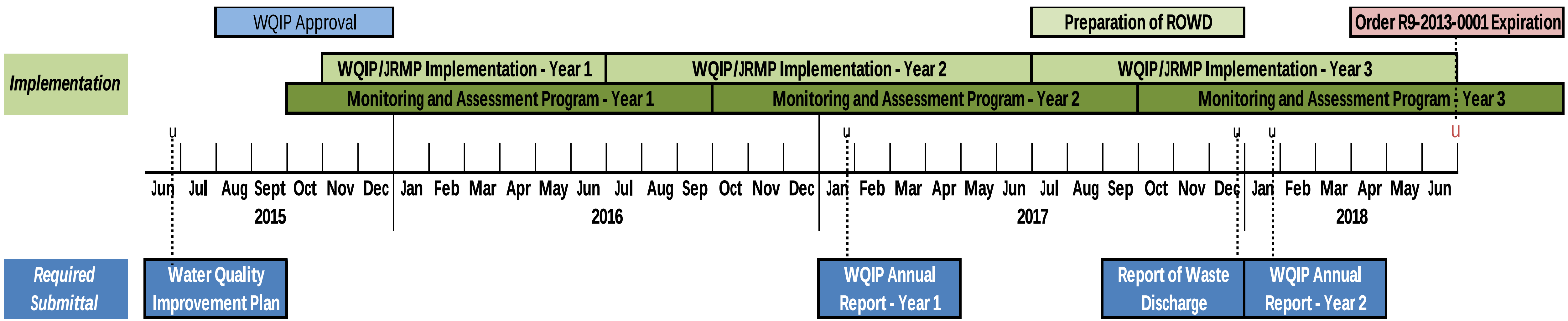


Figure 5-3. Water Quality Improvement Plan Assessment and Reporting Timeline

REFERENCES

AMEC. 2014. Draft Southern California Stormwater Monitoring Coalition (SMC) Annual Report 2013-2014. Prepared for SMC. December.

AMEC. 2014. San Luis Rey River Bacteria TMDL Quality Assurance Project Plan (QAPP). Prepared for the County of San Diego. June.

Armand Ruby Consulting (ARC). (2011). Source Prioritization Process for Bacteria, Draft.

Assembly Bill 411, Chapter 765. 1997 (AB411). An Act to Amend Sections 115880, 115885, and 115915 of the Health and Safety Code, Relating to Public Beaches. Sacramento, California. October.

Bannerman et al. (1993). Sources of Pollutants in Wisconsin Stormwater. Water Science and Technology.

Beach Cities Watershed Management Group (WMG). 2014. Enhanced Watershed Management Program (EWMP) Work Plan. June.

Berg, J., Hedges, S., & Jakubowski, S. (2009). Evaluating Irrigation Effectiveness – Effects of runoff-reducing weather based irrigation (Smart Timers).

City of Oceanside. (2011). Lower San Luis Rey River Bacteria Source Identification Study.

City of San Diego. (2004). Mission Bay Clean Beaches Initiative Bacterial Source Identification Study Final Report.

City of San Diego. (2011a). Phase II Pet Waste Bag Dispenser Station Design and Implementation.

County of San Diego. (2003). An Analysis of Total Dissolved Solids in San Diego County.

County of San Diego. (2011b). Countywide Model SUSMP, Standard Urban Stormwater Mitigation Plan Requirements for Development Applications.

County of Santa Barbara. (1999). Lower Rincon Creek Watershed Study: A Field Investigation into the Sources of Fecal Contamination in the Lower Rincon Creek Watershed and Ocean Interface (Surfzone). Santa Barbara County Environmental Health Services Division.

County of Santa Cruz. (2006). Assessment of Sources of Bacteria Contamination at Santa Cruz County Beaches.

Geosyntec Consultants. 2008. A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0). December.

Geosyntec Consultants. (2010b). Harbor Beaches of Ventura County (Kiddie Beach and Hobie Beach) Wet-Weather Bacteria Total Maximum Daily Load Implementation Plan for Unincorporated Ventura County.

Geosyntec Consultants. 2012. San Diego River Watershed Comprehensive Load Reduction Plan (CLRP). Prepared for the County of San Diego, Cities of El Cajon, La Mesa, Santee, San Diego, and Caltrans. October.

HDR. 2014. Nonstructural Non-Modeled Activity Pollutant Load Reduction Research – Addendum (Final). City of San Diego. November 5, 2014. http://www.sandiego.gov/stormwater/pdf/hdrreport.pdf

Irvine Ranch Water District (IRWD) and Orange County Metropolitan Water District (OCMWD). (2004). Residential Runoff Reduction Study.

Kitts et al. (2002). Identifying the Sources of Escheria coli Contamination to the Shellfish Growing Areas of the Morro Bay Estuary.

Krumgalz et al. (1992). Grain size effect on anthropogenic trace metal and organic matter distribution in marine sediments. Science Total Environment, Vol. 116, 15-30.

Larry Walker Associates, Mikhail Ogawa Engineering, Weston Solutions. 2011 Long-Term Effectiveness Assessment, San Diego Stormwater Copermittees Urban Runoff Management Programs, Final Report. June, 2011.

Pitt and Maclean. (1986). Toronto Area Watershed Management Strategy Study - Humber River Pilot Watershed Project. Ontario Ministry of the Environment.

Project Clean Water. (2010). From www.projectcleanwater.org

San Diego Association of Governments (SANDAG). (2010). From www.sandag.org

San Diego County Municipal Copermittees. 2011. Report of Waste Discharge Application for Renewal of NPDES Municipal Stormwater Permit for San Diego County. June 24. San Diego, CA.

San Diego County Regional Copermittees (SDCRC). (2010). Methodology for Annual and Long-Term Data Assessment for San Diego County Watershed Management Areas, Final Draft, Version 1.

San Diego Geographic Information Source. (2012). From www.sangis.org

San Diego Regional Water Quality Control Board (Regional Board). 2010. Revised TMDL for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (including Tecolote Creek). Resolution No. R9-2010-0001. Approved February 10, 2010. http://www.waterboards.ca.gov/sandiego/water_issues/programs/tmdls/docs/bacteria/updates_022410/2010-0210_BactiI_Resolution&BPA_FINAL.pdf.

San Diego Regional Water Quality Control Board (Regional Board). 2013. Resolution No. R9-2013-0001, National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Storm Drains Draining the Watershed in the San Diego Region (Permit). May 14.

Southern California Coastal Water Research Project (SCCWRP). 2005. Microbiological Water Quality at Reference Beaches in Southern California During Wet Weather (SCCWRP Technical Report 448). August.

Southern California Coastal Water Research Project (SCCWRP). 2007a. Sources, Patterns and Mechanisms of Storm Water Pollutant Loading From Watersheds and Land Uses of the Greater Los Angeles Area, California, USA (SCCWRP Technical Report 510), March.

Southern California Coastal Water Research Project (SCCWRP). 2007b. Assessment of Water Quality Concentrations and Loads from Natural Landscapes (SCCWRP Technical Report 500). February.

State Water Resources Control Board (State Water Board), 2009. Water Quality Control Plan for Enclosed Bays and Estuaries – Part I Sediment Quality. August.

Southern California Coastal Water Research Project (SCCWRP). 2012. Hydromodification Assessment and Management in California. (SCCWRP Technical Report 667). April.

Southern California Coastal Water Research Project (SCCWRP). 2013. San Diego Regional Reference Stream Study Quality Assurance Project Plan, Revised.

Southern California Coastal Water Research Project (SCCWRP). 2014. Work Plan for San Diego Wet Weather Epidemiology Study and Quantitative Microbial Risk Assessment.

State Water Research Control Board. (2012). Water Quality Control Policy for Siting, Design, Operation and Maintenance of Onsite Wastewater Treatment Systems (OWTS Policy). California State Water Resources Control Board.

State Water Resources Control Board (State Water Board), 2013. California Environmental Protection Agency, Surface Water Ambient Monitoring Program, Tools for Assessing the Biological Integrity of Surface Waters. Website visited December 2013. Website last updated October 16, 2014. http://www.waterboards.ca.gov/water_issues/programs/ swamp/tools.shtml. Accessed on November 4, 2013.

Steuer et al. (1997). Sources of Contamination in an Urban Basin in Marquette, Michigan and an Analysis of Concentrations, Loads, and Data Quality. U.S. Geological Survey, Water-Resources Investigations Report 97-4242.

Tetra Tech, Inc. 2013. San Diego River Watershed Comprehensive Load Reduction Plan – Phase II, http://www.sandiego.gov/stormwater/plansreports/index.shtml. July.

USDA, 1996. Urban Hydrology for Small Watersheds. United States Department of Agriculture, Natural Resources Conservation Service, Conservation Engineering Division, Technical Release 55.

U.S. Census Bureau. (2011). From www.census.gov

Weston. (2007). Phase II San Diego River – Ocean Beach Water Quality Improvement Project Report. Weston Solutions.

Weston. (2009). San Diego River Source Tracking Investigation – Phase 1, Final Report, Revision 1. Weston Solutions.

Weston. (2009b). San Diego River Source Tracking Investigation – Phase II, Final Report Revision 1. Weston Solutions.

Weston. (2011). 2011 Long-Term Effectiveness Assessment, San Diego Stormwater Copermittees Urban Runoff Management Programs, Final Report. Weston Solutions.

Weston. (2012). 2010-2011 Receiving Waters and Urban Runoff Monitoring Report. Weston Solutions.

Weston. (2013). 2011-12 Receiving Waters and Urban Runoff Monitoring Report. Weston Solutions.

Weston. (2014). Interim Five-Year MS4 Random Data Analysis. Weston Solutions.

Weston. 2014a. Transitional Receiving Water Monitoring Plan. Prepared for the San Diego County Copermittees. October.

Weston. 2014b. Transitional Monitoring and Assessment Report Appendix H Draft Bioassessment Monitoring Report. Prepared for the San Diego County Copermittees. December.

Weston. 2014c. Transitional Monitoring and Assessment Report Appendix I Draft Sediment Monitoring Report. Prepared for the San Diego County Copermittees. December.

Wright Water Engineers, Inc. and Geosyntec. (2010). International Stormwater BMP Database. From www.bmpdatabase.org

Xanthopoulos and Hahn. (1990). Pollutants attached to particles from drainage areas. Science of the Total Environment, Vol. 93, 441-448.

Chapter 1 – Appendix A: Document Crosswalk

As part of the WQIP Development, the Participating Agencies have collaboratively crafted this document "crosswalk" to provide permit provision references to the corresponding WQIP document sections. This crosswalk is intended to ease the review process.

Permit Provision		Corresponding WQIP Document Section	
A.4 and B	Compliance with Discharge Prohibitions and Receiving Water Limitations	1.3.1	WQIP Requirements
		5.1	MS4 Permit Requirements: Iterative Approach and Adaptive Management
B.2	Priority Water Quality Conditions	2.	Priority Water Quality Conditions
B.2.a.	Assessment of Receiving Water Conditions	2.1	Assessment of Receiving Water Conditions
B.2.a.(1)	Receiving water listed as impaired…	2.1.1	CWA Section 303(d) List of Water Quality Limited Segments
B.2.a.(2)	TMDLs adopted and under development…	2.1.2	TMDLs Adopted and Under Development
B.2.a.(3)	Receiving water recognized as sensitive or highly valued…	2.1.3	Sensitive or Highly Valued Receiving Waters
B.2.a.(4)	The receiving water limitations…	2.1.4	Receiving Water Limitations of Provision A.2
B.2.a.(5)	Known historical versus current physical, chemical, and biological…	2.1.5	Known Historical Versus Current Physical, Chemical, and Biological Water Quality Conditions
B.2.a.(6)	Available, relevant, and appropriately collected and analyzed…receiving water monitoring data…	2.1.6	Physical, Chemical, and Biological Receiving Water Monitoring Data
B.2.a.(7)	Available evidence of erosional impacts…	2.1.7	Hydromodification
B.2.a.(8)	Available evidence of adverse impacts to…receiving waters…	2.1.8	Available Evidence of Adverse Impacts to the Chemical, Physical, and Biological Integrity of Receiving Waters
B.2.a.(9)	The potential improvements in the overall condition of the Watershed Management Area…	2.1.9	Potential Improvements That Can be Achieved in the WMA
B.2.b	Assessment of Impacts From MS4 Discharges	2.2	Assessment of Impacts from MS4 Discharges
B.2.b.(1)	The discharge prohibitions of Provision A.1 and ….Provision A.3…	2.2.1	Prohibitions and Limitations of Provisions A.1 and A.3
B.2.b.(2)	Available, relevant, and appropriately collected and analyzed stormwater monitoring data…	2.2.2	Available Monitoring Data from MS4 Outfalls
B.2.b.(3)	Locations of each Copermittee's MS4 outfalls…	2.2.3	MS4 Outfall Locations that Discharge to Receiving Waters
B.2.b.(4)	Locations of outfalls that are known to persistently discharge non-stormwater…	2.2.4	MS4 Outfalls with Persistent Non-Stormwater Flow
B.2.b.(5)	Locations of outfalls that are known to discharge pollutants in stormwater…	2.2.5	MS4 Outfalls with Stormwater Known to Discharge Pollutants Causing or Contributing to Impacts on Receiving Water Beneficial Uses

Permit Provision		Corresponding WQIP Document Section	
B.2.b.(6)	The potential improvements in the quality of discharges from the MS4…	2.2.6	Potential Improvements That Can be Achieved in MS4 Discharges
B.2.c.	Identification of Priority Water Quality Conditions	2.3	Identification of Priority Water Quality Conditions
		2.3.1	Process to Identify Priority and High Priority Water Quality Conditions
B.2.c.(1)	The Copermittees must use the information…to develop a list of priority water quality conditions…	2.3.2	Priority Water Quality Conditions
B.2.c.(2)	The Copermittees must identify the highest priority water quality conditions…	2.3.3	Highest Priority Water Quality Conditions
B.2.d.	Identification of MS4 Sources of Pollutants and/or Stressors	2.4	Identification of MS4 Sources of Pollutants and/or Stressors
B.2.d.(1)	Pollutant generating facilities, areas, and/or activities…	2.4.1	Pollutant Generating Facilities, Areas, and/or Activities
B.2.d.(2)	Locations of Copermittees' MS4…	2.4.2	Location of the Participating Agencies' MS4s
B.2.d.(3)	Other known and suspected sources of non-stormwater or pollutants in stormwater discharges…	2.4.3	Other Potential Sources
B.2.d.(4)	Review of available data...	2.4.4	Review of Available Data
B.2.d.(5)	The adequacy of available data to identify and prioritize sources…	2.4.5	Data Adequacy
B.3.a	Water Quality Improvement Goals and Schedules	3.1	Water Quality Improvement Goals and Schedules
B.3.a.(1)	Numeric Goals	3.1.1 3.1.2 3.1.3	Compliance Pathways for Required Interim Goals Compliance Pathways for Required Final Goals Jurisdictional Goals
B.3.a.(2)	Schedules for Achieving Numeric Goals	3.1.4	Schedule for Compliance with Interim and Final Goals
B.3.b	Water Quality Improvement Strategies and Schedules	3.2	Water Quality Improvement Strategies
B.3.b.(1)	Jurisdictional Strategies	3.2.3	Jurisdictional Strategies
B.3.b.(2)	Watershed Management Area Strategies	3.2.3.7	Optional Watershed Management Area Strategies
B.3.b.(3)	Schedules for Implementing Strategies	3.2.12	Schedules for Implementing Strategies
B.3.b.(4)	Optional Watershed Management Area Analysis	3.4	Optional Watershed Management Area Analysis
B.4.a	Water Quality Improvement Plan, Monitoring and Assessment Program	4.1.1	Monitoring to Assess Goals and Schedules
B.4.b	Incorporate the monitoring and assessment requirements of Provision D	4.1	Water Quality Improvement Plan Monitoring Program
B.4.c and Attachment E.6	TMDL Monitoring Revised TMDL for Indicator Bacteria, Project I – Twenty Beaches and Creeks	4.1.2.5	TMDL Monitoring

Permit Provision		Corresponding WQIP Document Section	
	in the San Diego Region (including Tecolote)		
B.5	Iterative Approach and Adaptive Management Process	5	Iterative Approach and Adaptive Management Process
B.5.a	Re-Evaluation of Priority Water Quality Conditions, considering provisions B.5.a.(1)-B.5.a.(6)	5.2	Re-evaluation of Priority Water Quality Conditions (B.5.a)
B.5.b	Adaptation of Goals, Strategies and Schedules, considering provisions B.5.b.(1)-B.5.b.(10)	5.3	Adaptation of Goals, Strategies and Schedules
B.5.c	Adaptation of Monitoring and Assessment Program	5.4	Adaptation of Monitoring and Assessment Program
D	Monitoring and Assessment Program Requirements	4.1	Water Quality Improvement Plan Monitoring Program
D.1	Receiving Water Monitoring Requirements	4.1.2	Receiving Water Monitoring
D.1.(b)	Long-Term Receiving Water Monitoring Stations	4.1.2.2	Long-term Receiving Water Monitoring
D.1.(c)	Dry Weather Receiving Water Monitoring	4.1.2.2	Long-term Receiving Water Monitoring
D.1.(d)	Wet Weather Receiving Water Monitoring	4.1.2.2	Long-term Receiving Water Monitoring
D.1.(e)(1)	Regional Monitoring	4.1.2.3	Regional Monitoring Participation
D.1.(e)(2)	Sediment Quality Monitoring	4.1.2.4	Sediment Quality Monitoring
D.2	MS4 Outfall Discharge Monitoring	4.1.3	Storm Drain Outfall Monitoring
D.2.(a)	Transitional MS4 Outfall Discharge Monitoring		
D.2.(b)	Dry Weather MS4 Outfall Monitoring	4.1.3.1	Storm Drain Outfall Dry Weather Monitoring
D.2.(c)	Wet Weather MS4 Outfall Monitoring	4.1.3.2	Storm Drain Outfall Wet Weather Monitoring
D.3	Special Studies, with requirements D.3.(a)-D.3.(f)	4.1.4	Special Studies
D.4	Assessment Requirements	4.2	Water Quality Improvement Plan Assessment Program
D.4.(a)	Receiving Waters Assessments	4.2	Water Quality Improvement Plan Assessment Program
D.4.(b)	MS4 Outfall Discharges Assessments	4.2	Water Quality Improvement Plan Assessment Program
D.4.(c)	Special Studies Assessments	4.2	Water Quality Improvement Plan Assessment Program
D.4.(d)	Integrated Assessment of Water Quality Improvement Plan	4.2	Water Quality Improvement Plan Assessment Program
E.2	Illicit Discharge Detection and Elimination (IDDE)	4.1.5	IDDE Program
F.1	Water Quality Improvement Plans Reporting	1.3.2	Reporting Requirements
F.1.a.(1)	Public Participation Process	1.4.2	Public Participation
F.1.a.(2)	Priority Water Quality Conditions	1.4.2	Public Participation

Permit Provision		Corresponding WQIP Document Section	
F.1.a.(3)	Water Quality Improvement Goals, Strategies and Schedules	1.4.2	Public Participation
F.3	Progress Reporting	4.2	Water Quality Improvement Plan Assessment Program
F.4	Regional Clearinghouse	4.1.6	Regional Clearinghouse

LIST OF APPENDICES FOR CHAPTER 2

CHAPTER 2 – APPENDIX A: 303(D) LIST FOR WATER BODIES IN THE SAN DIEGO RIVER WATERSHED

Table 2A-1. 303(d) Listed Waterbodies in SDR Watershed

Sub Watershed	WATER BODY NAME (* Urban Runoff is listed as a Potential Source)	WATER BODY TYPE	ESTIMATED SIZE AFFECTED	UNIT	POLLUTANT	POTENTIAL SOURCES	SOURCE CATEGORY	Impacted Beneficial Use based on 2010 Integrated Report Line of Evidence	Existing Beneficial Uses for the waterbody from the Basin Plan
Downstream of Reservoirs	Alvarado Creek*	River & Stream	5	Miles	Selenium	Other Urban Runoff	Urban Runoff	Warm Freshwater Habitat	AGR; IND; REC1; REC2; WARM; WILD
Downstream of Reservoirs	Famosa Slough and Channel*	Estuary	32	Acres	Eutrophic	Urban Runoff/Storm Sewers	Urban Runoff	Marine Habitat	REC1; REC2; COMM; EST; WILD; RARE; MAR; MIGR; SPWN; SHELL
						Point Source	Unspecified Point Source		
						Nonpoint Source	Unspecified Nonpoint Source		
Downstream of Reservoirs	Forester Creek*	River & Stream	6	Miles	Fecal Coliform	Urban Runoff/Storm Sewers	Urban Runoff	Water Contact Recreation	IND; REC1; REC2; WARM; WILD
						Unknown Nonpoint Source	Unspecified Nonpoint Source		
						Unknown Point Source	Unspecified Point Source		
						Spills	Unpermitted Discharges		
					Selenium	Source Unknown	Source Unknown	Warm Freshwater Habitat	
					Total Dissolved Solids	Unknown Nonpoint Source	Unspecified Nonpoint Source	Industrial Service Supply	
						Unknown Point Source	Unspecified Point Source		
						Agricultural Return Flows	Agriculture		
						Flow Regulation/ Modification	Hydromodification		
						Urban Runoff/Storm Sewers	Urban Runoff		
					pH	Unknown Point Source	Unspecified Point Source	Industrial Service Supply	
						Habitat Modification	Habitat Modification		
						Industrial Point Sources	Industrial Wastewater		
						Unknown Nonpoint Source	Unspecified Nonpoint Source		
						Spills	Unpermitted Discharges		
Downstream of Reservoirs	Los Coches Creek	River & Stream	9	Miles	Selenium	Source Unknown	Source Unknown	Warm Freshwater Habitat	IND; REC1; REC2; WARM; WILD

Sub Watershed	WATER BODY NAME (* Urban Runoff is listed as a Potential Source)	WATER BODY TYPE	ESTIMATED SIZE AFFECTED	UNIT	POLLUTANT	POTENTIAL SOURCES	SOURCE CATEGORY	Impacted Beneficial Use based on 2010 Integrated Report Line of Evidence	Existing Beneficial Uses for the waterbody from the Basin Plan
Downstream of Reservoirs	Murray Reservoir*	Lake & Reservoir	119	Acres	Nitrogen	Urban Runoff/Storm Sewers	Urban Runoff	Warm Freshwater Habitat	MUN; IND; REC1; REC2; WARM; COLD; WILD; POW
						Unknown Nonpoint Source	Unspecified Nonpoint Source		
						Natural Sources	Natural Sources		
					pH	Source Unknown	Source Unknown	Municipal & Domestic Supply	
Downstream of Reservoirs	Pacific Ocean Shoreline, San Diego HU, at the San Diego River outlet, at Dog Beach*	Coastal & Bay Shoreline	0	Miles	Enterococcus	Source Unknown	Source Unknown	Water Contact Recreation	REC1; REC2; COMM; EST; WILD; RARE; MAR; MIGR; SPWN; SHELL
					Total Coliform	Unknown Nonpoint Source	Unspecified Nonpoint Source	Water Contact Recreation	
						Urban Runoff/Storm Sewers	Urban Runoff		
						Unknown Point Source	Unspecified Point Source		
Downstream of Reservoirs	San Diego River (Lower)*	River & Stream	16	Miles	Enterococcus	Point Source	Unspecified Point Source	Water Contact Recreation	AGR; IND; REC1; REC2; BIOL; WARM; WILD; RARE
						Nonpoint Source	Unspecified Nonpoint Source		
						Urban Runoff/Storm Sewers	Urban Runoff		
					Fecal Coliform	Wastewater	Municipal Wastewater	Water Contact Recreation	
						Point Source	Unspecified Point Source		
						Urban Runoff/Storm Sewers	Urban Runoff		
						Nonpoint Source	Unspecified Nonpoint Source		
					Low Dissolved Oxygen	Unknown Nonpoint Source	Unspecified Nonpoint Source	Warm Freshwater Habitat	
						Unknown Point Source	Unspecified Point Source		
						Urban Runoff/Storm Sewers	Urban Runoff		
					Manganese	Source Unknown	Source Unknown	Municipal & Domestic Supply	
					Nitrogen	Urban Runoff/Storm Sewers	Urban Runoff	Warm Freshwater Habitat	
						Nonpoint Source	Unspecified Nonpoint Source		
						Point Source	Unspecified Point Source		

Sub Watershed	WATER BODY NAME (* Urban Runoff is listed as a Potential Source)	WATER BODY TYPE	ESTIMATED SIZE AFFECTED	UNIT	POLLUTANT	POTENTIAL SOURCES	SOURCE CATEGORY	Impacted Beneficial Use based on 2010 Integrated Report Line of Evidence	Existing Beneficial Uses for the waterbody from the Basin Plan
					Phosphorus	Unknown Nonpoint Source	Unspecified Nonpoint Source	Warm Freshwater Habitat	
						Urban Runoff/Storm Sewers	Urban Runoff		
						Unknown Point Source	Unspecified Point Source		
					Total Dissolved Solids	Flow Regulation/Modification	Hydromodification	Agricultural Supply	
						Unknown Point Source	Unspecified Point Source		
						Natural Sources	Natural Sources		
						Unknown Nonpoint Source	Unspecified Nonpoint Source		
						Urban Runoff/Storm Sewers	Urban Runoff		
					Toxicity	Nonpoint Source	Unspecified Nonpoint Source	Warm Freshwater Habitat	
						Other Urban Runoff	Urban Runoff		
						Unknown Point Source	Unspecified Point Source		
Upstream of Reservoirs	El Capitan Lake*	Lake & Reservoir	1454	Acres	Color	Source Unknown	Source Unknown	Municipal & Domestic Supply	MUN; AGR; IND; PROC; REC1; REC2; WARM; COLD; WILD; RARE
					Manganese	Source Unknown	Source Unknown	Municipal & Domestic Supply	
					Phosphorus	Other Urban Runoff	Urban Runoff	Warm Freshwater Habitat	
					Total Nitrogen as N	Other Urban Runoff	Urban Runoff	Municipal & Domestic Supply	
					pH	Source Unknown	Source Unknown	Municipal & Domestic Supply	
Upstream of Reservoirs	San Vicente Creek (San Diego County)	River & Stream	16	Miles	Ammonia as Nitrogen	Source Unknown	Source Unknown	Warm Freshwater Habitat	MUN; AGR; IND; PROC; REC1; REC2; WARM; WILD
					Benthic Community Effects	Source Unknown	Source Unknown		
					Total Nitrogen as N	Source Unknown	Source Unknown		
					Toxicity	Source Unknown	Source Unknown		

Sub Watershed	WATER BODY NAME (* Urban Runoff is listed as a Potential Source)	WATER BODY TYPE	ESTIMATED SIZE AFFECTED	UNIT	POLLUTANT	POTENTIAL SOURCES	SOURCE CATEGORY	Impacted Beneficial Use based on 2010 Integrated Report Line of Evidence	Existing Beneficial Uses for the waterbody from the Basin Plan
Upstream of Reservoirs	San Vicente Reservoir*	Lake & Reservoir	1058	Acres	Chloride	Source Unknown	Source Unknown	Municipal & Domestic Supply	MUN; AGR; IND; PROC; REC1; REC2; WARM; COLD; WILD
						Water Diversions	Hydromodification		
						Unknown Nonpoint Source	Unspecified Nonpoint Source		
					Color	Water Diversions	Hydromodification		
						Unknown Nonpoint Source	Unspecified Nonpoint Source		
					Sulfates	Water Diversions	Hydromodification		
						Unknown Nonpoint Source	Unspecified Nonpoint Source		
					Total Nitrogen as N	Unknown Nonpoint Source	Unspecified Nonpoint Source		
						Urban Runoff/Storm Sewers	Urban Runoff		
					pH (high)	Water Diversions	Hydromodification		
						Unknown Nonpoint Source	Unspecified Nonpoint Source		

CHAPTER 2 – APPENDIX B: TMDL WQBELS FOR THE SAN DIEGO RIVER

Table 2B-1. (Order No. 2013-0001, Attachment E, Table 6.2a) Final Receiving Water Limitations Expressed as Bacteria Densities and Allowable Exceedance Frequencies for Beaches

Constituent	Wet Weather Days		Dry Weather Days	
	Single Sample Maximum[a,b] (MPN/100ml)	Single Sample Maximum Allowable Exceedance Frequency[c]	30-Day Geometric Mean[b] (MPN/100mL)	30-Day Geometric Mean Allowable Exceedance Frequency
Total Coliform	10,000	22%	1,000	0%
Fecal Coliform	400	22%	200	0%
Enterococcus	104	22%	35	0%

Notes:
a. During wet weather days, only the single sample maximum receiving water limitations are required to be achieved.
b. During dry weather days, the single sample maximum and 30-day geometric mean receiving water limitations are required to be achieved.
c. The 22% single sample maximum allowable exceedance frequency only applies to wet weather days. For dry weather days, the dry weather bacteria densities must be consistent with the single sample maximum REC-1 water quality objectives in the Ocean Plan.

Table 2B-2. (Order No. 2013-0001, Attachment E, Table 6.2b) Final Receiving Water Limitations Expressed as Bacteria Densities and Allowable Exceedance Frequencies for Creeks

Constituent	Wet Weather Days		Dry Weather Days	
	Single Sample Maximum[a,b] (MPN/100ml)	Single Sample Maximum Allowable Exceedance Frequency[c]	30-Day Geometric Mean[b] (MPN/100mL)	30-Day Geometric Mean Allowable Exceedance Frequency
Fecal Coliform	400	22%	200	0%
Enterococcus	61 (104)	22%	33	0%

Notes:
a. During wet weather days, only the single sample maximum receiving water limitations are required to be achieved.
b. During dry weather days, the single sample maximum and 30-day geometric mean receiving water limitations are required to be achieved.
c. The 22% single sample maximum allowable exceedance frequency only applies to wet weather days. For dry weather days, the dry weather bacteria densities must be consistent with the single sample maximum REC-1 water quality objectives in the Basin Plan.
d. A single sample maximum of 104 MPN/100ml for Enterococcus may be applied as a receiving water limitation for creeks, instead of 61 MPN/100mL, if one or more of the creeks addressed by these TMDLs (San Juan Creek, Aliso Creek, Tecolote Creek, Forrester Creek, San Diego River, and/or Chollas Creek) is designated with a "moderately to lightly used area" or less frequent usage frequency in the Basin Plan. Otherwise, the single sample maximum of 61 MPN/100mL for Enterococcus must be used to assess compliance with the allowable exceedance frequency.

Table 2B-3. (Order No. 2013-0001, Attachment E, Table 6.5) Interim Wet Weather Receiving Water Limitations Expressed as Interim Wet Weather Allowable Exceedance Frequencies

Watershed Management Area and Watershed	Water Body	Segment or Area	Interim Wet Weather Allowable Exceedance Frequencies		
			Total Coliform	Fecal Coliform	*Enterococcus*
San Diego River Mission San Diego HSA (907.11) and Santee HSA (907.12)	Forrester Creek	lower 1 mile	46%	43%	49%
	San Diego River	lower 6 miles	46%	43%	49%
	Pacific Ocean Shoreline	at San Diego River mouth at Dog Beach	46%	43%	51%

CHAPTER 2 – APPENDIX C: DETAILED MS4 SUMMARY DATA TABLES

Table 2C-3. Benchmarks and Sources

Data Source				
Constituent	**Units**	**Wet Weather Water Quality Benchmark**	**Dry Weather Water Quality Benchmark**	**Source**
pH	pH units	6.5-9.0	6.5-9.0	1. Basin Plan
Nitrate as N	mg/L	10	10	1. Basin Plan
Nitrate/Nitrite as N	mg/L	10	10	1. Basin Plan
Nitrite as N	mg/L	1	1	1. Basin Plan
Total Nitrogen	mg/L	NA	1	1. Basin Plan
Total Phosphorus	mg/L	2	0.1	2. MSGP 2000, 1. Basin Plan
Dissolved Phosphorous	mg/L	2	0.1	2. MSGP 2000, 1. Basin Plan
Total Suspended Solids	mg/L	100	58	2. MSGP 2000
Total Dissolved Solids (calculated)[1]	mg/L	500	500	1. Basin Plan
Fecal Coliform	MPN/100 mL	400	400	1. Basin Plan REC-1
Enterococci	MPN/100 mL	NA	151	1. Basin Plan
Total Coliform	MPN/100 mL	NA	NA	1. Basin Plan (Bays and Estuaries and Shell Criteria)
Ammonia as N	mg/L	CMC (Salmonids Absent) Calculation based on pH, Temp	CCC (Salmonids Absent) Calculation based on pH, Temp	3. U.S. EPA Water Quality Criteria (Freshwater)
Turbidity	NTU	20	20	1. Basin Plan
Chloride	mg/L	250	250	1. Basin Plan
Total Selenium	mg/L	NA	0.005	5. 40 CFR 131.38
Oil & Grease	mg/L	10	10	1 Basin Plan, 2. MSGP 2000
Biochemical oxygen demand	mg/L	30	10	2. MSGP 2000, 4. McNeeley (1979)
Chemical oxygen demand	mg/L	120	120	2. MSGP 2000
Dissolved Oxygen	mg/L	<5	<5	1. Basin Plan

* NA indicate no criteria or published value was available or applicable to the matrix or program.

1. San Diego Regional Water Quality Control Plan for the San Diego Region (Basin Plan), 1994 (with amendments effective prior to April 25, 2007)
2. Multisector General Permit for Industrial Activities, Section 2
3. U.S. EPA, 1999 Update of Ambient Water Quality Criteria for Ammonia, EPA-822-R-99-014, December 1999

4. Mcneely, R.N., Neimasis, V.P., Dwyer, L. (1979), Oxygen-chemical oxygen demand. In: Water Quality Sourcebook. A guide to water quality parameters. Water Quality Branch Inland Waters Directorate, Environment Canadá, Ottawa, p.32-33.

5. 40 CFR 131.38

(a) Water Quality Benchmark for total dissolved solids is based on the San Diego Regional Water Quality Control Plan by watershed for the San Diego Region (Basin Plan), 1994 (with ammendments effective prior to April 25, 2007).

NA - No criteria or published value was available or applicable to the matrix or program.

Sources

Please refer to the San Diego County Copermittee Regional Monitoring Program Benchmark Sources for benchmark source citations

Chapter 2 – Appendix D: Priority and Highest Priority Water Quality Conditions

Table 2D-1. SDR WMA Priority Water Quality Conditions - Dry Weather [B.2.c.(1)]

STEP 3															
1	2	3	4		5		6		7	8		9			10
Sub Watershed	Extent (water body name) B.2.c.(1)(b)	Condition or Pollutant	Condition observed in SDR WMA	Criterion Score (Observed Yes=1)	Impaired Beneficial Use B.2.c.(1)(a)	Criterion Score (Impaired Use Yes=1)	Exceeds LTEA/RMR Benchmarks	Criterion Score (Exceeds Benchmarks Yes=1)	Potential sources (2010 Integrated Report)	MS4 Discharge may contribute to condition B.2.c.(1)(d)	Criterion Score (Urban Runoff as Source=1)	Monitoring data and data gaps B.2.c(1)(e)/ Other Rationale	Criterion Score (Adequate Data Yes=1)	Criteria Tally	PWQC? (Score of 4 = PWQC, *Score of 5 = moves to HPWQC)
Downstream of Reservoirs	Alvarado Creek	Selenium	Yes	1	Warm Freshwater Habitat	1	No	0	Other Urban Runoff	Yes. Urban runoff listed as a source	1	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	3	No
	Famosa Slough and Channel	Eutrophic	Yes	1	Marine Habitat	1	Yes	1	Urban Runoff/Storm Sewers; Point Source; Nonpoint Source	Yes. Urban runoff listed as a source	1	Condition common to both MS4 outfall and receiving waters, based on Interim Five-Year MS4 Random Data Analysis (2014)	1	5	Yes *
	Forester Creek	Indicator Bacteria	Yes	1	Water Contact Recreation	1	Yes	1	Urban Runoff/Storm Sewers; Unknown Point Source; Unknown Nonpoint Source; Spills	Yes. Urban runoff listed as a source	1	Indicator Bacterial TMDL	1	5	Yes *
		Selenium	Yes	1	Warm Freshwater Habitat	1	No	0	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
		Total Dissolved Solids	Yes	1	Industrial Service Supply	1	Yes	1	Unknown Nonpoint Source; Unknown Point Source; Agricultural Return Flows; Flow Regulation/Modification; Urban Runoff/Storm Sewers	Yes. Urban runoff listed as a source	1	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	4	Yes
		pH	Yes	1	Industrial Service Supply	1	No	0	Unknown Point Source; Habitat Modification; Industrial Point Sources; Unknown Nonpoint Source; Spills	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
	Los Coches Creek	Selenium	Yes	1	Warm Freshwater Habitat	1	No	0	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
	Murray Reservoir	Nitrogen	Yes	1	Warm Freshwater Habitat	1	Yes	1	Urban Runoff/Storm Sewers; Unknown Nonpoint Source; Natural Sources	Yes. Urban runoff listed as a source	1	Condition common to both MS4 outfall and receiving waters, based on Interim Five-Year MS4 Random Data Analysis (2014)	1	5	Yes *
		pH	Yes	1	Municipal & Domestic Supply	1	No	0	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
	Pacific Ocean Shoreline, San Diego HU, at the San Diego River outlet, at Dog Beach	Enterococcus	Yes	1	Water Contact Recreation	1	Yes	1	Source Unknown	No evidence	0	Indicator Bacteria TMDL	1	4	Yes
		Total Coliform	Yes	1	Water Contact Recreation	1	Yes	1	Unknown Nonpoint Source; Urban Runoff/Storm Sewers; Unknown Point Source	Yes. Urban runoff listed as a source	1	Indicator Bacteria TMDL	1	5	Yes *

Table 2D-2. SDR WMA Highest Priority Water Quality Conditions - Dry Weather [B.2.c.(2)]

		STEP 4								
		11	12		13		14			15
Extent (water body name)	Condition or Pollutant	Approved TMDL Yes - HPWQC No - Continue	Spatially Appropriate and Robust Dataset	Criterion Score (Yes=1)	Storm water as predominant source	Criterion Score (Yes=1)	Sources controllable by MS4 Agency	Criterion Score (Yes=1)	Criteria Tally	HPWQC? (Score of 3 in Step 4 = HPWQC)
Alvarado Creek	Selenium	No	--	--	--	--	--	--	--	No
Famosa Slough and Channel	Eutrophic	No	Yes	1	No	0	No	0	1	No
Forester Creek	Indicator Bacteria	Yes	--	--	--	--	--	--	--	Yes
Forester Creek	Selenium	No	--	--	--	--	--	--	--	No
Forester Creek	Total Dissolved Solids	No	--	--	--	--	--	--	--	No
Forester Creek	pH	No	--	--	--	--	--	--	--	No
Los Coches Creek	Selenium	No	--	--	--	--	--	--	--	No
Murray Reservoir	Nitrogen	No	Y	1	N	0	N	0	1	No
Murray Reservoir	pH	No	--	--	--	--	--	--	--	No
Pacific Ocean Shoreline, San Diego HU, at the San Diego River outlet, at Dog Beach	Enterococcus	Yes	--	--	--	--	--	--	--	Yes
Pacific Ocean Shoreline, San Diego HU, at the San Diego River outlet, at Dog Beach	Total Coliform	Yes	--	--	--	--	--	--	--	Yes

Note: * Potential HPWQC

Table 2D-1. SDR WMA Priority Water Quality Conditions - Dry Weather [B.2.c.(1)]

STEP 3															
1	2	3	4		5		6		7	8		9			10
Sub Watershed	Extent (water body name) B.2.c.(1)(b)	Condition or Pollutant	Condition observed in SDR WMA	Criterion Score (Observed Yes=1)	Impaired Beneficial Use B.2.c.(1)(a)	Criterion Score (Impaired Use Yes=1)	Exceeds LTEA/RMR Benchmarks	Criterion Score (Exceeds Benchmarks Yes=1)	Potential sources (2010 Integrated Report)	MS4 Discharge may contribute to condition B.2.c.(1)(d)	Criterion Score (Urban Runoff as Source=1)	Monitoring data and data gaps B.2.c(1)(e)/ Other Rationale	Criterion Score (Adequate Data Yes=1)	Criteria Tally	PWQC? (Score of 4 = PWQC, *Score of 5 = moves to HPWQC)
Downstream of Reservoirs	San Diego River (Lower)	Enterococcus	Yes	1	Water Contact Recreation	1	Yes	1	Point Source; Nonpoint Source; Urban Runoff/Storm Sewers	Yes. Urban runoff listed as a source	1	Priority condition common to both MS4 outfall and receiving waters Based on FY11-12 Regional Monitoring Report for SDR-MLS & SDR-TWAS1 Total Phosphorous (NPDES Program; SMC Program; Third-Party Data) Dissolved Phosphorous (NPDES Program) TDS (NPDES Program; SMC Program; Third-Party Data) Total Nitrogen (SMC Program) Fecal Coliform/Enterococcus (Third-Party Data)	1	5	Yes *
		Fecal Coliform	Yes	1	Water Contact Recreation	1	Yes	1	Wastewater; Point Source; Urban Runoff/Storm Sewers; Nonpoint Source	Yes. Urban runoff listed as a source	1		1	5	Yes *
		Low Dissolved Oxygen	Yes	1	Warm Freshwater Habitat	1	No	0	Unknown Nonpoint Source; Unknown Point Source; Urban Runoff/Storm Sewers	Yes. Urban runoff listed as a source	1		0	3	No
		Manganese	Yes	1	Municipal & Domestic Supply	1	No	0	Source Unknown	No evidence	0		0	2	No
		Nitrogen	Yes	1	Warm Freshwater Habitat	1	Yes	1	Urban Runoff/Storm Sewers; Nonpoint Source; Point Source	Yes. Urban runoff listed as a source	1		1	5	Yes *
		Phosphorus	Yes	1	Warm Freshwater Habitat	1	Yes	1	Unknown Nonpoint Source; Urban Runoff/Storm Sewers; Unknown Point Source	Yes. Urban runoff listed as a source	1		1	5	Yes *
		Total Dissolved Solids	Yes	1	Agricultural Supply	1	Yes	1	Flow Regulation/Modification; Unknown Point Source; Natural Sources; Unknown Nonpoint Source; Urban Runoff/Storm Sewers	Yes. Urban runoff listed as a source	1		1	5	Yes *
		Toxicity	Yes	1	Warm Freshwater Habitat	1	No	0	Nonpoint Source; Other Urban Runoff; Unknown Point Source	Yes. Urban runoff listed as a source	1		0	3	No
		IBI	Yes	1	N/A	0	Yes	1	N/A	Yes. Urban runoff/storm sewers as source of Flow Regulation/Modification	1	Poor IBI scores noted in LTEA and RMR	1	4	Yes

Table 2D-2. SDR WMA Highest Priority Water Quality Conditions - Dry Weather [B.2.c.(2)]

STEP 4								
11	12		13		14			15
Approved TMDL Yes - HPWQC No - Continue	Spatially Appropriate and Robust Dataset	Criterion Score (Yes=1)	Storm water as predominant source	Criterion Score (Yes=1)	Sources controllable by MS4 Agency	Criterion Score (Yes=1)	Criteria Tally	HPWQC? (Score of 3 in Step 4 = HPWQC)
Yes	--	--	--	--	--	--	--	Yes
Yes	--	--	--	--	--	--	--	Yes
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	Y	1	N	0	N	0	1	No
No	Y	1	N	0	N	0	1	No
No	Y	1	Y	0	N	0	1	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No

Note: * Potential HPWQC

Table 2D-1. SDR WMA Priority Water Quality Conditions - Dry Weather [B.2.c.(1)]

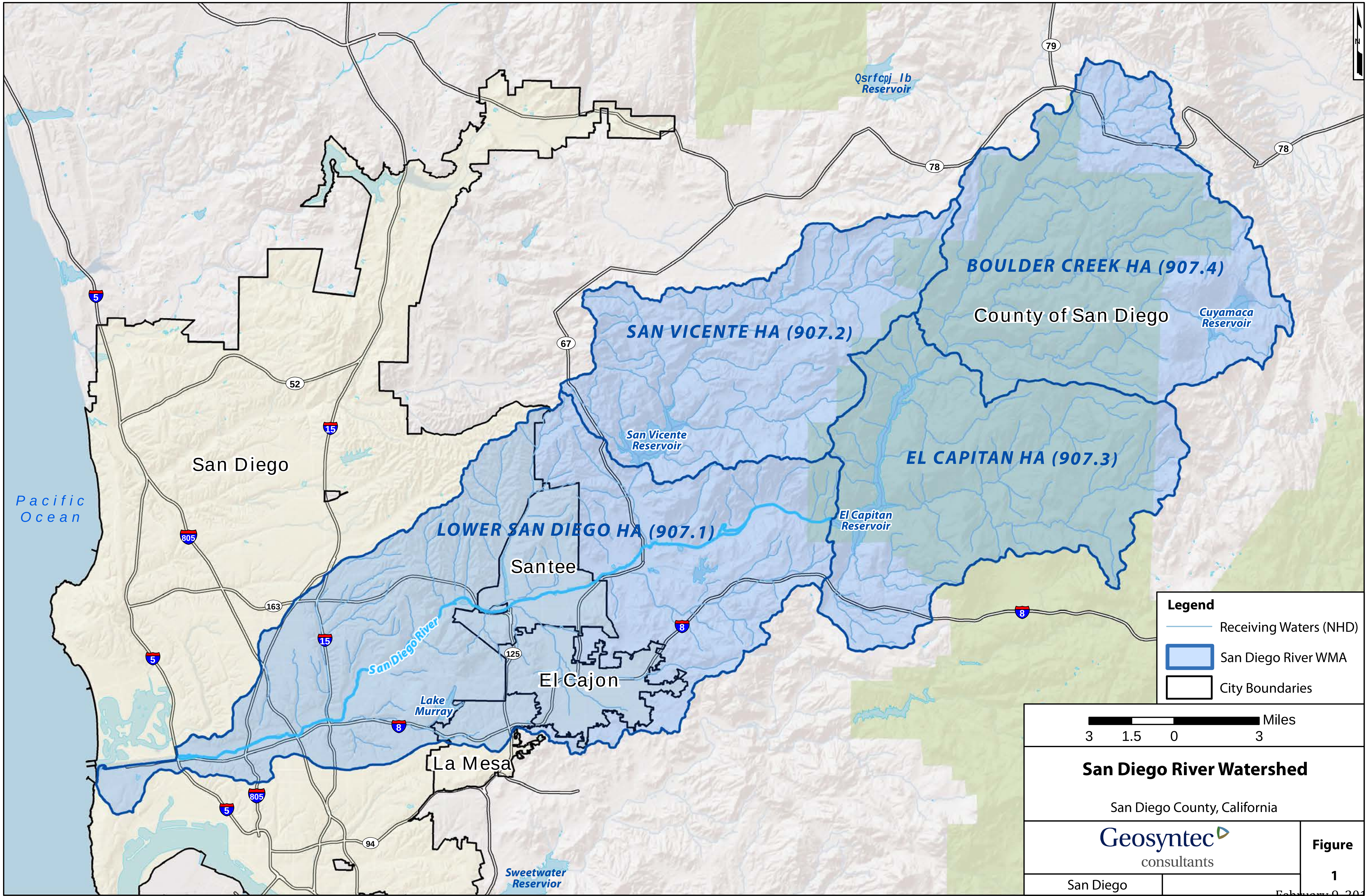
STEP 3															
1	2	3	4		5		6		7	8		9			10
Sub Watershed	Extent (water body name) B.2.c.(1)(b)	Condition or Pollutant	Condition observed in SDR WMA	Criterion Score (Observed Yes=1)	Impaired Beneficial Use B.2.c.(1)(a)	Criterion Score (Impaired Use Yes=1)	Exceeds LTEA/RMR Benchmarks	Criterion Score (Exceeds Benchmarks Yes=1)	Potential sources (2010 Integrated Report)	MS4 Discharge may contribute to condition B.2.c.(1)(d)	Criterion Score (Urban Runoff as Source=1)	Monitoring data and data gaps B.2.c(1)(e)/ Other Rationale	Criterion Score (Adequate Data Yes=1)	Criteria Tally	PWQC? (Score of 4 = PWQC, *Score of 5 = moves to HPWQC)
Upstream of Reservoirs	El Capitan Lake	Color	Yes	1	Municipal & Domestic Supply	1	No	0	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
		Manganese	Yes	1	Municipal & Domestic Supply	1	No	0	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
		Phosphorus	Yes	1	Warm Freshwater Habitat	1	Yes	1	Other Urban Runoff	Yes. Urban runoff listed as a source	1	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	4	Yes
		Total Nitrogen as N	Yes	1	Municipal & Domestic Supply	1	Yes	1	Other Urban Runoff	Yes. Urban runoff listed as a source	1	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	4	Yes
		pH	Yes	1	Municipal & Domestic Supply	1	No	0	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
	San Vicente Creek (San Diego County)	Ammonia as Nitrogen	Yes	1	Warm Freshwater Habitat	1	No	0	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
		Benthic Community Effects	Yes	1		1	No	0	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
		Total Nitrogen as N	Yes	1		1	Yes	1	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	3	No
		Toxicity	Yes	1		1	No	0	Source Unknown	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
	San Vicente Reservoir	Chloride	Yes	1	Municipal & Domestic Supply	1	No	0	Source Unknown; Water Diversions; Unknown Nonpoint Source	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
		Color	Yes	1		1	No	0	Water Diversions; Unknown Nonpoint Source	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
Upstream of Reservoirs	San Vicente Reservoir	Sulfates	Yes	1	Municipal & Domestic Supply	1	No	0	Water Diversions; Unknown Nonpoint Source	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No
		Total Nitrogen as N	Yes	1		1	Yes	1	Unknown Nonpoint Source; Urban Runoff/Storm Sewers	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	3	No
		pH (high)	Yes	1		1	No	0	Water Diversions; Unknown Nonpoint Source	No evidence	0	Inconclusive monitoring data to link MS4 outfall data to receiving water condition	0	2	No

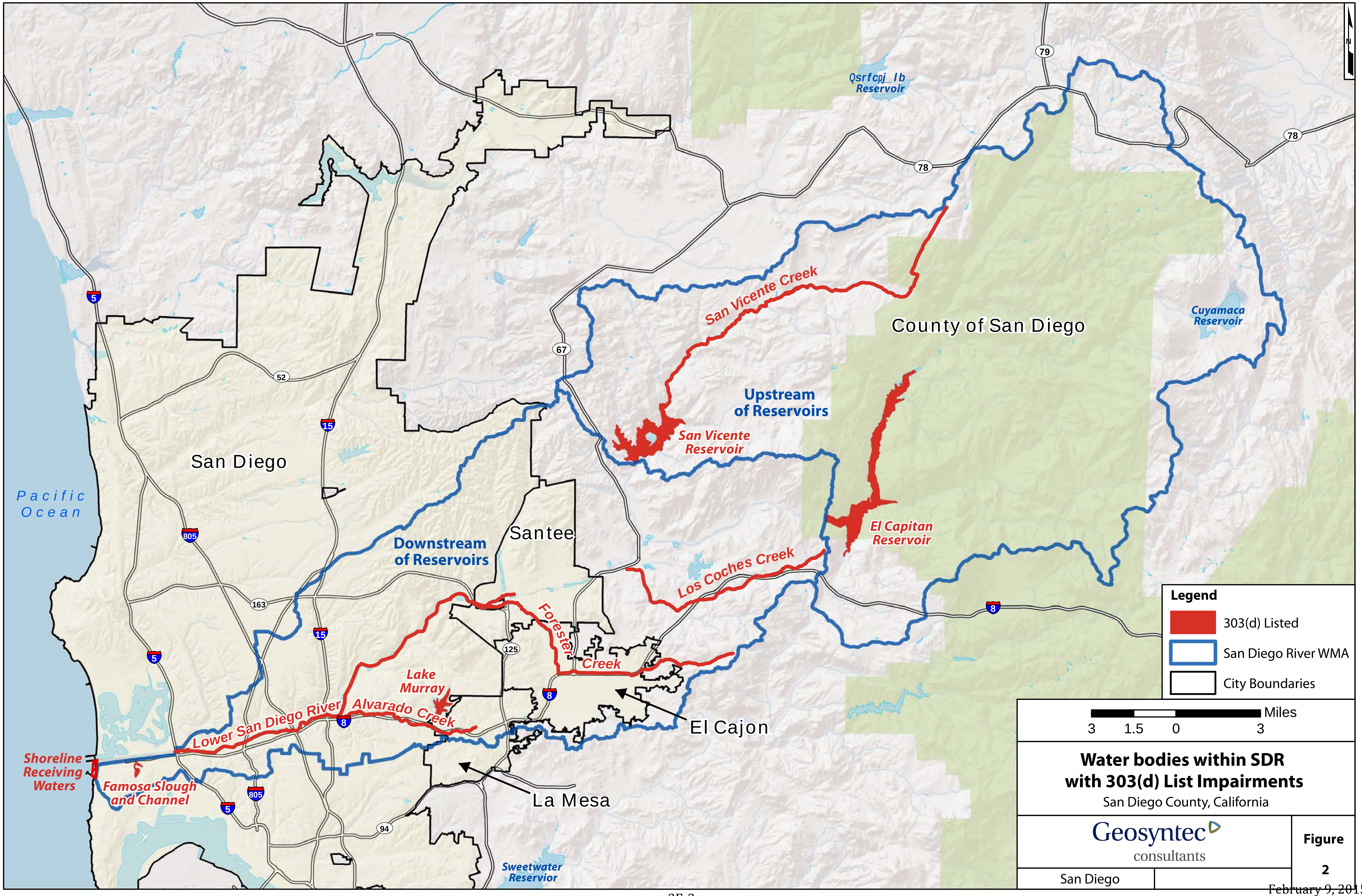
Note: * Potential HPWQC

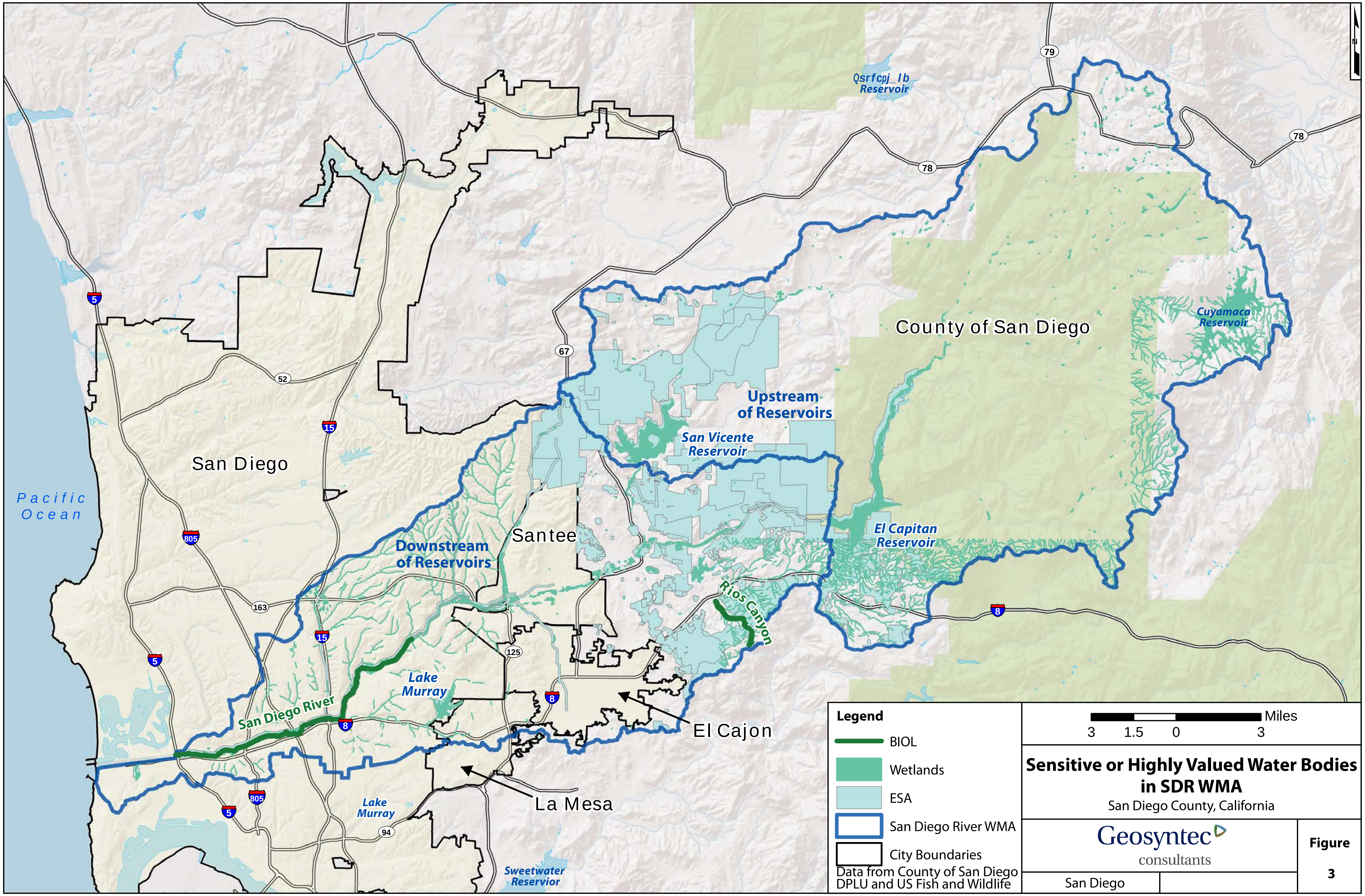
Table 2D-2. SDR WMA Highest Priority Water Quality Conditions - Dry Weather [B.2.c.(2)]

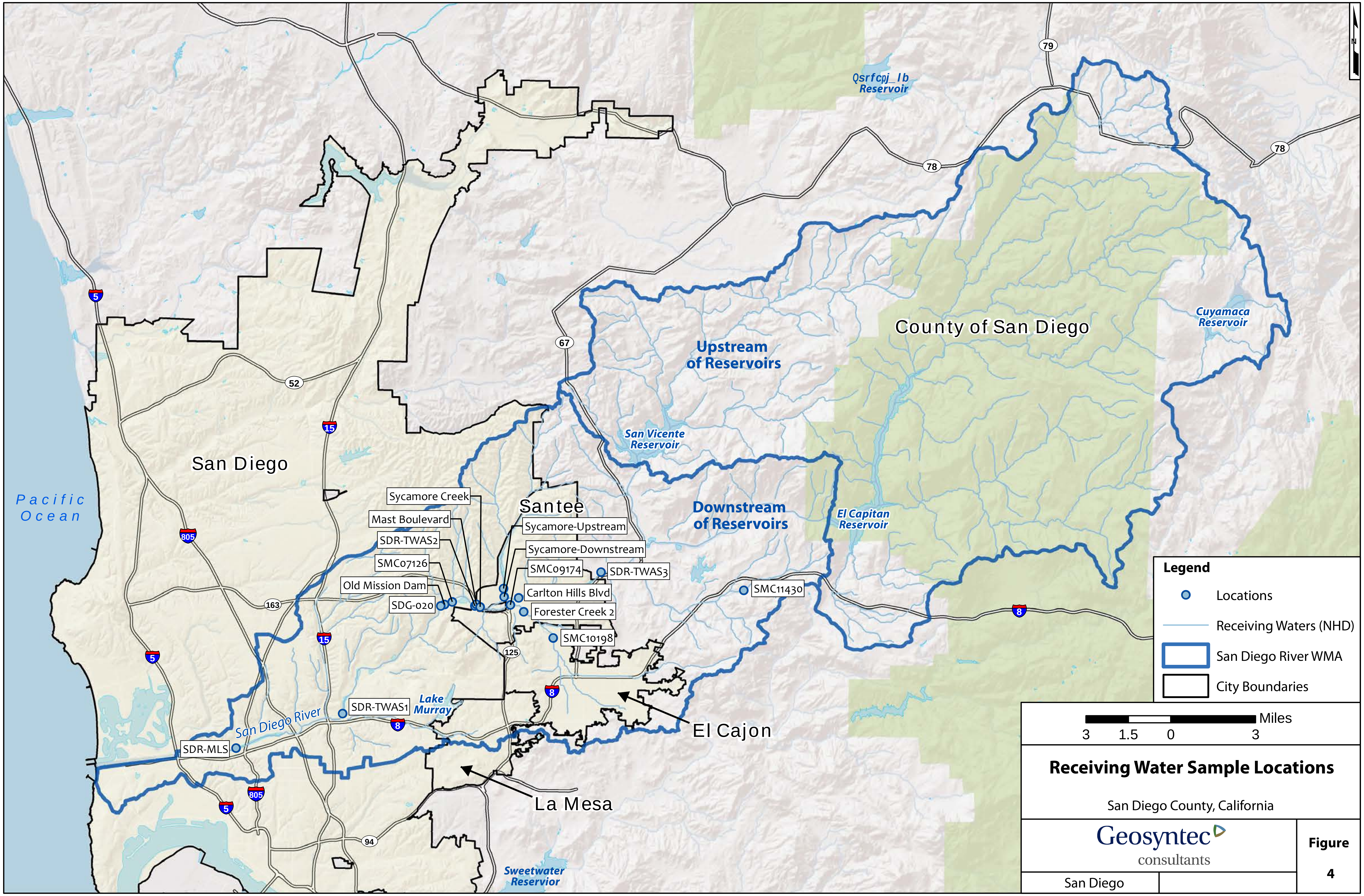
STEP 4								
11	12		13		14			15
Approved TMDL Yes - HPWQC No - Continue	Spatially Appropriate and Robust Dataset	Criterion Score (Yes=1)	Storm water as predominant source	Criterion Score (Yes=1)	Sources controllable by MS4 Agency	Criterion Score (Yes=1)	Criteria Tally	HPWQC? (Score of 3 in Step 4 = HPWQC)
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No
No	--	--	--	--	--	--	--	No

CHAPTER 2 – APPENDIX E: MAP FIGURES IN 11X17 FORMAT

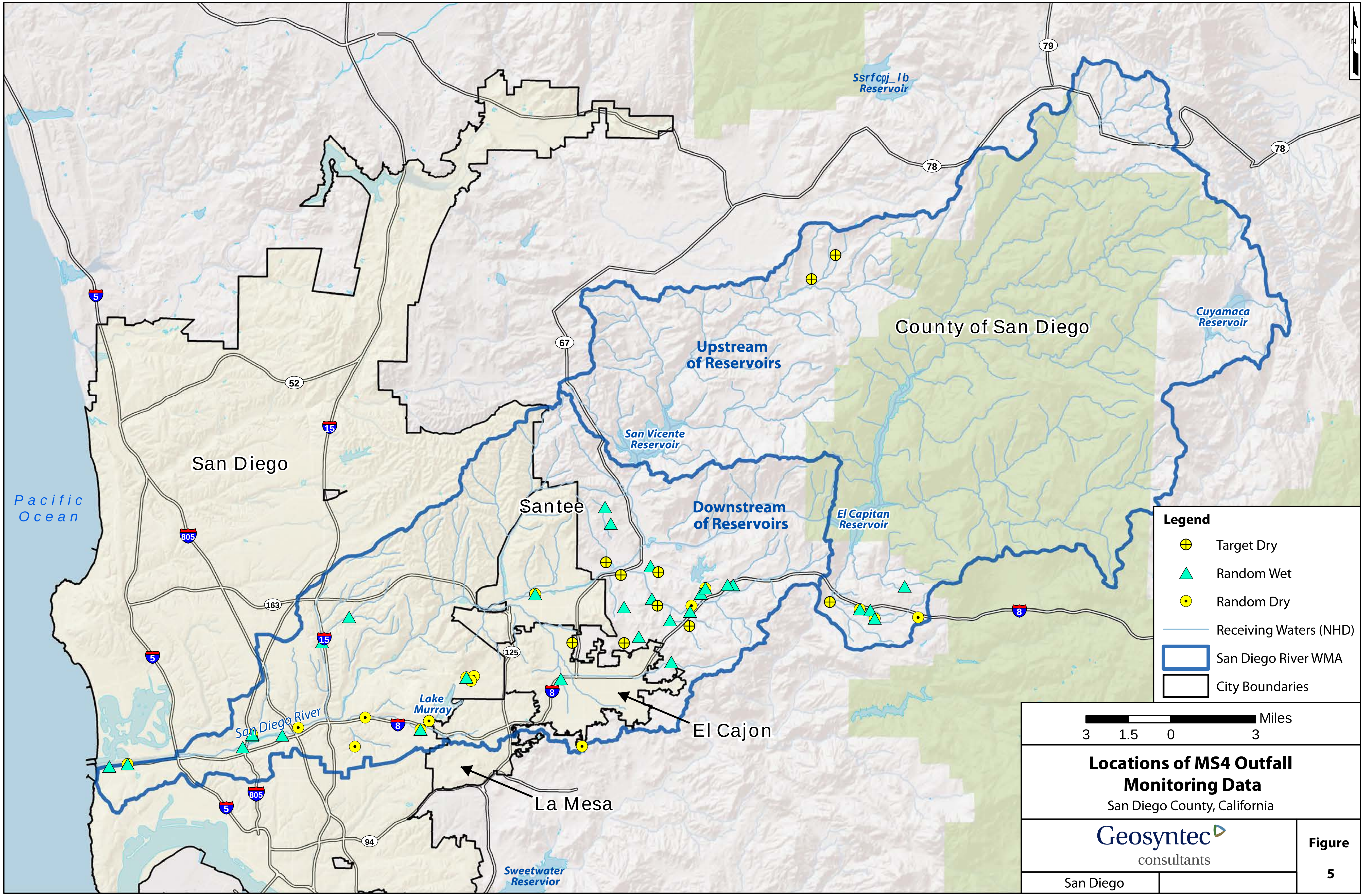

San Diego River Watershed
San Diego County, California
Figure
1
Geosyntec consultants
San Diego
February 9, 2015
Legend
Receiving Waters (NHD)
San Diego River WMA
City Boundaries
Miles
3 1.5 0 3
BOULDER CREEK HA (907.4)
SAN VICENTE HA (907.2)
EL CAPITAN HA (907.3)
LOWER SAN DIEGO HA (907.1)
County of San Diego
San Diego
Santee
El Cajon
La Mesa
Pacific Ocean
Cuyamaca Reservoir
San Vicente Reservoir
El Capitan Reservoir
Lake Murray
Sweetwater Reservoir
San Diego River


Pacific Ocean
San Diego
Santee
El Cajon
La Mesa
County of San Diego
Upstream of Reservoirs
Downstream of Reservoirs
San Vicente Creek
San Vicente Reservoir
El Capitan Reservoir
Los Coches Creek
Forester Creek
Lake Murray
Alvarado Creek
Lower San Diego River
Shoreline Receiving Waters
Famosa Slough and Channel
Cuyamaca Reservoir
Sweetwater Reservoir
Legend
303(d) Listed
San Diego River WMA
City Boundaries
Miles
3 1.5 0 3
Water bodies within SDR with 303(d) List Impairments
San Diego County, California
Geosyntec consultants
Figure 2
San Diego
February 9, 2015

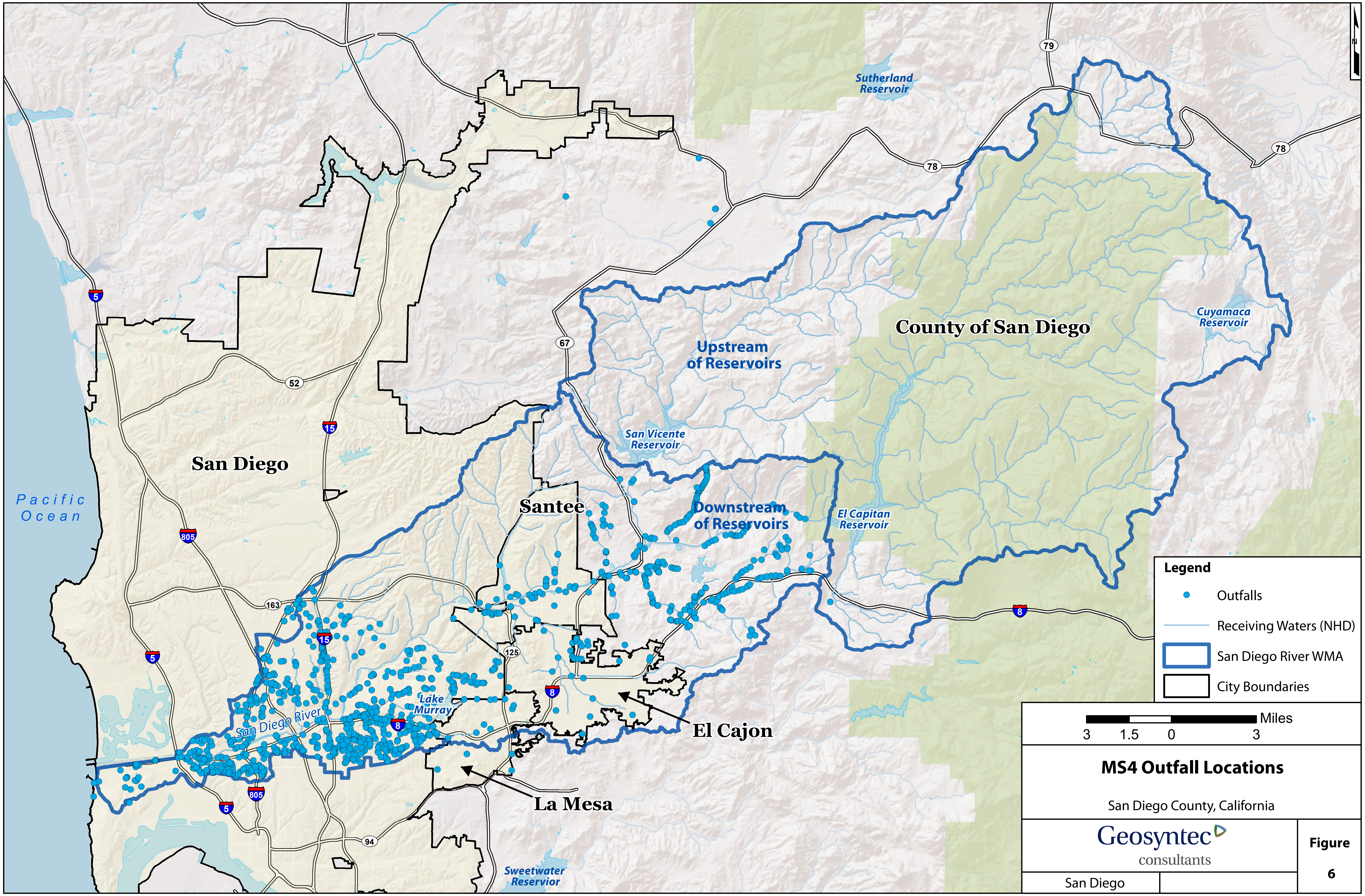

Sensitive or Highly Valued Water Bodies in SDR WMA
San Diego County, California
Legend
BIOL
Wetlands
ESA
San Diego River WMA
City Boundaries
Data from County of San Diego DPLU and US Fish and Wildlife
Miles
3 1.5 0 3
Geosyntec consultants
San Diego
Figure
3
County of San Diego
San Diego
Santee
El Cajon
La Mesa
Pacific Ocean
Upstream of Reservoirs
Downstream of Reservoirs
San Vicente Reservoir
El Capitan Reservoir
Cuyamaca Reservoir
Sweetwater Reservior
Lake Murray
San Diego River
Rios Canyon



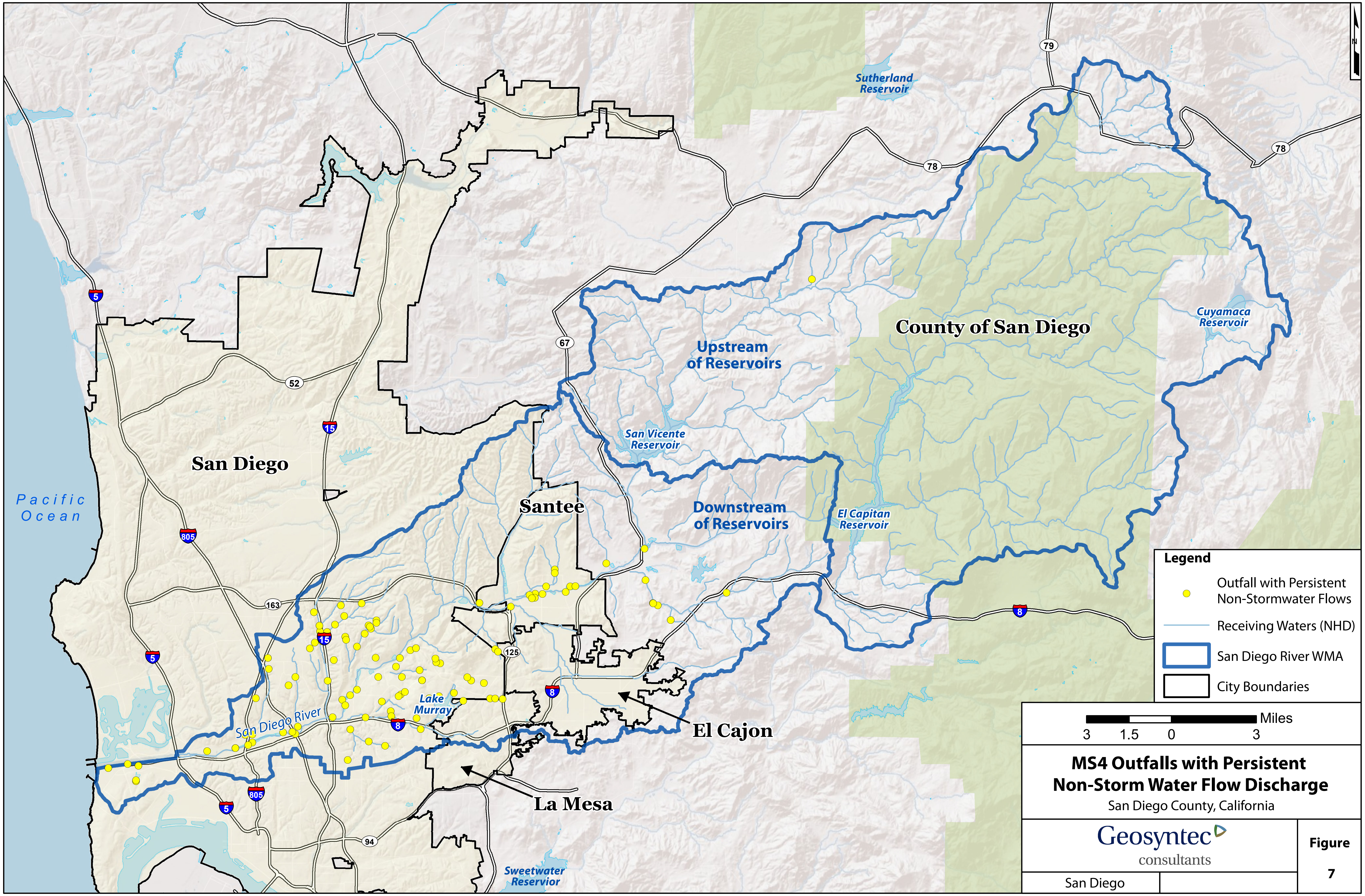
Receiving Water Sample Locations
San Diego County, California
Geosyntec consultants
San Diego
Figure
4
Legend
Locations
Receiving Waters (NHD)
San Diego River WMA
City Boundaries
Miles
3 1.5 0 3
County of San Diego
Upstream of Reservoirs
Downstream of Reservoirs
San Diego
Santee
El Cajon
La Mesa
Pacific Ocean
San Diego River
Lake Murray
San Vicente Reservoir
El Capitan Reservoir
Cuyamaca Reservoir
Sweetwater Reservoir
Qsrfcpj_Ib Reservoir
Sycamore Creek
Mast Boulevard
SDR-TWAS2
SMC07126
Old Mission Dam
SDG-020
Sycamore-Upstream
Sycamore-Downstream
SMC09174
SDR-TWAS3
Carlton Hills Blvd
Forester Creek 2
SMC10198
SMC11430
SDR-TWAS1
SDR-MLS
5
805
15
8
52
163
67
125
94
78
79

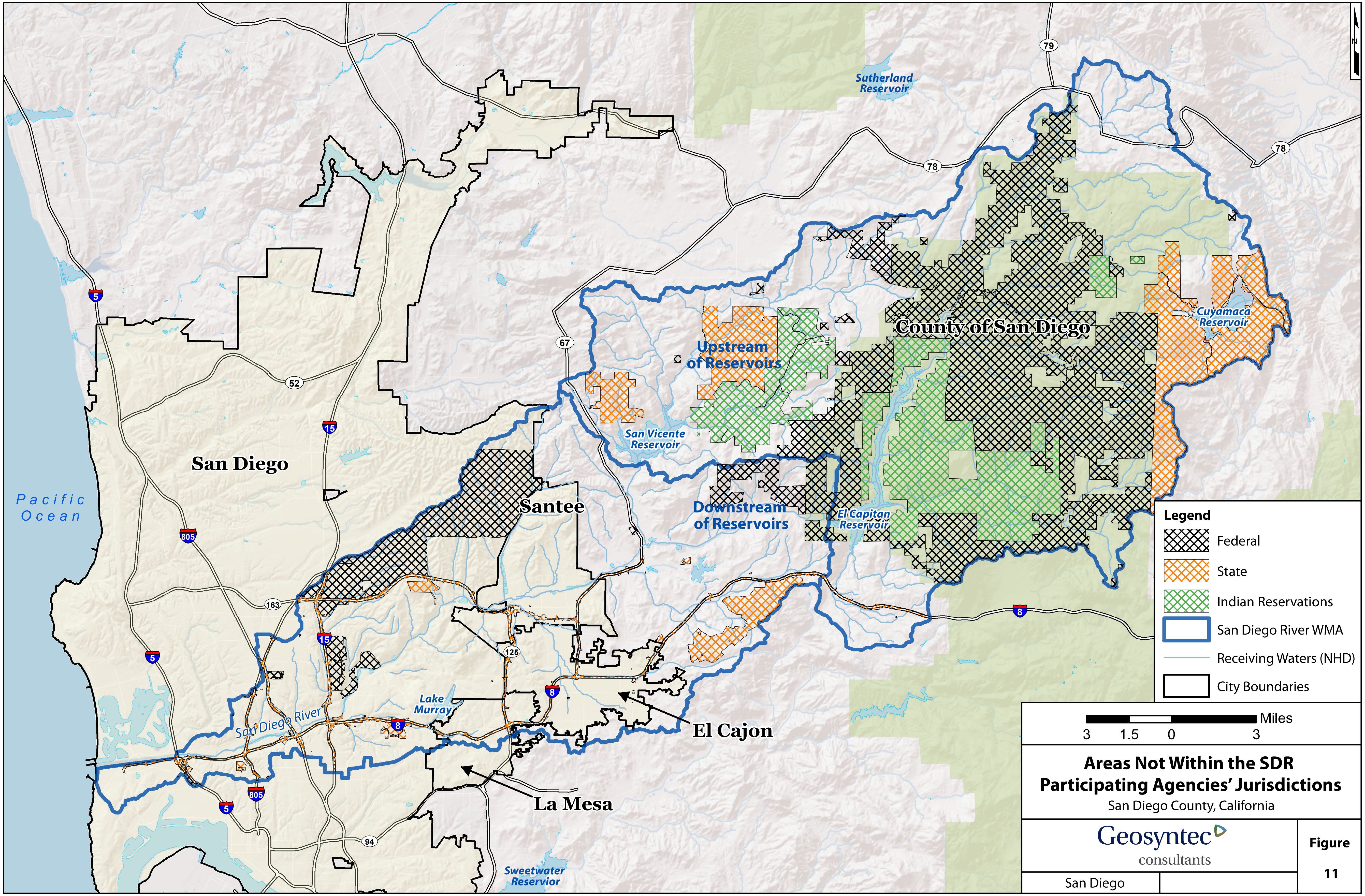


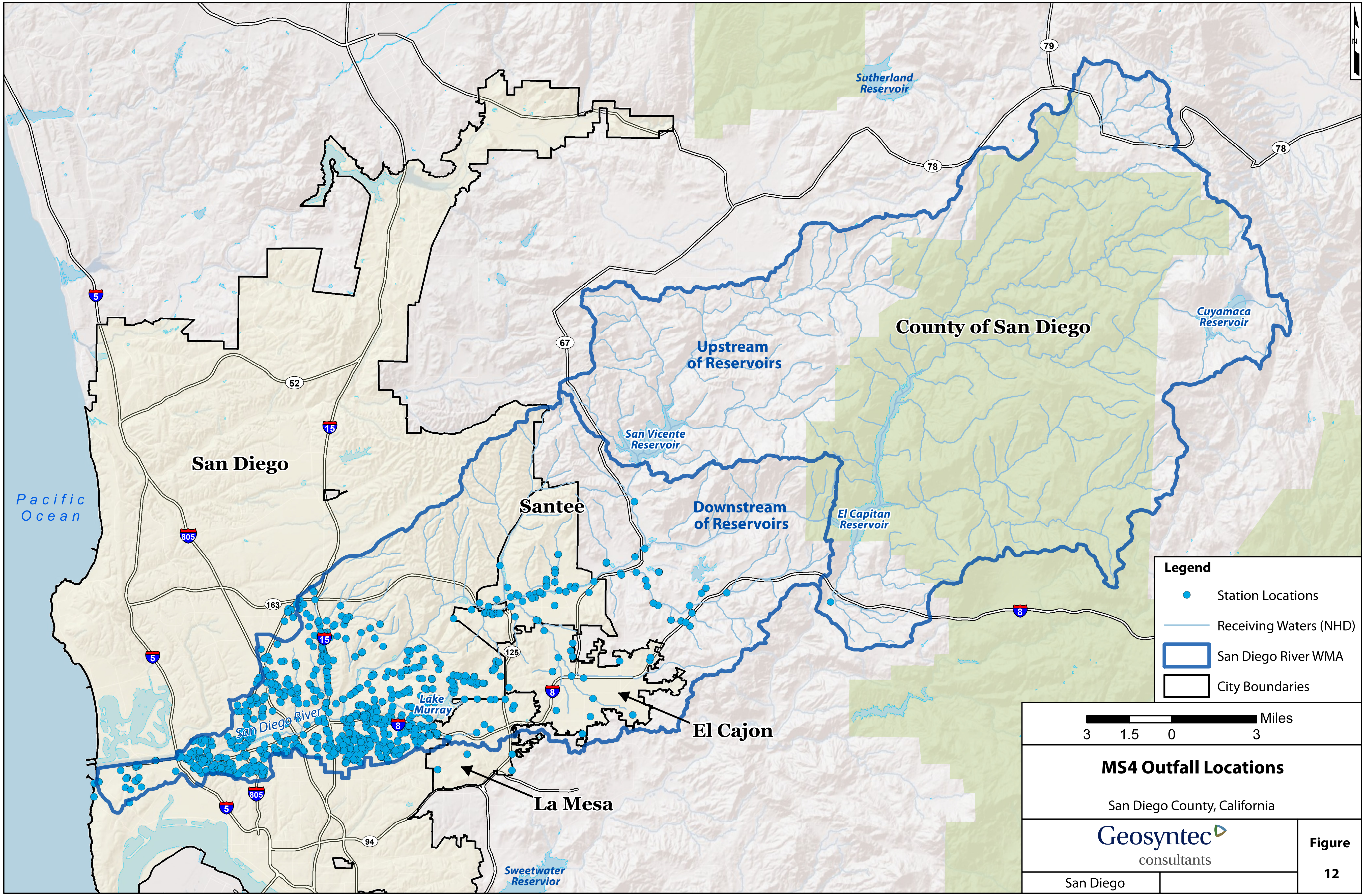
Pacific Ocean
San Diego
Santee
El Cajon
La Mesa
County of San Diego
Upstream of Reservoirs
Downstream of Reservoirs
San Vicente Reservoir
El Capitan Reservoir
Cuyamaca Reservoir
Sweetwater Reservoir
Lake Murray
San Diego River
Legend
Target Dry
Random Wet
Random Dry
Receiving Waters (NHD)
San Diego River WMA
City Boundaries
Miles
3 1.5 0 3
Locations of MS4 Outfall Monitoring Data
San Diego County, California
Geosyntec consultants
San Diego
Figure
5



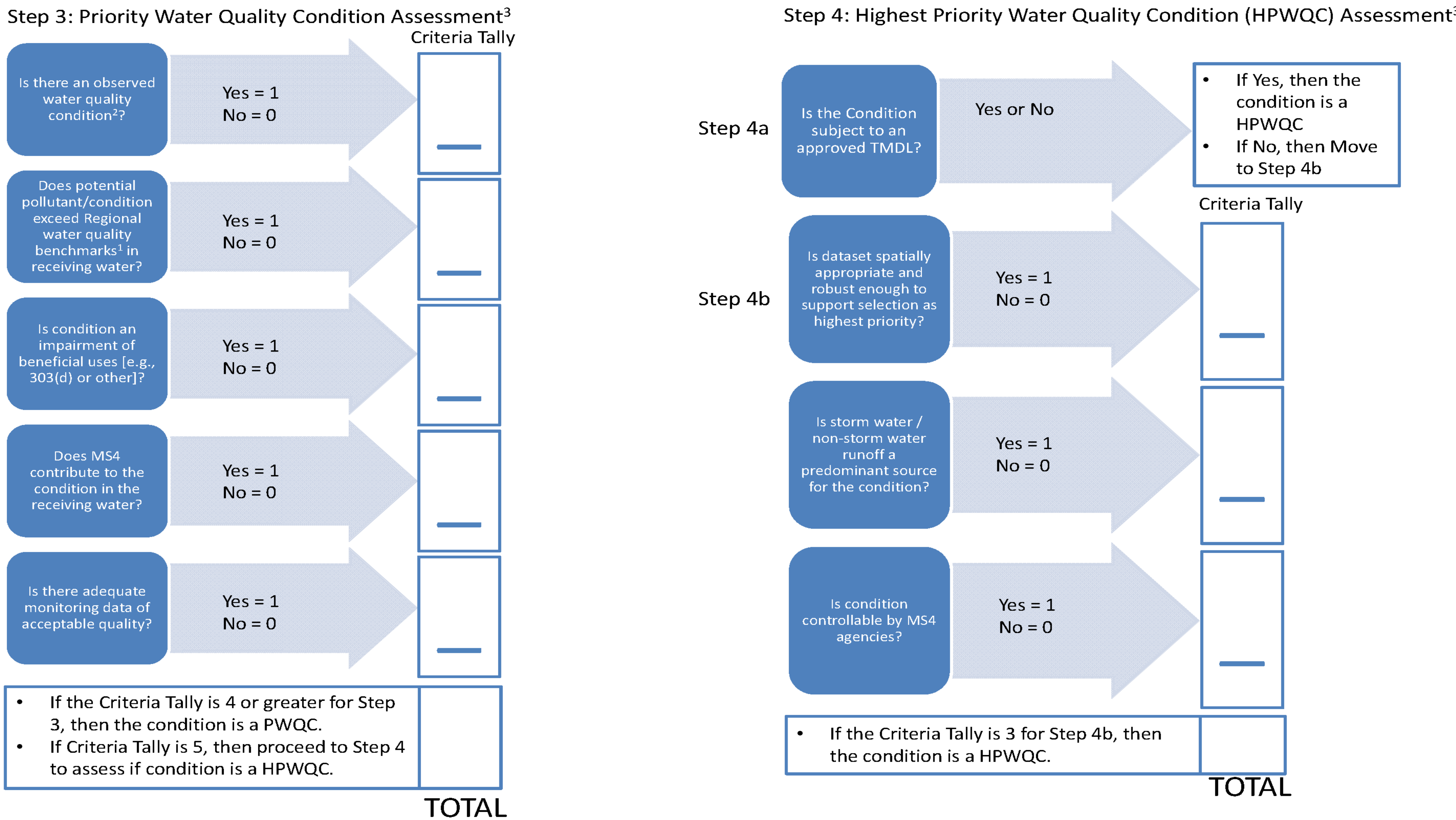
Sutherland Reservoir
County of San Diego
Upstream of Reservoirs
Cuyamaca Reservoir
San Vicente Reservoir
San Diego
Santee
Downstream of Reservoirs
El Capitan Reservoir
Pacific Ocean
Lake Murray
San Diego River
El Cajon
La Mesa
Sweetwater Reservoir
Legend
Outfalls
Receiving Waters (NHD)
San Diego River WMA
City Boundaries
Miles
3 1.5 0 3
MS4 Outfall Locations
San Diego County, California
Geosyntec consultants
San Diego
Figure
6


Sutherland Reservoir
County of San Diego
Upstream of Reservoirs
Cuyamaca Reservoir
San Vicente Reservoir
San Diego
Santee
Pacific Ocean
Downstream of Reservoirs
El Capitan Reservoir
Lake Murray
San Diego River
El Cajon
La Mesa
Sweetwater Reservior
Legend
Outfall with Persistent Non-Stormwater Flows
Receiving Waters (NHD)
San Diego River WMA
City Boundaries
Miles
3 1.5 0 3
MS4 Outfalls with Persistent Non-Storm Water Flow Discharge
San Diego County, California
Geosyntec consultants
San Diego
Figure
7


Sutherland Reservoir
Upstream of Reservoirs
County of San Diego
Cuyamaca Reservoir
San Vicente Reservoir
San Diego
Pacific Ocean
Santee
Downstream of Reservoirs
El Capitan Reservoir
Lake Murray
San Diego River
El Cajon
La Mesa
Sweetwater Reservoir
Legend
Federal
State
Indian Reservations
San Diego River WMA
Receiving Waters (NHD)
City Boundaries
Miles
3 1.5 0 3
Areas Not Within the SDR Participating Agencies' Jurisdictions
San Diego County, California
Geosyntec consultants
San Diego
Figure
11


Sutherland Reservoir
County of San Diego
Upstream of Reservoirs
San Vicente Reservoir
Cuyamaca Reservoir
San Diego
Pacific Ocean
Santee
Downstream of Reservoirs
El Capitan Reservoir
Lake Murray
San Diego River
El Cajon
La Mesa
Sweetwater Reservoir
Legend
Station Locations
Receiving Waters (NHD)
San Diego River WMA
City Boundaries
Miles
3 1.5 0 3
MS4 Outfall Locations
San Diego County, California
Geosyntec consultants
San Diego
Figure
12

CHAPTER 2 – APPENDIX F: METHODOLOGY TABLE



Footnotes:
[1] Regional water quality benchmarks were developed by the San Diego Regional Monitoring Workgroup for use in assessing the regional monitoring program results.
[2] In addition to monitoring data, public input was collected to aid in identifying priorities.
[3] Stormwater managers use Best Professional Judgment (BPJ) to aid in prioritization of programs and projects. Factors to be included limit the number of HPWQCs, and are based on consideration of multiple benefit effects of current BMPs and other jurisdictional programs, as well as the cost effectiveness of new strategies.

Figure 2F-1. Prioritization of Water Quality Conditions

LIST OF APPENDICES FOR CHAPTER 3

CHAPTER 3 – APPENDIX A: IDENTIFICATION OF WATER QUALITY IMPROVEMENT STRATEGIES

APPENDIX 3A: IDENTIFICATION OF WATER QUALITY IMPROVEMENT STRATEGIES [B.2.E]

The Participating Agencies maintain robust jurisdictional programs in compliance with the 2007 Permit JURMP requirement and the 2013 Permit JRMP requirement. These programs include management measures and baseline activities to minimize the effects of urban runoff from the jurisdiction's stormwater conveyance system on receiving waters to the maximum extent practicable. Potential shifts of current resources and/or enhancement of existing jurisdictional programs will focus on areas and/or activities to be most effective at targeting bacteria. These extensive baseline programs include, but are not limited to:

- Development and redevelopment planning, including the BMP Design Manual, as well as BMP and Low Impact Development (LID) implementation;
- Construction management and inspection program;
- Existing development management, including inspection of municipal, industrial, commercial, and residential (2013 Permit) land uses, as well as implementation of BMP operation and maintenance;
- Illicit Discharge Detection and Elimination (IDDE) program, including the elimination of dry weather flows;
- Education of municipal, industrial, commercial, and residential audiences;
- Public outreach and participation activities; and
- Stormwater conveyance cleaning and street sweeping.

Caltrans is not party to the Municipal Stormwater Permit. Caltrans maintains a Statewide Stormwater Management Plan to reduce the discharge of pollutants in compliance with State Board Order No. 2012-0011-DWQ which became effective July 1, 2013. Caltrans also submits Annual Reports to the State Board reporting non-compliance and discharges that may contribute to an exceedance of water quality standards.

Based on jurisdiction size, types of activities, and land uses within the jurisdictions, not all agencies implement BMPs on the same scale. Jurisdictional programs are highly tailored to the conditions within the jurisdiction that may contribute to water quality impairments.

In addition to the implementation of the strong jurisdictional programs, the Participating Agencies have evaluated the findings identified under Provisions B.2.a through B.2.d, and identified strategies that can result in improvements to water quality in storm drain discharges and/or receiving waters. Input received during public workshops, as well as from the Consultation Panel, was taken into account during the development of these strategies. For example, green infrastructure was brought up during the public workshop as well as by the Consultation Panel and is incorporated below.

The identification of improvement strategies below is intended to create a list of activities that may or may not be implemented by each Participating Agency; and at this stage no commitment is made with regard to each strategy. The County of San Diego has concerns as funding sources for implementation of structural BMPs have not been identified. By reason of constraints in California law and the California constitution, Caltrans funds are subject to legislative appropriation and availability of funds. Each Participating Agency considered the proposed strategies when developing numeric goals, strategies and schedules. The water quality improvement strategies developed included nonstructural and structural BMPs, retrofits, and stream restoration projects. These strategies are described in the sections below. Design guidelines and technical considerations for these BMPs, including criteria to determine appropriate BMPs based on sources and site-specific characteristics, will be discussed in detail in the BMP Design Manual, which is currently under development.

NONSTRUCTURAL BMPS [B.2.E.(1)]

Nonstructural BMPs considered as part of the Participating Agencies' strategy to address the HPWQC include:

Identification and Control of Sewage Discharge to Copermittee Storm Drain Systems

This program may include water quality monitoring for indicators of human sewage constituents, storm drain discharge inspections to identify locations with persistent dry weather flows, an IDDE hotline for citizens to report spills or suspicious discharges, or the use of cameras or continuous automated flowmeters in storm drains to identify or measure infiltration and/or illicit connections. Finally, special studies such as dye tracing, canine source tracking, and/or microbial source tracking may be employed to answer specific, targeted questions.

If human sources are determined to be a significant source of pollutant loading, accelerated repair or upgrade of sanitary sewer and storm drain systems would encourage proactive mitigation of bacteria and nutrient pollution resulting from the sanitary sewer system and/or groundwater. To increase the effectiveness of IDDE, current programs could be expanded to include a tiered dry weather source investigation including: (1) visual surveys of storm drain discharges to identify dry weather flow locations, (2) GIS-based prioritization where aging sewer laterals are above and near storm drains that are observed to occasionally flow during dry weather, (3) video survey of the storm drains to identify leaks from the top of the pipe and/or sewer dye tracing studies, and (4) fecal source tracking studies that use canine scent tracking and/or microbial source tracking.

Homelessness Waste Management Program

In areas of the watershed where homeless encampments are determined to be a significant pollutant source, effective programs may include establishing ordinances that reduce encampments, enhancing programs to reduce the number of homeless people in encampments, and enforcing new and existing laws to decrease the negative impact on water quality. Options to reduce water quality impacts of homeless encampments can also be combined with efforts to reduce homelessness. For example, partnering with non-profit organizations to inspect and remove trash generated by encampments leverages existing social programs, watershed volunteer programs, and water quality programs to address a common concern. Another example would be to support partnership effort by social service providers to provide sanitation and trash management for persons experiencing homelessness. The removal of invasive species in the watershed is an additional strategy for management of homeless encampments, as they provide shelter and allow encampments to remain hidden from view. Homeless waste management programs have not only targeted pollutant reduction benefits, there is the potential these programs supporting, larger socio-economic issues.

Trash Cleanups

In addition to partnering with non-profit organizations working to help the homeless population, Participating Agencies may work with other non-profits to organize river and trash cleanups. These cleanups may target specific audiences, such as children or businesses, or they may focus on specific reaches where trash is prevalent. For example, the San Diego River Park Foundation holds trash cleanups and tracks the amount of trash removed. Participating agencies regularly partner with this well-managed organization to clean up the watershed.

Onsite Wastewater Treatment Source Reduction

The State Board has adopted the State Policy for Water Quality Control for Siting, Design, and Operation and Management of Onsite Wastewater Treatment Systems (SWRCB, 2012). As a response to Assembly Bill 885, the policy would establish a statewide, risk-based, five tiered approach for the management of OWTSs installations and replacements and set a level of performance and protection expected from OWTSs. Existing OWTSs fall into Tier 3. Currently, no OWTSs in the San Diego River Watershed would qualify as Tier 3.

Irrigation Runoff Reduction and Good Landscaping Practices

Effective methods to reduce irrigation runoff could include development of educational outreach and training, increased inspections, punitive measures for overwatering, tiered water rates, or distribution of smart irrigation controllers and/or other financial incentive programs that decrease watering volume. Irrigation runoff reduction programs can also be integrated with BMPs that encourage landscaping and smart gardening practices, reducing the load of fertilizers and chemicals that end up in stormwater, such as integrated pest management, reducing fertilizer and pesticide use, xeriscaping, and turf conversion. To facilitate the use of these natural approaches, ordinances, education and outreach, and financial incentives can be implemented. These programs could be expanded to include home owner associations. Based on studies, it is believed that increased irrigation runoff controls, such as inspection, enforcement, and incentives in commercial and residential land uses will generate pollutant load reductions.

Residential/Small-Scale Low Impact Development Incentive Program

This wet weather nonstructural control is an incentive program that encourages residents and businesses to capture or redirect runoff from roofs using Low Impact Development principles to reduce flow to storm drains. A comprehensive residential rain barrel and downspout retrofit program could include public education and outreach, as well as significant financial incentives. Examples of these incentives could include offering rain barrels at no or reduced cost, rebate programs for downspout retrofits, and financial assistance for conversion to sustainable landscapes.

Commercial/Industrial Good Housekeeping

Requiring good housekeeping practices involves establishing and enforcing ordinances for commercial, industrial, and multi-family residential facilities. Programs that address wet weather load reductions may include increased inspection and enforcement of grease removal equipment for restaurants, increased training/outreach to and enforcement of mobile washing services, monitoring trash enclosures for proper waste disposal, and cleaning of private catch basins and drain inlets. Dry weather controls can also include discouraging vehicle washing, power washing and other wash down activities that produce nuisance flows to storm drains.

Pet Waste Program

BMPs for pet waste pick-up and disposal could include both educational outreach and enforcement to encourage residents and pet owners to clean up after their pets. Examples include park signage, receptacles for pet waste, waste bag distribution stations, designated dog parks, strict ordinances to regulate pet waste clean-up, and educational outreach at pet stores, animal shelters, veterinary offices, and other sites frequented by pet owners. Pet waste management practices may also include BMPs relating to horseback riding activities.

Animal Facilities Management

An effective source control program could include an inventory and frequent inspection of horse ranches, livestock areas, kennels and other pet service areas. Community outreach tools would include education materials that stress manure and wash water management, directing drainage away from and/or around exposed stalls, and watershed awareness. These BMPs would address both commercial and private facilities.

Redevelopment and LID Implementation

The San Diego County Copermittees' SUSMP require advanced stormwater treatment through LID implementation for all development and redevelopment that affects a minimum of 5,000 square feet of impervious area in specific project categories. The SUSMP requirements apply to residential, commercial, industrial, educational, and transportation land uses for wet weather. The SUSMP guides applicants through the design and submittal process to ensure the necessary stormwater features are being implemented. Project designs must show runoff being infiltrated or else treated by bioretention facilities, planter boxes, filters, settling ponds, or constructed wetlands (County of San Diego, 2011b).

Erosion Monitoring and Repair

Jurisdictions may implement inspection, enforcement, maintenance, and repair programs for erosion and slope stabilization issues. These programs will proactively identify concerns and areas requiring action to minimize erosion caused by anthropogenic activities. Additionally, the updated BMP design manual that the Copermittees are developing will address regulatory requirements.

Street and Median Sweeping

Street and median sweeping is a common practice for reducing street sediment and therefore urban runoff pollutant loads from transportation land uses. High-efficiency street sweeping equipment, such as regenerative air sweepers or vacuum assisted sweepers can significantly increase the amount of sediment removed from roadways. The street and median sweeping within the watershed appears to be an effective program for managing the sediment transport of bacteria. Street sweeping BMPs provide water quality benefits for multiple pollutants of concern through transportation-related source load mitigation and the removal of multiple associated pollutants.

Storm Drain Cleaning

Cleaning sediment and trash from storm drain inlets and conveyance systems can reduce pollutant loads of bacteria, nutrients, trash, metals, and sediments in receiving waters. Load reductions that can be gained by the cleaning of drain inlets and storm drains will depend on the extent, timing and frequency of cleaning. As technology continues to advance, high efficiency storm drain cleaning equipment allows for improved bacteria load reductions and therefore could be phased in to replace older equipment. Optimization of cleaning schedules allows jurisdictions to obtain the most benefit for their programs.

Education and Outreach

Participating Agencies maintain extensive education and outreach programs across the watershed. These programs work with community-based groups to organize trash clean-ups, educate the public through workshops, meetings, festival participation, and maintain websites for education as well as enforcement. These programs could include outreach to property managers responsible for home owners associations and management districts on water use and maintenance of common lands.

Property Based Inspections and Enforcement

Participating Agencies maintain an inspection and enforcement program. As part of this WQIP, jurisdictions may decide to increase the property inspections and fast track enforcement actions to achieve a higher level of public compliance.

Structural BMPs [B.2.e.(1)]

Structural BMPs, both large centralized and smaller distributed features, are also being considered by the Participating Agencies. These BMPs may be located on public or private property.

BMP terminology varies across the industry. The City of San Diego describes four categories of structural BMPs.

Table 3A-1 shows how the proposed structural BMPs will fit into this new terminology.

Table 3A-1. BMP Terminology

Current Participating Agency BMPs Types	City of San Diego BMP Types		
	Green Infrastructure	Water Quality Improvement BMPs	Multi-Use Community Basins
Infiltration BMPs	X		X
Rainwater Harvesting	X		
Biofiltration BMPs	X		X
Green Streets	X		X
Advanced Treatment and Proprietary Devices		X	X
Infrastructure Improvement, storm drain repair and Replacement, and Ancillary/Source Control BMPs		X	
Pretreatment BMPs	X	X	X
Retrofits for Priority Conditions	X	X	

Structural BMPs that will be considered as part of the Participating Agencies' strategy to address the high priority water quality conditions are described below.

Infiltration BMPs

These may include green streets, infiltration basins, trenches, and galleries, bioretention systems, dry wells, hybrid bioretention/dry wells, permeable pavements, or a combination of BMPs. With the exception of permeable pavements, which are solely distributed, all of these may be centralized or distributed systems. These systems involve capture and filtration of stormwater into pervious soils.

Rainwater harvesting

This refers to a type of distributed BMP that works by capturing stormwater runoff and storing it to maximize efficient use of the water. By reducing the amount of stormwater runoff that flows overland into a stormwater conveyance system, loads of bacteria and other pollutants are reduced. Onsite use of the harvested water for non-potable domestic purposes conserves potable water and, where directed to unpaved surfaces, can potentially recharge groundwater in local aquifers.

Biofiltration BMPs

Biofiltration BMPs are vegetated facilities that utilize natural treatment systems to capture and treat stormwater runoff through a variety of physical and biological treatment processes. Runoff that passes through a biofiltration system is treated by the natural absorption and filtration characteristics of the plants, soils, and microbes. Biofiltration BMPs include constructed wetlands, subsurface flow wetlands, biofiltration or bioinfiltration facilities with underdrains, planter boxes, and green streets.

Green Streets

Green street practices are options that can be infiltration BMPs, biofiltration BMPs, or a combination. Green streets are generally implemented on a distributed scale and can be placed in new development or redevelopment areas. A green street facility is a small BMP, such as a swale or planter box, that collects stormwater runoff from streets and either infiltrates or filters the water, thus improving water quality.

Advanced Treatment and Proprietary Devices

Advanced treatment, such as low flow diversions to disinfection/treatment plants, and proprietary devices, such as prefabricated, modular infiltration galleries, are additional options for stormwater treatment for bacteria and other pollutants. There are many options for proprietary devices that would fit into, combine, or expand on the BMP types listed above. In areas where the HPWQC is a challenging pollutant such as bacteria, advanced treatment BMPs provide water quality benefits for multiple pollutants of concern as a result of required pretreatment or the removal of flows from the flow stream.

Infrastructure Improvement, Storm Drain repair and Replacement, and Ancillary/Source Control BMPs

This option could include maintenance, repair or replacement of leaking sewer lines, repairing or lining storm drains, or implementation of dry weather flow treatment. Though these are structural BMPs, identification of locations for improvements would be performed as part of a nonstructural BMP, for instance IDDE programs or special bacteria source tracking studies.

Pretreatment BMPs

These systems may be used as part of a treatment train to enhance the performance of other structural BMPs. Examples of pretreatment BMP types include gross solids removal, hydrodynamic devices, trash racks, vegetated filter strips, vegetated swales, settling and storage, and extended detention basins. Pretreated stormwater is then conveyed to an infiltration, biofiltration, or other structural BMP.

Potential Effectiveness of Structural BMPs

Performance of individual BMPs varies and may be higher or lower depending on BMP design and other factors. **Table 3A-2** compares exceedance frequencies of primary contact standards for influent and effluent from most of the structural BMP categories described above, based on measured inflow and outflow concentrations for all BMPs in each category that met data quality and quantity criteria (Wright Water Engineers, Inc. and Geosyntec, 2010). Disinfection systems, which would consistently achieve recreational standards, are not included in **Table 3A-2** as they are primarily used for treating dry weather flows. While expected to be very effective at reducing bacteria concentrations, quantifying the bacteria reduction benefits of pretreatment BMPs in a treatment train is not yet possible using available data or the Structural BMP Prioritization and Analysis Tool (SBPAT). As additional data becomes available in the future, it may be possible to quantify the benefits of these structural BMPs.

Table 3A-2. Percent Inflow/Outflow Values Greater than Primary Contact Recreation Standard (200 MPN/100 mL) for Fecal Coliforma (adapted from Wright Water Engineers, Inc. and Geosyntec, 2010)

	Detention Basin	Grass Swale	Manufactured Device	Media Filter	Retention Pond	Capture and Use	Infiltration
Influent Concentration	83 % (77-90)	85 % (77-94)	98 % (94-100)	74 % (65-83)	61 % (49-74)	No Data	No Data
Effluent Concentration	65 % (57-73)	93 % (87-99)	99 % (97-100)	59 % (49-69)	36 % (24-48)	0 %[b]	0 %[b]

[a] Percent exceedance 95 percent confidence intervals given in parentheses.
[b] Assumed no exceedances due to full capture; capture/use and infiltration BMPs not included in BMP database.

Retrofits for Priority Conditions [B.2.e(2)]

Retrofit projects in areas of existing development within the watershed can potentially be implemented to reduce sources of pollutants or stressors. The permit encourages retrofit projects for existing development where there are opportunities. Alternative compliance programs will identify retrofit projects where opportunities exist, but implementation will be on a jurisdictional basis. Example retrofit projects include the Woodside Avenue Water Quality Basin project and the Forrester Creek project (at Prospect in Santee).

Watercourse Rehabilitation [B.2.e(3)]

Stream restoration/enhancement projects are designed to add or replace impacted habitat with habitat having similar functions of equal or greater ecological value. These projects are expected to result in net pollutant load reduction through the following mechanisms: increased volume reductions; increased hydraulic residence time; increased settle able solids; and increase in decay coefficient to account for plant assimilative capacity. These projects also potentially increase infiltration capacity (and associated benefits) and the ability to improve IBI scores.

Strategy Summary

The strategies described in detail throughout this section are summarized in **Table 3A-3** below. These strategies build upon the robust jurisdictional programs implemented to comply with previous and current permits and to comply with the bacteria TMDLs in the watershed. Strategies include nonstructural BMPs, structural BMPs, retrofits, and stream restoration projects.

Table 3A-3. Strategies Identified to address Bacteria in the San Diego River Watershed

Existing Baseline Strategies[a]	Nonstructural Strategies[b]	Structural Strategies[c]
• Development and Redevelopment Planning • Construction Management and Inspections • Existing Development Management • Illicit Discharge Detection and Elimination • Education of Municipal, Industrial, Commercial, and Residential audiences • Public Outreach and Participation • Stormwater conveyance cleaning • Street sweeping • Commercial/Industrial inspections • Municipal audits	• Identification and control of sewage discharge to storm drains • Homelessness waste management • Trash cleanups • Onsite wastewater treatment source reduction • Irrigation runoff reduction and good landscaping practices • Residential and small-scale low impact development (LID) incentive program (Public-Private Partnerships) • Commercial/industrial good housekeeping • Pet waste programs • Animal facilities management • Redevelopment and LID implementation • Erosion Monitoring and Repair • Street and median sweeping • Storm drain cleaning • Education and Outreach • Property Based Inspections and Enforcement	• Infiltration BMPs (e.g., basins, bioretention, permeable pavement) • Rainwater harvesting • Biofiltration BMPs • Green Streets • Advanced treatment and proprietary devices • Infrastructure improvements • Pretreatment BMPs • Strategic retrofits in areas of existing development; • Water course rehabilitation (e.g., stream restoration/ enhancements)

[a] Existing Jurisdictional Programs
[b] Potential shifts of current resources and/or enhance existing Jurisdictional Programs to focus on areas/activities identified to be most effective at targeting reductions in bacteria
[c] The identification of potential improvement strategies is intended to create a list of activities that may or may not be implemented by each Participating Agency; and at this stage no commitment is made with regard to each strategy. The County of San Diego has concerns as funding sources for implementation of structural BMPs have not been identified. By reason of constraints in California law and the California constitution, Caltrans funds are subject to legislative appropriation and availability of funds.

Chapter 3 – Appendix B: Jurisdictional Strategies

San Diego River Illicit Discharge Detection and Elimination Program Strategies City of El Cajon	Implementation Timeframe	Frequency
1. Engage the public, jurisdictional staff, and other agency staff to proactively identify and report illicit discharges.		
Utilize municipal personnel and contractors to identify and report illicit discharges and connections.	Current	Continuous
Facilitate public reporting of illicit discharges and connections via telephone and email.	Current	Continuous
Coordinate with upstream entities to prevent illicit discharges from upstream sources from entering the MS4.	Current	Continuous
2. Develop and implement approaches to address the impacts of septic systems within the watershed.		
Investigate and eliminate illicit discharges and connections.	Current	Continuous
3. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.		
Implement practices and procedures to prevent/limit infiltration of seepage from sanitary sewers to the MS4.	Current	Continuous
Implement practices and procedures to address spills with the potential to enter the MS4.	Current	Continuous
Investigate and eliminate illicit discharges and connections.	Current	Continuous
4. Implement monitoring programs to provide new information to refine the prioritization of drainage areas.		
Conduct transitional MS4 outfall discharge program to identify persistent/transient flows.	FY 14-15	Twice per Year
Conduct watershed specific MS4 outfall discharge program to identify persistent/transient flows.	FY 15-16	TBD
5. Actively educate public on prohibitions related to illicit discharges and connections.		
Investigate and eliminate illicit discharges and connections.	Current	Continuous
Enforce legal authority to ensure all illicit discharges and connections that are identified are eliminated.	Current	As Needed
Optional Jurisdictional Strategies		
Maintain MS4 map to facilitate implementation of the IDDE program.	Current	Annual

San Diego River Watershed Development Planning Program Strategies City of El Cajon	Implementation Timeframe	Frequency
1. Provide updated materials, enhanced outreach, and training to convey land development requirements.		
Establish criteria designating priority development projects for new development and redevelopment projects.	FY 15-16	One Time
Update BMP design manual procedures to specify stormwater requirements applicable to development and redevelopment projects, identify and design appropriate BMPs, establish maintenance criteria, and establish alternative compliance options (where implemented).	Current	One Time
2. Develop and implement LID programs to complement standard permit requirements.		
Implement downspout disconnection program for industrial, commercial, and residential projects.	Current	Project Specific
Implement proprietary BMPs where appropriate for industrial, commercial, and residential projects.	Current	Project Specific
Implement rainwater harvesting where appropriate for industrial, commercial, and residential projects.	Current	Project Specific
3. Implement a Watershed Management Area Analysis to develop watershed specific requirements for structural BMP implementation and identify a list of candidate projects that could be used as alternative compliance options for Priority Development Projects.		
Develop and implement a Watershed Management Area Analysis to develop watershed specific requirements for structural BMP implementation.	FY 15-16	One Time
4. Implement a post construction BMP program for development projects to ensure proper construction and maintenance.		
Implement source control, LID, and on-site structural controls for all priority development projects.	Current	Continuous
Implement a program that ensures that all structural BMPs are designed, constructed, and maintained on PDPs.	Current	Continuous
Inspect all high priority structural BMPs prior to the rainy season for Copermittees.	Current	Annual
5. Enforce post construction requirements related to new and redevelopment.		
Require implementation of source control and low impact development (LID) BMPs for all development projects.	Current	Continuous

San Diego River Watershed Construction Management Program Strategies City of El Cajon	Implementation Timeframe	Frequency
1. Ensure that minimum BMPs are designated and required for construction projects.		
Require submittal of pollution control plan, construction BMP plan, and/or erosion and sediment control plan for projects requiring local permits involving soil disturbance activities.	Current	Continuous
Review and confirm that the submitted plan is in compliance.	Current	Continuous
Maintain, update, and prioritize a watershed based inventory of all projects issued local permits that allow soil disturbing activities.	Current	Quarterly
Implement or require implementation of BMPs that are site specific, seasonally appropriate, and appropriate to the construction phase year round.	Current	Continuous
Inspect construction sites at an appropriate frequency to require and confirm compliance with local permits and ordinances, as well as the MS4 Permit requirements.	Current	Per JRMP
Enforce legal authority to ensure inventoried construction projects are in compliance with all requirements.	Current	As Needed

San Diego River Existing Development Management Program Strategies City of El Cajon	Implementation Timeframe	Frequency
1. Maintain and improve data tracking methods for existing development inventories where necessary.		
Maintain and update a watershed based inventory of existing development (i.e., commercial, industrial, and municipal facilities and residential areas).	Current	Annual
2. Develop and implement approaches to address the impacts of improper water use and irrigation runoff.		
Provide or expand targeted outreach to homeowners associations	FY 15-16	Continuous
3. Improve and/or continue existing pet waste programs.		
Continue implementation of pet waste bag dispensers in public parks	Current	Continuous
4. Improve trash management strategies within the watershed.		
Implement a schedule of operation and maintenance for public streets, unpaved roads, paved roads, and paved highways.	Current	Continuous
5. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.		
Implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers.	Current	Continuous
6. Improve and implement existing outreach programs to target key sources and pollutants.		
Provide targeted outreach via printed materials to residential areas	FY 15-16	Continuous
7. Enhance existing MS4 maintenance programs.		
Implement a schedule of operation and maintenance activities for the MS4 and related structures.	Current	Per JRMP
Consider implementation of dry weather flow diversions depending on outcome of Watershed Management Area Analysis	FY 15-16	As Needed and Funding Allows
8. Develop and implement targeted programs to address issues in residential areas.		
Conduct residential management area focused inspections.	FY 15-16	Per JRMP
9. Improve existing inspection programs to more efficiently target key sources.		
Conduct inspections of inventoried existing development to ensure compliance. Each area/activity inspected once every five years minimum, with equivalent of 20% of inventory inspected annually.	Current	Per JRMP

San Diego River Existing Development Management Program Strategies City of El Cajon	Implementation Timeframe	Frequency
10. Actively enforce stormwater and urban runoff requirements for existing development.		
Designate and require minimum set of BMPs required for all inventoried existing development.	Current	One Time
Enforce legal authority to ensure inventoried existing development facilities and/or areas are in compliance with all requirements.	Current	As Needed
11. Identify and facilitate retrofit opportunities in areas of existing development.		
Develop a strategy to identify opportunities and facilitate the implementation of retrofit projects in areas of existing development.	FY 15-16	One Time
Consider implementation of green streets depending on WMAA results	FY 15-16	Dependent on Results, Need, and Funding
Optional Jurisdictional Strategies		
Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties.	Current	Continuous
Develop a strategy to identify opportunities and facilitate the implementation of stream, channel, and/or habitat rehabilitation projects in areas of existing development.	FY 15-16	One Time
Forrester Creek Bacteria Management Plan implementation	FY 15-16	Continuous

San Diego River Illicit Discharge Detection and Elimination Program Strategies City of La Mesa	Implementation Timeframe	Frequency
1. Engage the public, jurisdictional staff, and other agency staff to proactively identify and report illicit discharges.		
Utilize municipal personnel and contractors to identify and report illicit discharges and connections.	Current	Continuous
Provide enhanced internal training for field staff related to illicit discharges.	FY 15-16	Annual
Facilitate public reporting of illicit discharges and connections via telephone and email.	Current	Continuous
Coordinate with Helix Water District regarding water line flushing and discharges to the MS4	FY 15-16	Continuous
Coordinate with upstream entities to prevent illicit discharges from upstream sources from entering the MS4.	Current	Continuous
2. Develop and implement approaches to address the impacts of septic systems within the watershed.		
Investigate and eliminate illicit discharges and connections.	Current	Continuous
3. Develop and implement approaches to address the impacts of homeless activities within the watershed.		
Cleanup of encampment sites on public and private lands.	FY 15-16	As Needed
Coordination with La Mesa Police Department to perform routine sweeps	FY 15-16	Continuous
4. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.		
Require all Food Service Establishments to install grease removal equipment to prevent fats, oils, and grease from obstructing sewer lines	FY 15-16	Continuous
Increase outreach to facilities and residences generating fats, oils, and grease.	FY 15-16	Continuous
Implement practices and procedures to prevent/limit infiltration of seepage from sanitary sewers to the MS4.	Current	Continuous
Implement practices and procedures to address spills with the potential to enter the MS4.	Current	As Needed
Implement sanitary sewer system rehabilitation program (e.g., condition assessments, prioritization, pipe replacement)	FY 15-16	Continuous
Investigate and eliminate illicit discharges and connections.	Current	Continuous

San Diego River Illicit Discharge Detection and Elimination Program Strategies City of La Mesa	Implementation Timeframe	Frequency
5. Implement monitoring programs to provide new information to refine the prioritization of drainage areas.		
Conduct transitional MS4 outfall discharge program[1] to identify persistent/transient flows.	FY 14-15	Twice per Year
Conduct watershed specific MS4 outfall discharge program to identify persistent/transient flows.	FY 15-16	Twice per Year
6. Actively educate public on prohibitions related to illicit discharges and connections.		
Investigate and eliminate illicit discharges and connections.	Current	Continuous
Enforce legal authority to ensure all illicit discharges and connections that are identified are eliminated.	Current	As Needed
Optional Jurisdictional Strategies		
Maintain MS4 map to facilitate implementation of the IDDE program.	Current	Annual

San Diego River Watershed Development Planning Program Strategies City of La Mesa	Implementation Timeframe	Frequency
1. Provide updated materials, enhanced outreach, and training to convey land development requirements.		
Establish criteria designating priority development projects for new development and redevelopment projects.	FY 15-16	One Time
Update BMP design manual procedures to specify stormwater requirements applicable to development and redevelopment projects, identify and design appropriate BMPs, establish maintenance criteria, and establish alternative compliance options (where implemented).	Current	One Time
2. Implement a Watershed Management Area Analysis to develop watershed specific requirements for structural BMP implementation and identify a list of candidate projects that could be used as alternative compliance options for Priority Development Projects.		
Develop and implement a Watershed Management Area Analysis to develop watershed specific requirements for structural BMP implementation.	FY 15-16	One Time
3. Consider the development of an alternative compliance program for Priority Development Projects.		
Consider implementation of an alternative compliance program to provide off-site alternatives for pollutant control and hydromodification management.	FY 18-19	Continuous
4. Implement a post construction BMP program for development projects to ensure proper construction and maintenance.		
Implement source control, LID, and on-site structural controls for all priority development projects.	Current	Continuous
Implement a program that ensures that all structural BMPs are designed, constructed, and maintained on PDPs.	Current	Continuous
Inspect all high priority structural BMPs prior to the rainy season for Copermittees.	Current	Annual
5. Enforce post construction requirements related to new and redevelopment.		
Require implementation of source control and low impact development (LID) BMPs for all development projects.	Current	Continuous
Enforce legal authority to ensure all development projects are in compliance with all post construction requirements.	Current	As Needed
Update ordinances to reflect new land development requirements.	FY 15-16	One Time

San Diego River Watershed Construction Management Program Strategies City of La Mesa	Implementation Timeframe	Frequency
1. Ensure that minimum BMPs are designated and required for construction projects.		
Require submittal of pollution control plan, construction BMP plan, and/or erosion and sediment control plan for projects requiring local permits involving soil disturbance activities.	Current	Continuous
Review and confirm that the submitted plan is in compliance.	Current	Continuous
Maintain, update, and prioritize a watershed based inventory of all projects issued local permits that allow soil disturbing activities.	Current	Quarterly
Implement or require implementation of BMPs that are site specific, seasonally appropriate, and appropriate to the construction phase year round.	Current	Continuous
Inspect construction sites at an appropriate frequency to require and confirm compliance with local permits and ordinances, as well as the MS4 Permit requirements.	Current	Per JRMP
Enforce legal authority to ensure inventoried construction projects are in compliance with all requirements.	Current	As Needed
2. Provide enhanced outreach and coordination to convey construction requirements.		
Increase coordination with internal engineering and building inspections programs through internal meetings and enhanced training.	FY 15-16	Continuous

San Diego River Existing Development Management Program Strategies City of La Mesa	Implementation Timeframe	Frequency
1. Maintain and improve data tracking methods for existing development inventories where necessary.		
Maintain and update a watershed based inventory of existing development (i.e., commercial, industrial, and municipal facilities and residential areas).	Current	Annual
2. Develop and implement approaches to address the impacts of improper water use and irrigation runoff.		
Increase outreach regarding over irrigation.	FY 15-16	Continuous
Install weather based irrigation controllers in municipal parks.	FY 15-16	On Going
Explore options for coordination with Helix Water District regarding water conservation programs.	FY 15-16	Continuous
3. Improve and/or continue existing pet waste programs.		
Continue implementation of pet waste program.	Current	Continuous
Provide focused outreach to residents using kiosks in municipal parks.	FY 15-16	Continuous
4. Improve trash management strategies within the watershed.		
Coordinate with I Love a Clean San Diego to install cigarette ashcans throughout the downtown area.	FY 15-16	Continuous
Perform trash assessments and outreach targeting multi-family residential land uses.	FY 15-16	Continuous
Increase street sweeping frequencies in priority areas.	FY 15-16	Continuous
5. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.		
Implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers.	Current	Continuous
Perform coordinated inspections for stormwater and FOG at food service establishments.	Current	Continuous
6. Improve and implement existing outreach programs to target key sources and pollutants.		
Provide enhanced internal training to parks staff.	FY 15-16	Annual
Provide enhanced internal training to street maintenance staff.	FY 15-16	Annual
7. Develop and implement targeted programs to address issues in residential areas.		
Prioritize residential management areas for focused inspections.	FY 15-16	Continuous
8. Improve existing inspections programs to more efficiently target key sources.		
Perform evaluations of businesses for exposure to stormwater though increased patrols and inspections.	FY 15-16	Per JRMP

San Diego River Existing Development Management Program Strategies City of La Mesa	Implementation Timeframe	Frequency
9. Actively enforce stormwater and urban runoff requirements for existing development.		
Increase coordination with City Code Enforcement where properties are out of compliance.	FY 15-16	As Needed
Increased enforcement as appropriate as a result of increased business inspections.	FY 15-16	As Needed
10. Identify and facilitate retrofit opportunities in areas of existing development.		
Install weather based irrigation controllers in municipal parks.	FY 15-16	Continuous
11. Improve coordination between agencies.		
Explore options for coordination with Helix Water District regarding water conservation programs.	FY 15-16	Continuous
Optional Jurisdictional Strategies		
Alvarado Creek Restoration Project	FY 15-16	One Time Project

San Diego River Illicit Discharge Detection and Elimination Program Strategies City of Santee	Implementation Timeframe	Frequency
1. Engage the public, jurisdictional staff, and other agency staff to proactively identify and report illicit discharges.		
Utilize municipal personnel and contractors to identify and report illicit discharges and connections.	Current	Continuous
Facilitate public reporting of illicit discharges and connections via telephone and email.	Current	Continuous
Coordination with Padre Dam Municipal Water District regarding sanitary sewer overflow notifications and cleanup.	Current	Continuous
Coordinate with upstream entities to prevent illicit discharges from upstream sources from entering the MS4.	Current	Continuous
2. Develop and implement approaches to address the impacts of homeless activities within the watershed.		
River “sweeps” to address homeless encampments twice per month.	Current	Twice per Month
Weekly patrols of known encampment areas.	Current	Weekly
Implement Bicycle Patrol Team in conjunction with San Diego County Sherriff’s Department	FY 15-16	Continuous
Improved coordination between Public Works staff and San Diego County Sherriff’s Department.	Current	Continuous
Provide waste stations for homeless encampments (e.g., portable toilets, trash receptacles)	FY 15-16	TBD
Continue coordination of Enforcement Team including the Fire Marshall, Code Enforcement, Stormwater Program Manager, City Attorney, and Sherriff’s Department	Current	Continuous
3. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.		
Coordination with Padre Dam Municipal Water District regarding sanitary sewer overflow notifications and cleanup.	Current	Continuous
Increase use of fact sheet for sewer maintenance.	Current	Continuous
Implement practices and procedures to prevent/limit infiltration of seepage from sanitary sewers to the MS4.	Current	Continuous
Implement practices and procedures to address spills with the potential to enter the MS4.	Current	Continuous
Investigate and eliminate illicit discharges and connections.	Current	Continuous

San Diego River Illicit Discharge Detection and Elimination Program Strategies City of Santee	Implementation Timeframe	Frequency
4. Implement monitoring programs to provide new information to refine the prioritization of drainage areas.		
Conduct transitional MS4 outfall discharge program[1] to identify persistent/transient flows.	FY 14-15	Twice per Year
Conduct watershed specific MS4 outfall discharge program to identify persistent/transient flows.	FY 15-16	Twice per Year
5. Actively educate public on prohibitions related to illicit discharges and connections.		
Investigate and eliminate illicit discharges and connections.	Current	Continuous
Enforce legal authority to ensure all illicit discharges and connections that are identified are eliminated.	Current	As Needed
Optional Jurisdictional Strategies		
Maintain MS4 map to facilitate implementation of the IDDE program.	Current	Annual

San Diego River Watershed Development Planning Program Strategies City of Santee		Implementation Timeframe	Frequency
1.	Provide updated materials, enhanced outreach, and training to convey land development requirements.		
	Establish criteria designating priority development projects for new development and redevelopment projects.	FY 15-16	One Time
	Update BMP design manual procedures to specify stormwater requirements applicable to development and redevelopment projects, identify and design appropriate BMPs, establish maintenance criteria, and establish alternative compliance options (where implemented).	Current	One Time
2.	Develop and implement LID programs to complement standard permit requirements.		
	Require full enclosures for trash areas.	FY 15-16	Continuous
3.	Implement a Watershed Management Area Analysis to develop watershed specific requirements for structural BMP implementation and identify a list of candidate projects that could be used as alternative compliance options for Priority Development Projects.		
	Develop and implement a Watershed Management Area Analysis to develop watershed specific requirements for structural BMP implementation.	FY 15-16	One Time
4.	Consider the development of an alternative compliance program for Priority Development Projects.		
	The City will consider implementation of an alternative compliance program to provide off-site alternatives for pollutant control and hydromodification management, dependent on need and funding.	FY 18-19	One Time
5.	Implement a post construction BMP program for development projects to ensure proper construction and maintenance.		
	Implement source control, LID, and on-site structural controls for all priority development projects.	Current	Continuous
	Implement a program that ensures that all structural BMPs are designed, constructed, and maintained on PDPs.	Current	Continuous
	Inspect all high priority structural BMPs prior to the rainy season for Copermittees.	Current	Annual
6.	Enforce post construction requirements related to new and redevelopment.		
	Require implementation of source control and low impact development (LID) BMPs for all development projects.	Current	Continuous
	Enforce legal authority to ensure all development projects are in compliance with all post construction requirements.	Current	As Needed

San Diego River Watershed Construction Management Program Strategies City of Santee	Implementation Timeframe	Frequency
1. Ensure that minimum BMPs are designated and required for construction projects.		
Require submittal of pollution control plan, construction BMP plan, and/or erosion and sediment control plan for projects requiring local permits involving soil disturbance activities.	Current	Continuous
Review and confirm that the submitted plan is in compliance.	Current	Continuous
Maintain, update, and prioritize a watershed based inventory of all projects issued local permits that allow soil disturbing activities.	Current	Quarterly
Implement or require implementation of BMPs that are site specific, seasonally appropriate, and appropriate to the construction phase year round.	Current	Continuous
Inspect construction sites at an appropriate frequency to require and confirm compliance with local permits and ordinances, as well as the MS4 Permit requirements.	Current	Per JRMP
Enforce legal authority to ensure inventoried construction projects are in compliance with all requirements.	Current	As Needed
Target construction sites with increased enforcement as appropriate, especially related to trash management.	FY 15-16	As Needed
2. Provide enhanced outreach and coordination to convey construction requirements.		
Provide internal staff training related to construction stormwater management.	Current	Annual
Provide public education and outreach targeting the construction industry.	FY 15-16	Continuous
Coordination with engineering and building inspections divisions to address SSOs caused by debris in sanitary sewer lines following new construction; review sign off procedures to ensure that debris in lines is avoided.	FY 15-16	Continuous

San Diego River Existing Development Management Program Strategies City of Santee		Implementation Timeframe	Frequency
1.	Maintain and improve data tracking methods for existing development inventories where necessary.		
	Maintain and update a watershed based inventory of existing development (i.e., commercial, industrial, and municipal facilities and residential areas).	Current	Annual
2.	Develop and implement approaches to address the impacts of improper water use and irrigation runoff.		
	Coordinate with Padre Dam Municipal Water District to encourage proper enforcement of water conservation requirements.	FY 15-16	Continuous
	Coordinate with Padre Dam Municipal Water District to provide joint outreach to residents and businesses regarding irrigation practices.	FY 15-16	Continuous
	Coordinate with Padre Dam Municipal Water District to increase incentive programs	FY 15-16	Continuous
	Coordinate with County of San Diego to promote Sustainable Landscapes Program.	FY 15-16	Continuous
	Develop education and outreach to reduce over-irrigation.	FY 15-16	TBD
3.	Improve and/or continue existing pet waste programs.		
	Pet Waste Bag Dispenser Stations in City Parks and Residential Areas	Current	Continuous
4.	Improve trash management strategies within the watershed.		
	Develop and distribute “Keep Lids Closed” stickers for dumpsters.	FY 15-16	Continuous
	Target commercial centers for increased enforcement, especially related to trash management.	FY 15-16	As Needed
	Coordination with Santee School District for trash management.	Current	Continuous
	Implement a schedule of operation and maintenance for public streets, unpaved roads, paved roads, and paved highways.	Current	Continuous
	Require sweeping and maintenance of private roads in targeted areas.	Current	Continuous
	Continue reporting and evaluating volumes of trash removed from illegal dumping activities	Current	Annual
	Develop outreach program similar to the “Don’t Trash California” campaign, including updates to existing outreach materials.	Current	Continuous
	Enhance and expand trash cleanups through community-based organizations involving target audiences.	FY 15-16	TBD

San Diego River Existing Development Management Program Strategies City of Santee	Implementation Timeframe	Frequency
5. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.		
Implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers.	Current	Continuous
Develop a strategy to identify and provide outreach to gray water system owners	FY 15-16	One Time
6. Improve and implement existing outreach programs to target key sources and pollutants.		
Increase seasonal specific outreach related to water use via business journals.	FY 15-16	Quarterly
Enhanced outreach to pool owners and maintenance companies - due to economic downturn, people have stopped maintaining pools, when flushed, may contain bacteria.	FY 15-16	Continuous
Golf Course - outreach specific to management of landscaping and water use; bio solids use as fertilizer/storage.	FY 15-16	Continuous
SDR Trail Expansion (City Parks) - interpretive signage; demonstration project for drought tolerant/native landscaping, permeable surfaces, and other LID.	FY 15-16	One Time Project
Improve consistency and content of websites to highlight enforceable conditions and reporting methods.	FY 15-16	One Time Update
Enhance school and recreation-based education and outreach.	FY 15-16	TBD
7. Enhance existing MS4 maintenance programs.		
Implement a schedule of operation and maintenance activities for the MS4 and related structures.	Current	Per JRMP
Prioritized MS4 cleaning program based on land use density and traffic flows.	Current	Per JRMP
Investigate potential to use ultra-violet lights in the MS4.	FY 15-16	One Time
Implement invasive species removal projects in coordination with San Diego River Conservancy.	Current	As Needed
8. Develop and implement targeted programs to address issues in residential areas.		
Conduct residential management area focused inspections.	FY 15-16	Per JRMP
Prioritize residential management areas for focused inspections.	FY 15-16	Continuous
Provide or expand targeted outreach to homeowners associations.	FY 15-16	TBD
Provide targeted outreach via printed materials to residential areas.	FY 15-16	Continuous

San Diego River Existing Development Management Program Strategies City of Santee	Implementation Timeframe	Frequency
9. Improve existing inspections programs to more efficiently target key sources.		
Conduct inspections of inventoried existing development to ensure compliance. Each area/activity inspected once every five years minimum, with equivalent of 20% of inventory inspected annually.	Current	Per JRMP
10. Actively enforce stormwater and urban runoff requirements for existing development.		
Designate and require minimum set of BMPs required for all inventoried existing development.	Current	One Time
Increase identification and enforcement of actionable erosion and slope stabilization issues on private property and require stabilization and repair.	FY 15-16	Continuous
Enforce legal authority to ensure inventoried existing development facilities and/or areas are in compliance with all requirements.	Current	As Needed
11. Identify and facilitate retrofit opportunities in areas of existing development.		
Develop a strategy to identify opportunities and facilitate the implementation of retrofit projects in areas of existing development.	FY 15-16	One Time
Consider implementation of green streets depending on WMAA results.	FY 15-16	Dependent on Results, Need, and Funding
Coordinate with Padre Dam Municipal Water District to increase incentive programs	FY 15-16	Continuous
Coordinate with County of San Diego to promote Sustainable Landscapes Program.	FY 15-16	Continuous
13. Improve coordination between agencies.		
Increased public outreach through external professional organizations (e.g., APWA, ASCE, Chamber of Commerce) - leveraging groups/contacts/newsletter.	FY 15-16	TBD
Coordinate with Padre Dam Municipal Water District to encourage proper enforcement of water conservation requirements.	FY 15-16	Continuous
Coordinate with Padre Dam Municipal Water District to provide joint outreach to residents and businesses regarding irrigation practices.	FY 15-16	Continuous
Coordinate with Padre Dam Municipal Water District to increase incentive programs.	FY 15-16	Continuous
Coordinate with County of San Diego to promote Sustainable Landscapes Program.	FY 15-16	Continuous

San Diego River Existing Development Management Program Strategies City of Santee	Implementation Timeframe	Frequency
Optional Jurisdictional Strategies		
Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties.	Current	Continuous
Develop a strategy to identify opportunities and facilitate the implementation of stream, channel, and/or habitat rehabilitation projects in areas of existing development.	FY 15-16	One Time

San Diego River Illicit Discharge Detection and Elimination Program Strategies County of San Diego	Implementation Timeframe	Frequency
1. Engage the public, jurisdictional staff, and other agency staff to proactively identify and report illicit discharges.		
Develop and implement a strategy for investigating and addressing ICIDs.	FY 15	One Time
Maintain MS4 map to facilitate implementation of the IDDE program.	Current	Annual
Provide enhanced and focused training for County field staff related to illicit discharges.	FY 16	Annual
Refer homeless issue complaints to Sheriff or appropriate jurisdictions.	Current	Continuous
Bilingual hotline answered by I Love a Clean San Diego (ILACSD; live operator) with multiple avenues for online reporting.	FY 16	Continuous
Coordinate with upstream entities to prevent illicit discharges from upstream sources from entering the MS4.	Current	Continuous
2. Develop and implement approaches to address the impacts of septic systems within the watershed.		
Address septic system failures where observed.	Current	As Needed
3. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.		
Coordinate spill response with responsible sewer agencies.	Current	Continuous
Implement practices and procedures to address spills with the potential to enter the MS4.	Current	Continuous
4. Implement monitoring programs to provide new information to refine the prioritization of drainage areas.		
Monitor MS4 outfalls for discharges of potential ICIDs.	Current	Annual
5. Actively enforce prohibitions related to illicit discharges and connections.		
Investigate and eliminate illicit discharges and connections.	Current	Continuous
Enforce legal authority to ensure all illicit discharges and connections that are identified are eliminated.	Current	As Needed
Update ordinances to reflect current ICID requirements and strategies.	FY 15-16	One Time
Implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management, and existing development in the Enforcement Response Plan.	Current	Continuous

San Diego River Illicit Discharge Detection and Elimination Program Strategies County of San Diego	Implementation Timeframe	Frequency
Optional Jurisdictional Strategies		
Implement septic system rebate program with availability of grant funding.	FY 16	Continuous
Develop a pilot online septic system maintenance outreach program.	Current	Continuous
In collaboration with the Department of Environmental Health, consider development of incentive programs for pumping septic systems in high risk areas adjacent to waterways (within 600 ft.) or stormwater system; subject to grant funding.	TBD	TBD
In collaboration with the Department of Environmental Health, consider developing program for on-site wastewater treatment (septic) systems. May include mapping and risk assessment, inspection, or maintenance practices.	TBD	TBD
Consider collaboration with wastewater agencies to identify where sewer and stormwater infrastructure are in close proximity and confirm the absence of flow at nearby stormwater MS4 outfall during dry weather.	TBD	TBD
Collaborate with watershed partners to evaluate feasibility of invasive plant and invasive/feral animal removal.	Current	Continuous
Consider collaboration with watershed partners to remove invasive non-native plants (Arundo) upstream areas rivers or tributaries to increase flood and fire protection and reduce the number of unauthorized encampments on the river bottom.	TBD	TBD
Investigate the feasibility of developing a pilot program (including training) - volunteer surveillance program.	FY 16-17	Continuous
Conduct dry weather Microbial Source Tracking study at MS4 outfalls with flow; further prioritization of drainage areas.	FY15	One time

San Diego River Watershed Development Planning Program Strategies County of San Diego	Implementation Timeframe	Frequency
1. Provide updated materials, enhanced outreach, and training to convey land development requirements.		
Update BMP Design Manual procedures to determine nature and extent of storm water requirements applicable to development projects and to identify conditions of concern for selecting, designing, and maintaining appropriate structural BMPs.	In Development	FY 16
Conduct BMP Design Manual training - Internal	FY 16	One Time
Conduct BMP Design Manual training – External	FY 16	One Time
2. Implement a Watershed Management Area Analysis to develop watershed specific requirements for structural BMP implementation and identify a list of candidate projects that could be used as alternative compliance options for Priority Development Projects.		
Develop and implement a Watershed Management Area Analysis to develop watershed specific requirements for structural BMP implementation.	FY 15-16	One Time
3. Consider the development of an alternative compliance program for Priority Development Projects.		
Consider implementation of an alternative compliance program to provide off-site alternatives for pollutant control and hydromodification management.	Future	In development
4. Implement a post construction BMP program for development projects to ensure proper construction and maintenance.		
All development projects: Implement or require implementation of source control BMPs to minimize pollutant generation at each project and implement LID BMPs to maintain or restore hydrology of the area, where applicable and feasible.	Current	Continuous
Priority Development Projects (PDP): In addition to requirement for all development projects, implement or require implementation of onsite structural BMPs to control pollutants and manage hydromodification for PDPs.	Current	Continuous
Implement a program that requires and confirms PDP structural BMPs are designed, constructed, and maintained to remove pollutants.	Current	Continuous
5. Enforce post construction requirements related to new and redevelopment.		
Enforce legal authority to ensure all development projects are in compliance with all post construction requirements.	Current	Continuous
Update county ordinance related to land development; reference to updated BMP manual.	FY 15	One Time
Implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management, and existing development in the Enforcement Response Plan.	Current	Continuous

Optional Jurisdictional Strategies		
Investigate feasibility of developing a Green Streets Program.	TBD	TBD
Consider feasibility of developing an alternative compliance program to enable "offsite" compliance for new and redevelopment projects.	TBD	TBD
Investigate feasibility of Land Acquisitions for habitat restoration or preservation.	TBD	TBD
Investigate feasibility of Retrofitting projects in areas of existing development.	TBD	TBD
Consider collaboration with COSD internal departments to leverage mutually beneficial projects to promote retrofits to include installation of controls to address priority pollutants, if feasible.	TBD	TBD
Investigate feasibility of planning for Structural BMPs.	TBD	TBD
Consider the need to plan, design, and conduct environmental review for the following or equivalent structural BMPs to reduce bacteria and other priority pollutants, as needed. • SDR WQIP - SDCo-R-01, wet pond/subsurface flow wetland. • SDR WQIP - SDCo-R-02, infiltration basin. • SDR WQIP - SDCo-R-03, enhanced constructed wetland. • SDR WQIP - MJ-R-01, gross solids and trash removal. • SDR WQIP - MJ-R-02, infiltration basin.	TBD	TBD
Investigate feasibility of Incentives.	TBD	TBD
Investigate feasibility of Detention basins.	TBD	TBD
Investigate feasibility of Treatment systems.	TBD	TBD
Investigate feasibility of Stream, channel, and/or habitat rehabilitation projects.	TBD	TBD

San Diego River Watershed Construction Management Program Strategies County of San Diego	Implementation Timeframe	Frequency
1. Ensure that minimum BMPs are designated and required for construction projects.		
Maintain and update a watershed-based inventory of all construction projects issued a local permit that allows ground disturbance or soil disturbing activities.	FY 16	Quarterly
Implement or require implementation of BMPs that are site specific, seasonally appropriate, and appropriate to the construction phase year round.	TBD	Continuous
Enforce legal authority to ensure inventoried construction projects are in compliance with all requirements.	Current	As Needed
Update county ordinance related to construction; reference to existing grading ordinance	Current	As Needed
Implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management, and existing development in the Enforcement Response Plan.	Current	Continuous
Notify the SDWB by email (Nonfilers_R9waterboards.ca.gov) within five (5) calendar days of issuing escalated enforcement to a construction site that poses a significant threat to water quality as a result of violations or other noncompliance	FY 16	Continuous
Notify the SDWB by email (Nonfilers_R9waterboards.ca.gov) any persons required to obtain coverage under the statewide Industrial General Permit and Construction General Permit and failing to do so, within five (5) calendar days from the time the Copermittee become aware of the circumstances.	FY 16	Continuous
2. Provide enhanced outreach and coordination to convey construction requirements.		
Conduct internal training on Construction Management	Current	Annual

San Diego River Existing Development Management Program Strategies County of San Diego		Implementation Timeframe	Frequency
1.	Maintain and improve data tracking methods for existing development inventories where necessary.		
	Maintain and update a watershed-based inventory of all existing development that may discharge a pollutant load to and from the MS4.	Current	Annual
	Make improvements to tracking watershed based inventories via consolidated database	FY 16	Continuous
	Designate a minimum set of BMPs required for all existing development inventories, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities, as appropriate.	Current	Continuous
2.	Develop and implement approaches to address the impacts of improper water use and irrigation runoff.		
	Develop Sustainable Landscapes Program based on available grant funding	FY 16	Continuous
	Conduct over irrigation outreach pilot study	Current	One Time
	Conduct Homeowners Associations Outreach and Coordination Pilot Study	Current	Continuous
3.	Improve and/or continue existing pet waste programs.		
	Facilitate pet waste management in county Parks through outreach or bad dispensers.	Current	Continuous
	Conduct large residential property pet waste management outreach	Current	Continuous
4.	Improve trash management strategies within the watershed.		
	Sponsor Trash Collection Events (public outreach/part).	Current	Multiple per Year
5.	Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.		
6.	Improve and implement existing outreach programs to target key sources and pollutants.		
	Create an Equestrian BMP Handbook.	FY 16	One Time
	Develop, improve, and distribute outreach materials for existing development.	Current	Continuous
	Conduct outreach presentations to elementary, middle, and high school students.	FY 15-16	Multiple per Year
	Conduct enhanced outreach to mobile landscaping service providers.	FY 15-16	Continuous
	Conduct large property residential pet waste management outreach.	FY 15-16	TBD
	Conduct Educational Workshops (e.g., IPM, manure management).	Current	TBD
	Conduct Education & Outreach Effectiveness Survey.	Current	Annual

San Diego River Existing Development Management Program Strategies County of San Diego	Implementation Timeframe	Frequency
7. Enhance existing Stormwater maintenance programs.		
Operate and maintain (inspect and clean) MS4 and related structures (catch basins, storm drain inlets, detention basins, etc.).	Current	Continuous
Operate and maintain (e.g., inspect, sweep) County maintained streets, unpaved roads, paved roads, and paved highways	Current	Continuous
8. Develop and implement targeted programs to address issues in residential areas.		
Focused residential inspections based on strategic assessments (modeling, MST, persistent flows, regulatory, monitoring data, SFR/MFR (112 RMAs based on HSA).	FY 16	5-year timeframe
Implement a public education and participation program to promote and encourage development of programs, management practices and behaviors that reduce the discharge of pollutants in storm water prioritized by high risk behaviors, pollutants of concern, and target audiences.		
9. Improve existing inspections programs to more efficiently target key sources.		
Conduct inspections of inventoried existing development to ensure compliance.	Current	Per JRMP
Implementation of operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, detention basins, etc.).	Current	Annual
10. Actively enforce stormwater and urban runoff requirements for existing development.		
Require implementation of minimum BMPs for existing development (commercial, industrial, municipal, and residential) that are specific to the facility, area types and pollutant generating activities, as appropriate.	Current	Continuous
Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties.	Current	Continuous
Designate a minimum set of BMPs required for all inventories existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities, as appropriate.	Current	One Time
Enforce legal authority to ensure inventoried existing development facilities and/or areas are in compliance with all requirements.	Current	As Needed
Update county ordinance related to existing development; reference to existing guidance documents.	FY 15	One Time

San Diego River Existing Development Management Program Strategies County of San Diego	Implementation Timeframe	Frequency
Implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management, and existing development in the Enforcement Response Plan.	Current	Continuous
11. Develop and implement a strategy to identify and facilitate retrofit opportunities in areas of existing development.		
Develop a strategy to identify opportunities and facilitate the implementation of retrofit projects in areas of existing development.	FY 15-16	One Time
Promote and encourage implementation of designated BMPs at residential areas.	FY 16	Continuous
12. Perform strategic monitoring to improve understanding of sources and water quality within the watershed.		
13. Improve coordination between agencies.		
Collaborate with partner agencies and groups to promote incentive programs for BMP retrofits, including rain barrels, smart controllers, soil sensors, turf replacement, etc.	Current	Continuous
Optional Jurisdictional Strategies		
Consider development of incentive programs for water conservation (turf replacement, smart irrigation controllers, irrigation modifications, sustainable landscapes, rain barrels), in collaboration with water agencies and others, to reduce priority pollutants.	TBD	TBD
Investigate the feasibility of developing and implementing an incentive program for BMP Retrofits (Public- Private Partnerships – a County sponsored program to offer incentives for rain barrel installation, downspout disconnects from the storm drain system, etc.)	TBD	TBD
Consider partnerships with Master Gardeners to provide education opportunities on water use and practices for gardening.	TBD	TBD
Consider collaboration with community groups to provide “boots on the ground” local information to focus implementation efforts on reducing bacteria and other pollutants, close to the source.	TBD	TBD
Consider collaboration with watershed partners to encourage consistent messaging to specific targeted audiences (commercial, residents, and others) to conserve water and mitigate dry weather flows.	TBD	TBD
Investigate the feasibility of improvements to inspections data tracking through mobile phone applications	FY 16	Concurrent with Inspections
Investigate the feasibility of a residential inspections tracking program via mobile platform - miles, violations, etc.	FY 16	Concurrent with Inspections

San Diego River Existing Development Management Program Strategies County of San Diego	Implementation Timeframe	Frequency
Develop a strategy to identify candidate areas of existing development for stream, channel, and/or habitat rehabilitation projects and facilitate implementation of such projects.	FY 15	One Time
Develop and implement Stormwater Quality Master Plans for Special Drainage Fee Areas.	Current	Continuous
Consider expanding Homeowners Associations Outreach and Coordination, as needed and as funding is identified.	TBD	TBD
Implement full scale residential pet waste projects (commitments, large property, urban).	TBD	TBD
Consider evaluation and reprioritization of the Agriculture, Weights, and Measures stormwater program to determine inspection priorities for agricultural and related facilities.	TBD	TBD

San Diego River Watershed Optional Strategies County of San Diego
Consider collaboration with watershed partners on Round 4 of Proposition 84 IRWM grant opportunities to fund targeted educational programs, building of structural controls (brick and mortar projects), or incentive programs to reduce runoff.
Consider collaboration with watershed partners and Regional Water Quality Control Board on effective measures to reduce potential impact of pollutant loads to waterways from unauthorized encampments.
Consider investigating diverting persistent dry weather flows from storm drains to sanitary sewer, where feasible.
Consider the design of structural controls for persistent unpermitted dry weather flows where outreach has been unsuccessful and groundwater or other non-MS4 sources has been ruled out
Consider developing a strategy to evaluate opportunities to naturalize concrete stormwater conveyances, and identify potential funding sources (such as grants) for design and implementation.
Consider collaboration with Caltrans on their implementation of TMDLs at stream reaches on the Caltrans TMDL Prioritization List that are within the County's jurisdiction.

San Diego River Watershed Illicit Discharge Detection and Elimination Program Strategies Caltrans	Implementation Timeframe	Frequency
1. Engage the public, jurisdictional staff, and other agency staff to proactively identify and report illicit discharges.		
Utilize municipal personnel and contractors to identify and report illicit discharges and connections.	Current	Continuous
Facilitate public reporting of illicit discharges and connections via telephone and email.	Current	Continuous
Coordinate with upstream entities to prevent illicit discharges from upstream sources from entering the MS4.	Current	Continuous
Annual training for appropriate staff on implementation of ICID and Illegal Dumping Response Plan.	FY 15-16	Annual
Develop and implement procedures for educating the public with respect to ICIDs and illegal dumping.	Current	One Time, Continuous
2. Develop and implement approaches to reduce the impacts of public and private sanitary sewer systems within the watershed.		
Implement practices and procedures to address spills with the potential to enter the MS4.	Current	Continuous
Investigate and eliminate illicit discharges and connections.	Current	Continuous
3. Actively educate public on prohibitions related to illicit discharges and connections.		
Investigate and eliminate illicit discharges and connections.	Current	Continuous
Optional Jurisdictional Strategies		
Develop and Implement an IC/ID and Illegal Dumping Response Plan	FY 15-16	One Time, Continuous
Develop and implement procedures for investigating, remediating, and eliminating illicit connections and discharges.	Current	One Time, Continuous
Develop and implement procedures for the prevention of illegal dumping.	Current	One Time, Continuous

San Diego River Watershed Development Planning Program Strategies Caltrans	Implementation Timeframe	Frequency
1. Provide updated materials, enhanced outreach, and training to convey land development requirements.		
Stormwater Treatment BMP Technology Report and Stormwater Monitoring and BMP Development Status Report	FY 15-16	One Time/Annual
2. Implement a post construction BMP program for development projects to ensure proper construction and maintenance.		
Implement a program that ensures that all structural BMPs are designed, constructed, and maintained on PDPs.	Current	Continuous
Structural BMPs (which retain water for more than 96 hours) inventory	Current	Annual
Structural BMP inventory (which retain water for more than 96 hours) to California Department of Public Health electronically	Current	Annual
Inspect all high priority structural BMPs.	Current	Annual
3. Enforce post construction requirements related to new and redevelopment.		
Enforce legal authority to ensure all development projects are in compliance with all post construction requirements.	Current	As Needed

San Diego River Watershed Construction Management Program Strategies Caltrans		Implementation Timeframe	Frequency
1.	Ensure that minimum BMPs are designated and required for construction projects.		
	Implement or require implementation of BMPs that are site specific, seasonally appropriate, and appropriate to the construction phase year round.	Current	Continuous
2.	Provide enhanced outreach and coordination to convey construction requirements.		
	Provide internal staff training related to construction stormwater management.	Current	Annual
	Provide public education and outreach targeting the construction industry.	Current	Continuous
	Develop and implement new construction guidance as needed to comply with new Statewide Construction General Permit (CGP)	TBD	As Needed

San Diego River Existing Development Management Program Strategies Caltrans	Implementation Timeframe	Frequency
1. Maintain and improve data tracking methods for existing development inventories where necessary.		
Maintain and update a watershed based inventory of existing development (i.e., commercial, industrial, and municipal facilities and residential areas).	Current	Annual
2. Improve trash management strategies within the watershed.		
Implement “Don’t Trash California” campaign.	Current	Continuous
Promote “On the Job with Caltrans Litter Removal” video	Current	Continuous
Implementation of Adopt-A-Highway Statewide Program through coordination with local organizations.	Current	Continuous
Report and evaluate trash and litter activities.	Current	Annual
Implement a schedule of operation and maintenance for public streets, unpaved roads, paved roads, and paved highways.	Current	Continuous
Implement highway maintenance activities as required.	Current	Continuous
3. Improve and implement existing outreach programs to target key sources and pollutants.		
Implement and annually evaluate public education program.	Current	Annual
Co-sponsor CASQA’s Water Quality Newsflash	Current	Monthly
Implementation of Statewide Storm Drain Stenciling Program	Current	Continuous
Develop and implement Facility Pollution Prevention Plans via templates and guidance documents.	Current	Continuous
Develop and implement guidance to ensure industrial activities and facilities are covered by the Industrial General Permit as required.	Current	Continuous
Develop and implement a Municipal Coordination Plan	FY 15-16	Continuous
4. Enhance existing MS4 maintenance programs.		
Implement a schedule of operation and maintenance activities for the MS4 and related structures.	Current	Per SWMP
5. Improve existing inspections programs to more efficiently target key sources.		
Conduct inspections of inventoried existing development to ensure compliance. Each area/activity inspected once every five years minimum, with equivalent of 20% of inventory inspected annually.	Current	Per SWMP
6. Identify and facilitate retrofit opportunities in areas of existing development.		
Develop a strategy to identify opportunities and facilitate the implementation of retrofit projects in areas of existing development.	FY 15-16	One Time

San Diego River Existing Development Management Program Strategies Caltrans	Implementation Timeframe	Frequency
Optional Jurisdictional Strategies		
Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties.	Current	Continuous
Implement and evaluate the Vegetation Controls Program	Current	Continuous

A.1 City of San Diego Strategies and Funding Needs

~~The City of San Diego (City) has identified water quality improvement strategies that are~~ expected to provide the greatest benefits to the watershed and its residents, businesses, communities within the City's jurisdictional boundaries.

Strategies were selected by evaluating the following considerations, in descending priority:

- Potential to reduce pollutant loads for the highest priority condition condition(s)
- Potential to reduce loads for other pollutants (including priority water quality conditions)
- Cost effectiveness
- Feasibility and ease of implementation
- Social impacts and benefits
- Other[1] impacts and benefits

The strategies that provide the best value, most return on investment, and greatest range of benefits will be recommended, as needed, as the City moves forward in its water quality improvement efforts. The recommended strategies chosen will be consistent with those already identified in the Comprehensive Load Reduction Plans (CLRPs) for various TMDLs in the San Diego Region.

The City is currently developing a framework to evaluate potential other benefits the recommended strategies may provide beyond improved water quality. These additional benefits may be financial, environmental, or societal. The recommended strategies will be scored based on the number of other benefits they provide, and may guide future updates to the Water Quality Improvement Plan.

The cumulative storm water quality benefits of the Recommended Strategies identified in this Plan are needed to achieve the level of effort needed to demonstrate progress toward achieving the Water Quality Improvement Plan's (Plan) interim and final numeric goals. It is important to note that these strategies are subject to change through the iterative, adaptive management process set forth in this Water Quality Improvement Plan. Through the adaptive management process the Responsible Agencies will be able to implement strategies and assess their impact to water quality and use new available information to refine, modify, remove, replace, or add strategies which will ensure the most effective suite of strategies are being implemented. Therefore, actual implementation of strategies is dependent upon both approval of funding in future annual budgets and adjustments that may occur as part of the iterative process.

---

[1] Other benefits refer to outcomes of a strategy beyond water quality improvements. Other benefits can include reduced air pollution, increased water conservation, watershed protection, public open space, aesthetics-induced property value increases, and increased business investments.

The recommended strategies will be implemented by the City; they are not intended to be implemented by private entities (e.g., development, business, industry, etc.). Some of the City's strategies, such as development planning, may have implications for private entities. The City has also developed a schedule as a best estimate of the shortest amount of time required to plan and implement the strategies. A compliance analysis using a watershed model was conducted to identify the strategies required to be implemented to meet interim and final goals. The adaptive management process provides the framework to evaluate progress toward meeting the goals and allows for modification of strategies. As strategies are modified, the compliance analysis will be updated as needed to provide assurance that numeric goals will be met.

Optional strategies are activities that may be implemented by the City at any time at its discretion. Unlike the recommended strategies, optional strategies have not been determined to be necessary in order to achieve the Plan's interim and final numeric goals.

The City's Storm Water Division leads the City's efforts to protect and improve water quality and reduce flood risk. These activities include but are not limited to: public education, employee training, water quality monitoring, source identification, code enforcement, watershed management, and Best Management Practices development/implementation within the City's jurisdictional boundaries. The Storm Water Division is also tasked with providing the most efficient storm drain system operation and maintenance services including inspection, maintenance, and repair of storm drain systems in the public right of way and drainage easements. The complete list of strategies undertaken by the Storm Water Division is presented in this section.

The City has developed projected funding needs that will be used to submit annual budget requests to secure the resources necessary to comply with the Municipal Permit. These funding needs include four general categories:

(1) Storm Water Division funding needs to implement day-to-day operational JRMP activities as required by Provision E in the Municipal Permit;

(2) Storm Water Division funding needs for flood risk management programs associated with the JRMP, such as infrastructure repair and replacement;

(3) Storm Water Division funding needs for activities managed by the Storm Water Division to meet the goals identified in the WQIP; and

(4) Funding needs for City departments and divisions other than the Storm Water Division to implement day-to-day operational JRMP activities, as required by the Municipal Permit. Examples of JRMP activities include administration, training, and best management (BMP) implementation.

The City's Storm Water Division funding needs (which represent the first three categories above) are presented below as "City of San Diego" funding needs, but do not include funding needs for other City departments and divisions to implement required JRMP activities (category four above) because the recommended strategies included in this plan only apply to the City's Storm Water Division. For more information about the funding needs for non-Storm Water Division departments and divisions, please refer to the fiscal analysis in the City's Jurisdictional Runoff Management Plan (Section 10). Table A-1 presents the projected funding needs to implement the San Diego River WMA Water Quality Improvement Plan through FY40. The compliance period for San Diego River is through FY31, when the final goals are expected to be met. To maintain comparability among Water Quality Improvement Plan projected funding needs for different WMAs (the City is in six WMAs with different compliance schedules), ongoing operation and maintenance costs after the compliance period (between FY32 and FY40 for San Diego River) are included in Table A-1. However, the majority of the funding will be needed within the first 15 years to meet the numeric goals. Twenty five year funding needs (FY16 - FY40) for the San Diego River WMA are presented for JRMP activities, flood risk management programs, and Water Quality Improvement Plan activities by funding source: the City's General Fund (GF) or Capital Improvement Projects (CIP) funds. The General Fund is generally used for nonstructural strategies, design support, and operations and maintenance (O&M) of structural projects. CIP funding is used during the design and construction phase of structural projects. The source of the funding needs is the Storm Water Division's 2015 Watershed Asset Management Plan (WAMP) Cost Update, which will be made available on the Storm Water Division's website[2] in July 2015.

Figure A-1 illustrates the projected fiscal year annual funding needs over the 25-year compliance period for the Storm Water Division to implement its JRMP activities, flood risk management programs, and Water Quality Improvement Plan activities in the San Diego River WMA. Figure A-2 shows the projected fiscal year GF and CIP funding needs for each of these years. Figure A-3 and Figure A-4 show the projected fiscal year GF and CIP funding needs, respectively, by category for each of these years.

The recommended strategies selected are presented in Table 3B-1. The City's schedule table is found in Table A-2.

[2] http://www.sandiego.gov/stormwater/plansreports/

Table 3B-1
City of San Diego Projected Fiscal Year Funding Needs by Funding Source and Category for the San Diego River WMA (FY16-40)[1]

General Fund	
Water Quality Improvement Plan	$32,061,472
JRMP	$66,762,511
Flood Risk Management	$122,250,432
Sub Total General Fund	**$221,074,415**
CIP	
Water Quality Improvement Plan	$231,308,861
JRMP	$0
Flood Risk Management	$47,580,550
Sub Total CIP	**$278,889,411**
Total	
25 FY San Diego River WMA Total Need	**$499,963,826**

1. Does not include funding needs for other City of San Diego Departments or Divisions to implement JRMP required activities.

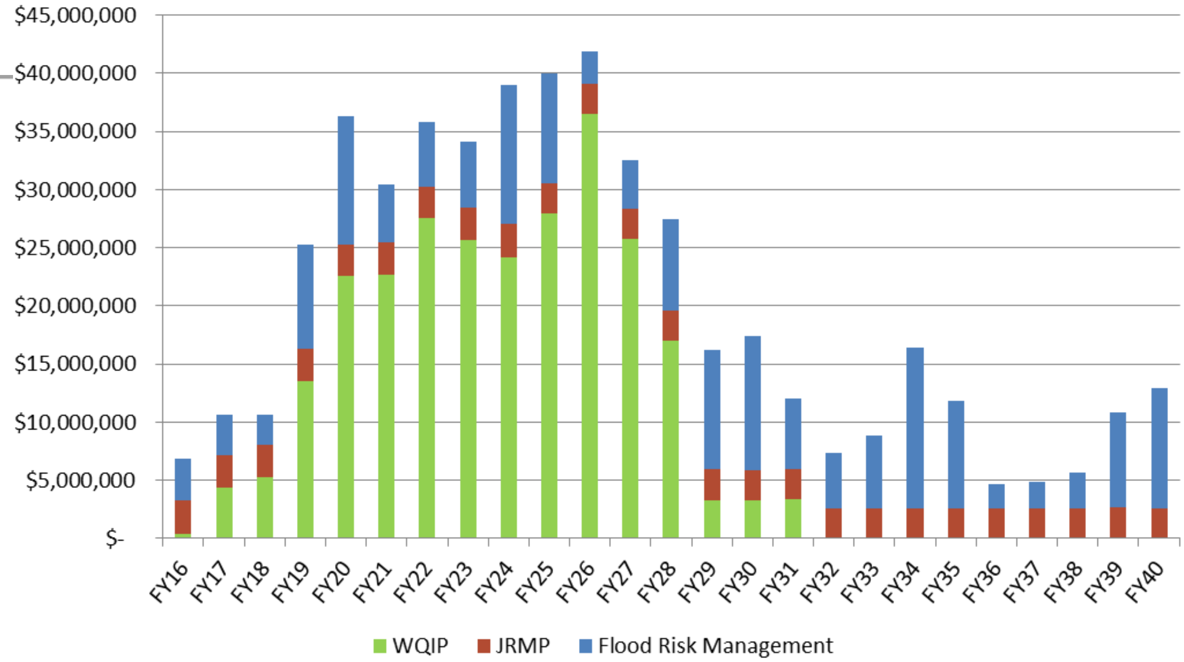


Figure 3B-1
City of San Diego Projected Fiscal Year Annual Funding Needs by Category for the San Diego River WMA

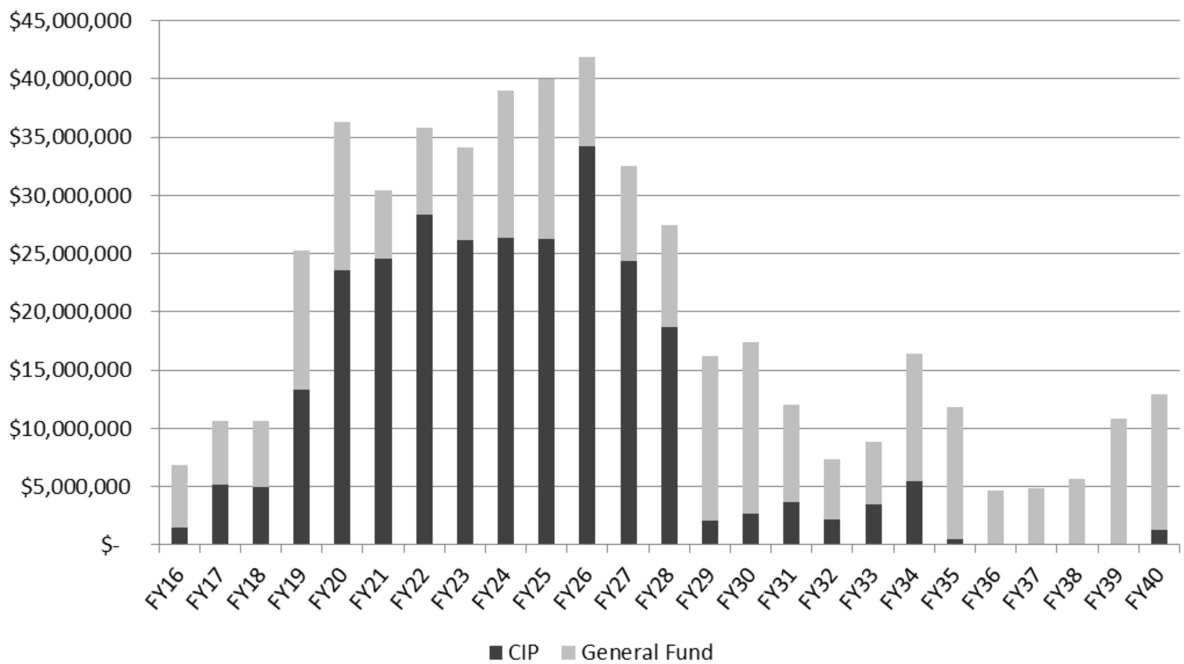


Figure 3B-2
City of San Diego Projected Fiscal Year Annual Funding Needs by Funding Source for the San Diego River WMA

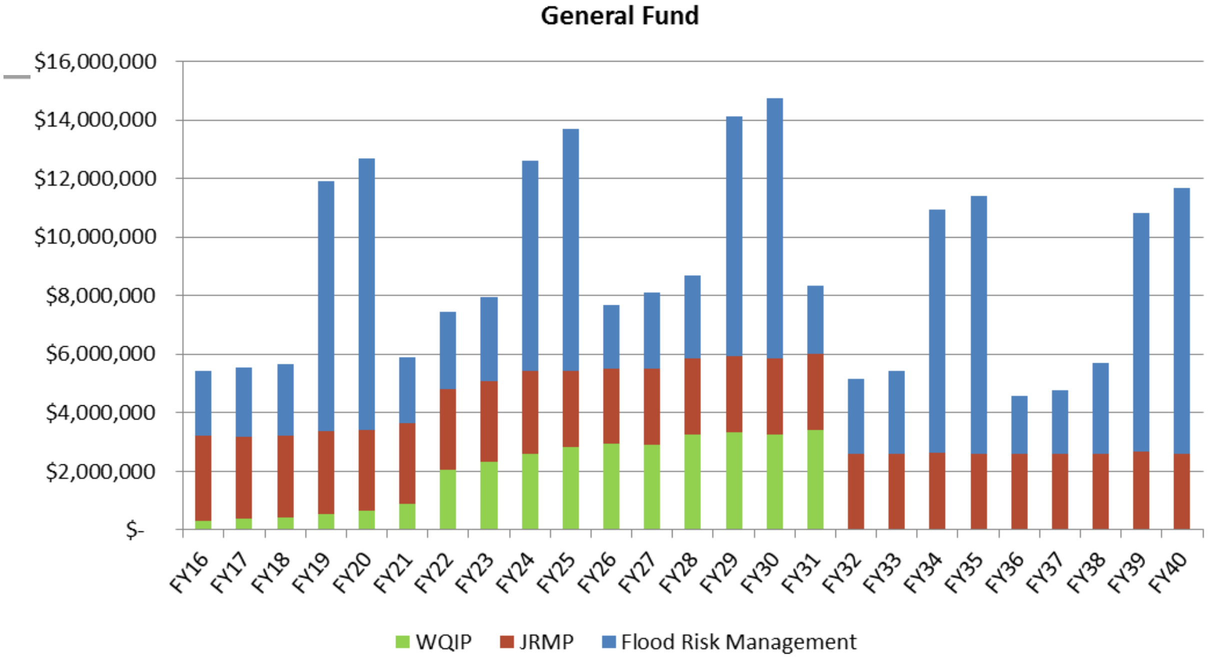


Figure 3B-3
City of San Diego Projected Fiscal Year Annual General Fund Funding Needs for the San Diego River WMA

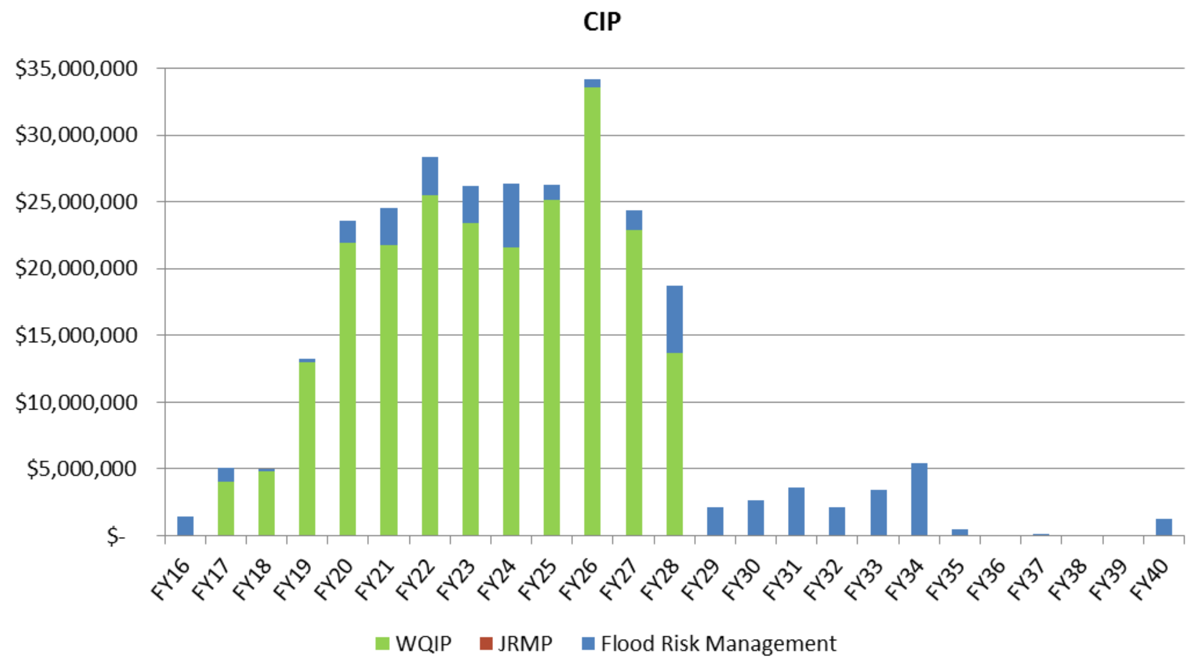


Figure 3B-4
City of San Diego Projected Fiscal Year Annual CIP Funding Needs for the San Diego River WMA

Table 3B-1 City of San Diego Jurisdictional Strategies

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
Jurisdictional Strategies						
Development Planning						
All Development Projects						
CSD-1	Establish guidelines and standards for all development projects; provide technical support related to implementation of source control BMPs to minimize pollutant generation at each project and implement LID BMPs to maintain or restore hydrology of the area or implement easements to protect water quality, where applicable and feasible. Includes internal coordination and collaboration between City departments (DSD, PWD, and Engineering) to improve success and long-term benefits of BMPs.	Refer to JRMP Section 4.	City-wide	Prior to FY16	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-1.1	Investigation and research of emerging technology.	Annually the Construction & Development Standards Group identifies new tasks to conduct literature review, communication with researchers outside of the City, physical testing and experimentation of new or emerging technologies, and other research with the goal of updating tools available for reducing pollutant loads from development and redevelopment sites.	City-wide	Prior to FY16	As needed	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-1.2	Approve and implement a green infrastructure policy.	The City will begin developing a policy in FY16 that will increase the green infrastructure requirements for City CIP projects. This policy will be coordinated with ongoing efforts to update City design manuals and LID design standards for public LID BMPs.	City-wide	FY16 (Begin)	As needed	T&SW with DSD and PWD
CSD-1.3	Develop Design Standards for Public LID BMPs.	Improve quality of design to ensure efficiency and reliability in public designs.	City-wide	FY14-FY15	As needed	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-1.4	Outreach to impacted industry regarding minimum BMP requirement updates.	Affects commercial, industrial, and residential development.	City-wide	FY15	As needed	TBD
CSD-2	Train staff on LID regulatory changes and LID practices.	Formal training is required for all staff involved in development plan review to increase knowledge of LID BMPs. Goal of training associated with LID practices and regulations is to promote LID implementation and to avoid adverse conditions such as trees planted within swales, or planned drainage patterns which obstruct or inhibit LID performance.	City-wide	FY16	As needed	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-3	Amend municipal code and ordinances, including zoning ordinances, to facilitate and encourage LID opportunities to support compliance with the MS4 Permit and TMDLs in a reasonable manner. Ensure consistency with the City of San Diego's BMP Design Manual. Update the Storm Water Standards Manual accordingly.	Municipal codes and ordinances will be brought to City Council for consideration to encourage LID implementation (e.g., runoff detention and filtration using natural filters and stormwater retention for reuse). LID stormwater management will be encouraged in proposed codes and ordinances associated with development and redevelopment projects, which are brought to City Council for consideration.	City-wide	FY15	As needed	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-4	Create a manual that outlines right-of-way design standards.	Create a manual that includes flood control performance standards, permanent BMP elements design standards, design standards for green streets and other BMPs, and maintenance access. Provides drainage and streets design standards. Opportunity to merge various existing manuals and provide consistency.	City-wide	FY15	One time	T&SW with DSD and PWD
CSD-5	Provide technical education and outreach to the development community on the design and implementation requirements of the MS4 Permit and Water Quality Improvement Plan requirements.	Technical education and outreach to the development community includes outreach on design standards, City design manuals, and the WMAA.	City-wide	Prior to FY16	Ongoing	T&SW with DSD
Priority Development Projects (PDPs)						
CSD-6	For PDPs, provide technical support to other City departments to ensure implementation of on-site structural BMPs to control pollutants and manage hydromodification by developing City wide storm water development standards and design guidelines.	Coordinate with other City departments to promote and confirm a thorough understanding of requirements for implementing structural BMPs that control pollutants and manage hydromodification. Included in that understanding are requirements to confirm proper design and construction through processes controlled by other City departments.	City-wide	FY16	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-6.1	Institute a program to verify and enforce maintenance and performance of treatment control BMPs.	Refer to JRMP Section 4.5.	City-wide	FY16	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-7	Update BMP Design Manual procedures to determine nature and extent of storm water requirements applicable to development projects and to identify conditions of concern for selecting, designing, and maintaining appropriate structural BMPs.	Refer to JRMP Section 4.	City-wide	FY15	Every 5 years/ permit cycle	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-7.1	Amend BMP Design Manual for trash areas. Require full four-sided enclosure, siting away from storm drains and cover. Consider the retrofit requirement.	Amend BMP Design Manual and zoning standards/requirements which address reduction of pollutants for common areas of trash build-up (e.g. restaurants, supermarkets, "big box" retail stores with food, pet stores). Most effective method for source control of bacteria and trash is to employ four-sized trash enclosures with a cover over trash areas.	City-wide	FY15	One time	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-7.2	Amend BMP Design Manual for animal-related facilities, such as such as animal shelters, "doggie day care" facilities, veterinary clinics, breeding, boarding and training facilities, groomers, and pet care stores.	Amend BMP Design Manual and zoning requirements (including retrofits) to provide supplemental standards for animal facilities (including animal shelters, dog daycares, veterinary clinics, groomers, pet car stores, and breeding, boarding, and training facilities). Supplemental standards may include requiring covered trash enclosures, identification of landscaped relief areas on site plans, ensuring drainage connections and treatment swales for areas that will not drain to the sanitary sewer, as well as inspection of grading, drainage, and landscaping for outdoor exercise areas.	City-wide	FY15	One time	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-7.3	Amend BMP Design Manual for nurseries and garden centers.	Amend BMP Design Manual to provide supplemental standards for plant nurseries and garden centers. Standards will focus on reducing irrigation runoff, and loading of sediment, pesticides, and nutrients. Measures may include: covered outdoor storage, green waste management BMPs, improved irrigation efficiency to reduce dry-weather runoff, and containment of runoff from impervious areas where plants and materials are stored.	City-wide	FY15	One time	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-7.4	Amend BMP Design Manual for auto-related uses.	Amend BMP Design Manual to provide supplemental standards for automotive-related uses to reduce loading of metals, oils, grease, and trash. Measures may include: four-sized covered trash enclosures, and careful review of auto-related usage areas (e.g. garage bays at repair shops) for grading, drainage, and drain connections to sanitary sewer systems.	City-wide	FY15	One time	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-8	Develop and administer an alternative compliance program for on-site structural BMP implementation (includes identifying Watershed Management Area Analysis [WMAA] candidate projects). Refer to Section 4.2.5.	Refer to JRMP Section 4.2.3.1.	City-wide	FY15	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-8.1	Create a fund that allows habitat acquisition, protection enhancement, and restoration in conjunction with other cooperating entities including community groups, academic institutions, state county, and federal agencies, etc.	This strategy may be implemented at any time at the City's discretion if the following triggers are met: 1) funding to address MS4 discharges is identified and secured, 2) staff resources are identified and secured, 3) partners have been identified and formal MOUs have been developed, and 4) consensus and community support has been achieved.	City-wide	Optional	TBD	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
Construction Management						
CSD-9	Coordinate with other City departments to promote and confirm a thorough understanding of requirements for implementing temporary BMPs that control sediment and other pollutants during the construction phase of projects. Included in that understanding are requirements to inspect at appropriate frequencies and effectively enforce requirements through process controlled by other City departments.	Refer to JRMP Section 5.	City-wide	FY16	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
Existing Development						
Commercial, Industrial, Municipal, and Residential Facilities and Areas						
CSD-10	Administer a program to require implementation of minimum BMPs for existing development (commercial, industrial, municipal, and residential) that are specific to the facility, area types, and PGAs, as appropriate. Includes inspection of existing development at appropriate frequencies and using appropriate methods.	Refer to JRMP Sections 6, 7, and 8.	City-wide	FY16	Ongoing	T&SW with DSD, PUD, & PWD
CSD-10.1	Update minimum BMPs for existing residential, commercial, and industrial development. Specific updates to BMPs include required street sweeping, catch basin cleaning, and maintenance of private roads and parking lots in targeted areas.	Refer to JRMP Appendix IX.	City-wide	FY15	Every 5 years	T&SW
CSD-10.2	Outreach to property managers and trash haulers to elevate the emphasis of power washing as a pollutant source.	Emphasis will be placed on non-compliant washing as an enforceable violation.	City-wide Residential, commercial and industrial areas	FY15	Ongoing	T&SW
CSD-10.3	Implement property based inspections.	Property-based inspections increase awareness and responsibility for individual properties to tackle issues associated with trash, landscapes, and parking areas. Expanding beyond the business-level inspections will achieve different and more effective opportunities for education, outreach, inspection, and enforcement to encourage water conservation strategies.	City-wide	Prior to FY16	Ongoing	T&SW
CSD-10.4	Review policies and procedures to ensure discharges from swimming pools meet permit requirements.	Verify and bring to City Council for consideration an update (as needed) for the City's Municipal Code (43.0301) to meet new permit requirements for swimming pool discharges.	City-wide	FY15	As needed	T&SW, City Attorney (Civil & Criminal)

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-11	Promote and encourage implementation of designated BMPs for residential and non-residential areas.	Landscape-based rebates are a "gateway" for adoption of other beneficial practices and are one of the nonstructural methods which address impacts from single-family residential areas (City of San Diego 2011 program development background study). Residential incentives can include: education and training (neighborhood watershed field days), and aggressive subsidies or rebates for grass replacement and rainwater harvesting. Existing programs will be expanded overall, and also have targeted expansion within specific subwatershed, particularly with highest water quality priority conditions.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, MWD, CWA & local water agencies
CSD-11.1	Residential and Commercial BMP: Rain Barrel	The existing PUD rebate program will continue for residential properties and expand for commercial properties for water collection, conservation, and reuse with rain barrels.	City-wide Residential Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies
CSD-11.2	Residential and Commercial BMP: Grass Replacement	The existing PUD grass replacement cash rebate program will continue and expand for residential and commercial properties. Program encourages a reduction in water use through the conversion of non-artificial grass to water wise plant material, while maintaining a high level of living landscape to benefit the environment. Program does not allow for conversion to artificial turf.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies
CSD-11.3	Residential and Commercial BMP: Downspout Disconnect	Disconnecting downspouts provide alternate runoff pathways from rooftops, sidewalks, driveways, and roads. Disconnecting downspouts from residential areas to pervious land can allow for depression storage and infiltration.	City-wide Residential and Commercial Areas	FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies
CSD-11.4	Residential and Commercial BMP: Microirrigation	The existing PUD micro-irrigation rebate program will continue and increase for residential and commercial properties. Application of microirrigation aims to improve the efficiency of landscape irrigation through the precise application of water.	City-wide Residential Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies
CSD-11.5	Provide Onsite Water Conservation Surveys.	Provide free onsite water conservation surveys to commercial and residential customers to reduce overirrigation and to encourage water conservation.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies
MS4 Infrastructure						

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-12	Implementation of operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, channels as allowed by resource agencies, detention basins, pump stations, etc.) for water quality improvement and for flood control risk management.	Refer to JRMP Section 7.	City-wide	FY16	Ongoing	T&SW
CSD-12.1	Proactively repair and replace MS4 components to provide source control from MS4 infrastructure.	In order to limit inflow of pollutants and reduce pollutant loads, proactive measures will be taken to improve, repair, and replace MS4 components. The City of San Diego will start a multi-year program of repairing and replacing storm drain pipes to reduce sediment loading to the MS4. Development of an assessment management program and bond issues will be addressed. Exploration of daylighting pipes will take place where feasible and appropriate.	City-wide	FY16	Ongoing	T&SW
CSD-12.2	Replacement of hard assets including storm drains and structures.	Refer to JRMP Section 7.	City-wide	FY16	Ongoing	T&SW
CSD-13	Coordinate with other City departments (PUD) to implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers.	Refer to JRMP Section 7.	City-wide	FY16	Ongoing	T&SW with PUD
CSD-13.1	Identify sewer leaks and areas for sewer pipe replacement prioritization.	Risk assessment to include identifying targeted areas (age, location, proximity to MS4), coming up with methodology, pilot, desktop exercise/analysis.	City-wide	FY16	As needed	T&SW with PUD
Roads, Street, and Parking Lots						
CSD-14	Implement operation and maintenance activities for public streets, unpaved roads, paved roads, and paved highways.	Refer to JRMP Section 7.	City-wide	FY16	Ongoing	T&SW
Pesticide, Herbicides, and Fertilizer BMP Program						
CSD-15	Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties. Includes education, permits, and certifications.	Refer to JRMP Sections 7, 8, and 9.	City-wide	FY16	Ongoing	T&SW with Parks and Rec
Retrofit and Rehabilitation in Areas of Existing Development						
CSD-16	Develop and implement a strategy to identify candidate areas of existing development appropriate for retrofitting projects and facilitate the implementation of such projects.	Refer to JRMP Appendix XIX. The Offsite Alternative Compliance Program will include methods for identifying and assessing potential retrofit projects in existing development areas. Retrofit project selection will be based upon a variety of factors including proximity to high priority water quality conditions, potential pollutant load removal effectiveness, and feasibility of implementation. The program will include protocols related to funding mechanisms for project construction and long-term maintenance, payment and credit structures, and water quality equivalency standards.	City-wide	TBD	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-17	Develop and implement a strategy to identify candidate areas of existing development for stream, channel, or habitat rehabilitation projects and facilitate implementation of such projects.	Refer to JRMP Appendix XIX. The Offsite Alternative Compliance Program (Section 3.2 and Appendix 3A) will include methods for identifying and assessing potential stream, channel, or habitat rehabilitation projects in existing development areas. Rehabilitation project selection will be based upon a variety of factors including existing stream or habitat degradation, potential future cumulative stream or habitat impacts, and feasibility of implementation. The program will include protocols related to funding mechanisms for project construction and long-term maintenance, payment and credit structures, and water quality equivalency standards.	City-wide	TBD	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
Illicit Discharge, Detection, and Elimination (IDDE) Program						
CSD-18	Implement Illicit Discharge, Detection, and Elimination (IDDE) Program per the JRMP. Requirements include: maintaining an MS4 map, using municipal personnel and contractors to identify and report illicit discharges, maintaining a hotline for public reporting of illicit discharges, monitoring MS4 outfalls, and investigating and addressing any illicit discharges.	Refer to JRMP Section 3.	City-wide	Prior to FY16	Ongoing	T&SW
Public Education and Participation						
CSD-19	Implement a public education and participation program to promote and encourage development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water prioritized by high-risk behaviors, pollutants of concern, and target audiences.	Refer to JRMP Section 9.	City-wide	Prior to FY16	Ongoing	T&SW
CSD-19.1	Continue implementation of a Pet Waste Program.	Pet Waste Program includes outreach on "Scoop the poop", installation of posts for dispensers, distribution of lawn signs, and attendance at dog-related community activities.	City-wide	Prior to FY16	Ongoing	T&SW with Parks and Rec
CSD-19.2	Promote and encourage implementation of designated BMPs in commercial and industrial areas.	Provide education and outreach on BMPs for commercial businesses and industrial facilities.	City-wide Non-residential Areas	Prior to FY16	Ongoing	T&SW with PUD; Funding: Prop 84 and water districts (MWD)
CSD-19.3	Expand outreach to homeowners' association (HOA) common lands and HOA incentives.	Approaches to consider include: offering incentives to HOAs and maintenance districts to adopt water-conserving/efficiency and stormwater-reduction changes to their landscapes, irrigation, and maintenance; conducting workshops with property managers; providing supplemental standards, inspection, or enforcement for HOA-managed properties.	City-wide	FY16	Ongoing	T&SW

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-19.4	Develop an outreach and training program for property managers responsible for HOAs and maintenance districts.	Approaches to engage HOAs and property managers include: conducting workshops with property managers, providing supplemental standards, inspections or enforcement around HOA properties, and offering incentives to HOAs and maintenance districts to adopt changes to landscapes, irrigation, or maintenance which promote water conservation or stormwater reduction. Property managers are also a target for enhanced outreach.	City-wide	FY16	Ongoing	T&SW
CSD-19.5	Enhance and expand trash cleanups through community-based organizations involving target audiences.	Increase effectiveness and reach of trash/beach cleanups and community based efforts by engaging community groups to self-define and carry-out trash clean-ups. Longstanding partnerships and sponsorships with I Love A Clean San Diego and others are recommended to be continued and enhanced. To effectively target stream clean-up efforts, focus on partnerships with community organizations which provide strong engagement with target audiences and communities.	City-wide	FY16	Ongoing	T&SW; Park and Rec
CSD-19.6	Improve consistency and content of websites to highlight enforceable conditions and reporting methods.	Websites will be updated to provide a user-friendly format and clarity for stormwater violations, conditions which citizens can and should report, and how to make such reports. Examples of reports for common incidents will be developed and posted which may vary locally and regionally. Photographs of allowable practices as well as illegal practices should be shown for utmost clarity. Displaying hotline numbers prominently on the website and near the photographs of illegal practices will ensure that those seeking to report will be able to do so easily. Also ensure hotline number and website are searchable and can be retrieved by simple internet searches.	City-wide	Prior to FY16	Ongoing	T&SW
CSD-19.7	Enhance school and recreation-based education and outreach.	Develop curriculum and establish distribution in public schools. Includes education on water conservation.	City-wide	FY15	Ongoing	T&SW, PUD with community-based organization
CSD-19.8	Develop education and outreach to reduce irrigation runoff.	Example approaches to reduce or eliminate irrigation runoff may include: education and outreach, prohibition, enhanced enforcement of existing prohibitions, and pilot projects such as the City of Del Mar's pilot door hanger project.	City-wide	Prior to FY16	Ongoing	T&SW with PUD

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-19.9	Develop regional training for water-using mobile businesses.	Consider development of supplemental standards for mobile businesses including: covered trash enclosures, careful review of washing areas (grading, drainage, landscaping, sanitary sewer system connectivity), and appropriate signage (either through zoning for retrofits or "best fix" approaches, or through BMP Design Manual standards). Businesses may include carpet cleaners, tile installers, plumbers, etc.	City-wide	FY16	Ongoing	T&SW
CSD-19.10	Enhance education and outreach based on results of effectiveness survey and changing regulatory requirements.	Use effectiveness surveys to enhance existing education and outreach programs while proactively keeping up with and incorporating changing regulatory requirements.	City-wide	FY16	Ongoing	T&SW
CSD-19.11	Continue to promote and encourage implementation of Integrated Pest Management (IPM) for residents and businesses.	The City will continue to provide education on IPM techniques during presentations and on the City's Think Blue website.	City-wide	Prior to FY16	Ongoing	T&SW
Enforcement Response Plan						
CSD-20	Continue to implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management, and existing development in the Storm Water Code Enforcement Unit's Standard Operating Procedures (SOPs) - Enforcement Response Plan.	Refer to JRMP Appendix XIII.	City-wide	Prior to FY16	Ongoing	T&SW with PUD, other City enforcement compliance programs
CSD-20.1	Increase enforcement of irrigation runoff.	Increased enforcement policies against irrigation runoff will be established in tandem with the education and outreach programs on how these actions lead to pollutant loading. By shifting to property-based inspections irrigation runoff can be handled as enforceable violations once the public is well-informed.	City-wide	FY16	Ongoing	T&SW
CSD-20.2	Increase enforcement of water-using mobile businesses.	In addition to education, pollution associated with mobile business sources can be handled through policy, code development, inspections of business practices, and enforcement.	City-wide	FY16	Ongoing	T&SW
CSD-21	Increase enforcement of all minimum BMPs for existing residential, commercial, and industrial development.	Increased enforcement of existing development minimum BMPs.	City-wide	FY16	As needed	T&SW
CSD-22	Increase enforcement associated with property-based inspections.	Shifting inspections from businesses-specific to property-based will increase effectiveness and sense of responsibility and ownership. Education and outreach must be followed up with inspection and enforcement of regulations to encourage proper landscape and water conservation strategies.	City-wide	FY16	Ongoing	T&SW
CSD-23	Increase enforcement of sweeping and maintenance of private roads and parking lots in targeted areas.	Refer to Minimum BMPs in JRMP (Appendix IX).	City-wide	FY16	Ongoing	T&SW

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-24	Increase identification and enforcement of actionable erosion and slope stabilization issues on private property and require stabilization and repair.	Eroding and unstable slope areas on private property (excluding construction sites) will be identified as potential sediment loading sources and subject to enforcement. In the short term, this will target enhanced inspection and enforcement programs to ensure inspectors address erosion and slope instability for the purpose of education.	City-wide	FY16	Ongoing	T&SW
Additional Nonstructural Strategies						
CSD-25	Conduct a Comprehensive Benefits Analysis to identify benefits other than water quality that are applicable to each of the specific WQIP strategies.	The analysis identifies which other benefits apply to each strategy, and documents the assumptions making those linkages. The delineation of other benefits to strategies includes a general description of each benefit, and a listing of the assumptions that were made to link those benefits to strategies. In addition, the other benefits are characterized with respect to who is directly affected: the city, local residents, local businesses, or visitors. This analysis may be used as part of the adaptive management process to modify future strategies.	City-wide	FY15	One time	T&SW
CSD-26	Address and clean up trash from transient encampments with collaboration from the Homeless Outreach Team.	Coordinate with the Homeless Outreach Team to respond to transient encampment trash complaints.	City-wide	FY16	Ongoing	T&SW with Police, ESD, Urban Corps, Alpha Project
CSD-27	Continue participating in source reduction initiatives.	Source reduction initiatives are ultimately the most effective measure to remove pollutants from surface waters, where feasible. Bans or progressive phase-outs that may be considered include: leaf blowers, plastic bags, architectural copper (generally a legacy issue), as well as prohibiting or more aggressively regulating vehicle washing. Additional source reduction initiatives to consider include pesticide sales at hardware stores and irrigation supply stores.	City-wide	Prior to FY16	Ongoing	T&SW
CSD-27.1	Coordinate with Fleet Services to replace City-owned vehicle brake pads with copper-free brake pads as they become commercially available.	Consider legislative mandate and cooperative implementation of copper-free brake pads on city-owned vehicle to reduce pollutant deposition.	City-wide	FY18	Ongoing	T&SW, ESD with PWD (Fleet Services)
CSD-28	Proactively monitor for erosion, and complete minor repair and slope stabilization on municipal property.	Actively identify and repair eroding slopes that may be contributing to sediment loading. Prepare an inventory and assessment of eroding areas and their risk to surface waters. Follow assessment with a schedule for ongoing inspection and stabilization (potentially based on a number or percentage of sites annually). Consider Caltrans program as a template.	City-wide	FY16	Ongoing	T&SW
CSD-29	Conduct special studies.	Special studies will be conducted to gather data to identify pollutant sources, appropriate targets, or other information. Includes collaboration with universities.	City-wide	FY16	Ongoing	T&SW

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-29.1	Participate in Reference Watershed Study.	The San Diego Regional Reference Stream Study (currently being conducted by the Southern California Coastal Water Research Project). The study will develop numeric targets that account for "natural sources" to establish the concentrations or loads from streams in a minimally disturbed or "reference" condition. Refer to Section 5.1 for further details.	Region-wide	Prior to FY16	One time	T&SW, SCCWRP, Regional copermittees
CSD-29.2	Participate in Reference Beach Study.	The San Diego Regional Reference Beach Study will develop numeric targets that account for "natural sources" to establish the concentrations or loads from the beach in a minimally disturbed or "reference" condition. The purpose of this monitoring program is to advise the public of potential health risks that could occur with water contact recreation at local beaches. DEH will post a health advisory notice or close a beach when FIB results are above REC-1 water quality standards.	Region-wide (San Diego River)	Prior to FY16	One time	T&SW, SCCWRP, Regional copermittees
CSD-29.3	Conduct a Cost of Service Study.	Conduct a Cost of Service Study that will examine the full cost of flood control and storm water strategies needed to comply with storm water regulations for the City of San Diego. The City of San Diego's Watershed Asset Management Plan will be used as the basis for the study.	City-wide	FY16	One time	TBD
CSD-30	Conduct Sustainable Return on Investment (SROI) analysis to estimate strategies' co-benefits and impacts to the public and the private sector on a common scale.	SROI is an economics-based framework for evaluating quantitative and qualitative performance metrics and monetizing them, if possible, along a triple bottom line (i.e. financial, societal, and environmental). This strategy may be implemented at any time at the City's discretion if the following triggers are met: 1) funding to address MS4 discharges is identified and secured, 2) staff resources are identified and secured, 3) partners have been identified and formal MOUs have been developed, and 4) consensus and community support has been achieved.	City-wide	Optional	TBD	T&SW and public participation

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-31	Collaborate with the County, if a County-led regional social services effort is established, to provide sanitation and trash management for individuals experiencing homelessness and determine if the program is suitable and appropriate for jurisdictional needs to meet goals.	Support a non-profit or consortium to provide sanitation services associated with hygiene as well as trash management for persons experiencing homelessness. Rented or purchased shower/sanitary trailers providing mobile showers may be organized at specifically scheduled locations and times. This provision has been proposed as a method for preventing surface water usage for sanitation and bathing, as well as opportunity for outreach and referral by social service agencies. The trash management services will include providing trash bags, trash collection areas, and shower/sanitary facilities at centers which provide daytime shelter to their clients, or on a mobile-basis for known transit camps. This strategy may be implemented at any time at the City's discretion if the following triggers are met: 1) funding to address MS4 discharges is identified and secured, 2) staff resources are identified and secured, 3) partners have been identified and formal MOUs have been developed, and 4) consensus and community support has been achieved.	City-wide	Optional	TBD	T&SW
CSD-32	Participate in an assessment to determine if implementation of an urban tree canopy (UTC) program would benefit water quality and other City goals, where feasible.	Perform a feasibility study to determine if implementing an UTC program would be beneficial to the City's goals. UTC intercepts rainfall through increased coverage of leaves, branches, and stems and reduces runoff from the storm drainage system. Benefits associated with enhancing an UTC include reducing heat island effects and air pollution in addition to aesthetics and community benefits. Where feasible, native trees will be utilized to prevent invasive trees from migrating to open spaces and to conserve water. This strategy may be implemented at any time at the City's discretion if the following triggers are met: 1) funding to address MS4 discharges is identified and secured and 2) staff resources are identified and secured.	City-wide	Optional	TBD	Planning Dept. with T&SW, SANDAG, and Nature Conservancy

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-33	Conduct a feasibility study to test Permeable Friction Course (PFC), a porous asphalt that overlays impermeable asphalt.	Perform an assessment to determine the feasibility of implementing PFC on City streets. PFC, an overlay of porous asphalt, is an innovative roadway material that improves driving conditions in wet weather and water quality. Placed in a layer 25-50mm thick on top of regular impermeable pavement, PFC allows rainfall to drain within the porous layer rather than on top of the pavement. PFC has also been shown to reduce concentrations of pollutants commonly observed in highway runoff. PFC incorporates stormwater treatment into the roadway surface and does not require additional right-of-way. This strategy may be implemented at any time at the City's discretion if the following triggers are met: 1) funding to address MS4 discharges is identified and secured and 2) staff resources are identified and secured.	City-wide	Optional	One time	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-34	As opportunities arise and funding sources are identified, protect areas that are functioning naturally by avoiding impervious development and degradation on unpaved open space areas, creating permanent open space protections on undeveloped city-owned land, and accepting privately-owned undeveloped open areas.	This strategy may be implemented if there is interest in participation by the public or private entity with current control of the land. This strategy may be implemented at any time at the City's discretion if the following triggers are met: 1) identification of partners, if needed (public, private, non-profit), 2) identification of costs and potential sources of funding, 3) final agreement by public or private entity with current control of the land, 4) final agreement by all other participating partners including acceptance by intended land- or asset-owning City department, and 5) funding in place.	City-wide	Optional	TBD	TBD
CSD-35	Participate in a watershed council or group if one is established.	This strategy may be implemented at any time at the City's discretion if the following triggers are met: 1) partners have been identified and formal MOUs have been developed and 2) consensus and community support has been achieved.	City-wide	Optional	TBD	TBD
CSD-36	Prohibit introduction of invasive plants in new development and redevelopment projects.	Coordinate with the City's Development Services Department to continue to prohibit introduction of invasive species such as Arundo donax and Cortaderia selloana for new development or redevelopment projects as specified in the City's municipal code for landscape.	City-wide	Prior to FY16	Ongoing	T&SW with DSD
Green Infrastructure						
CSD-37	Bioretention at Allied Gardens Recreation Area.	Bioretention designed for Allied Gardens Recreation Area to treat a drainage area of 4.5 acres.	San Diego River WMA	FY16	Ongoing	T&SW with PWD
CSD-38	Bioretention at Famosa Slough.	Bioretention designed for Famosa Slough to treat a drainage area of 10.3 acres.	San Diego River WMA	FY17	Ongoing	T&SW with PWD
CSD-39	6 Vegetated Swales in Mission Trails Regional Park E. Fortuna Equestrian Staging Area	6 Vegetated Swales planned for Mission Trails Regional Park E. Fortuna Equestrian Staging Area	San Diego River WMA	FY17	Ongoing	T&SW with PWD

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-40	20.1 acres of bioretention have been identified as potential opportunities for green infrastructure implementation on public parcels to treat an impervious drainage area of 522.33 acres with a total storage volume of 23.97 acre-feet.	Staggered construction, operation, and maintenance of 20.1 acres of bioretention to treat an impervious drainage area of 522.33 acres with a total storage volume of 23.97 acre-feet.	San Diego River WMA	FY22	Ongoing	TBD
CSD-41	Cabrillo Heights Rain Garden	Rain garden constructed on Kearny Villa Rd. used to treat a drainage area of 6 acres.	San Diego River WMA	Prior to FY16	Ongoing	T&SW with PWD
Green Streets						
CSD-42	43.61 acres of green streets (35.77 acres of bioretention and 7.84 acres of permeable pavement) have been identified as potential opportunities for green street projects to treat a total drainage area of 10,715.24 acres with a total storage volume of 88.02 acre-feet.	Staggered construction, operation and maintenance of 43.61 acres of green streets (35.77 acres of bioretention and 7.84 acres of permeable pavement) to treat a total drainage area of 10,715.24 acres with a total storage volume of 88.02 acre-feet.	San Diego River WMA	FY24	Ongoing	TBD
Multiuse Treatment Areas						
Infiltration and Detention Basins						
CSD-43	Cleator Park	Construction, operation and maintenance of a 3.8 acre subsurface detention/infiltration system to treat a total drainage area of 333 acres (APN 4491100800). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	San Diego River WMA	FY19	Ongoing	T&SW with PWD
CSD-44	Cabrillo Heights Park	Construction, operation and maintenance of a 14 acre subsurface detention/infiltration system to treat a total drainage area of 238 acres (APN 4210500100 and 4213201100). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	San Diego River WMA	FY19	Ongoing	T&SW with PWD
CSD-45	Presidio Hills Golf Course and Park	Construction, operation and maintenance of a 12 acre subsurface detention/infiltration system to treat a total drainage area of 142 acres (APN 4425200800). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	San Diego River WMA	FY20	Ongoing	T&SW with PWD
CSD-46	Montgomery Field Airport	Construction, operation and maintenance of a 410 acre subsurface detention/infiltration system to treat a total drainage area of 410 acres (APN 4212901100). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	San Diego River WMA	FY20	Ongoing	T&SW with PWD
CSD-47	Ocean Beach Athletic Park and Robb Field	Construction, operation and maintenance of an 83 acre subsurface detention/infiltration system to treat a total drainage area of 315 acres (APN 4488000100). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	San Diego River WMA	FY22	Ongoing	T&SW with PWD

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-48	Lower North Shepherd Canyon	Construction, operation and maintenance of a 37 acre subsurface detention/infiltration system to treat a total drainage area of 757 acres (APN 3733022600, 3730715500, and 3733022400). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	San Diego River WMA	FY20	Ongoing	T&SW with PWD
CSD-49	Springall Academy	Construction, operation and maintenance of an 11 acre subsurface detention/infiltration system to treat a total drainage area of 324 acres (APN 4574000400). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	San Diego River WMA	FY21	Ongoing	T&SW with PWD
CSD-50	Serra Mesa Park and upslope canyon	Construction, operation and maintenance of a 20 acre subsurface detention/infiltration system to treat a total drainage area of 267 acres (APN 4213000700 and 421032200). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	San Diego River WMA	FY21	Ongoing	T&SW with PWD
Stream, Channel and Habitat Rehabilitation Projects						
CSD-51	If interim load reduction goals are not met and additional stream, channel, and habitat rehabilitation projects are required, implement as needed.	This strategy may be triggered as 1) funding to address MS4 discharges is identified and secured, 2) staff resources are identified and secured, 3) partners have been identified and formal MOUs have been developed, 4) permits required by regulatory agencies are secured, and 5) recommendations from the community are identified and consensus and community support has been achieved.	Areas identified during feasibility studies	Optional	TBD	T&SW
Water Quality Improvement BMPs						
Proprietary BMPs						
CSD-52	3 Drain Inserts in Complex Street Green Mall.	3 drainage inserts planned for implementation in Complex Street Green Mall.	San Diego River WMA	FY17	Ongoing	T&SW with PWD
CSD-53	Park Ridge hydrodynamic separator	A hydrodynamic separator used to treat onsite runoff of 37.6 acres.	San Diego River WMA	FY17	Ongoing	T&SW with PWD
CSD-54	El Capitan Reservoir	3 drainage inserts planned for implementation in El Capitan Reservoir.	San Diego River WMA	Prior to FY16	Ongoing	T&SW with PWD
CSD-55	Murray Reservoir	5 drainage inserts planned for implementation in Murray Reservoir.	San Diego River WMA	Prior to FY16	Ongoing	T&SW with PWD
CSD-56	San Vicente Reservoir	1 drainage insert planned for implementation in San Vicente Reservoir.	San Diego River WMA	Prior to FY16	Ongoing	T&SW with PWD

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-57	Serra Mesa/Kearny Mesa Library	A hydrodynamic separator used to treat onsite runoff at Serra Mesa/Kearny Mesa Library.	San Diego River WMA	Prior to FY16	Ongoing	T&SW with PWD
Dry Weather Flow Separation and Treatment Projects						
CSD-58	If interim load reduction goals are not met and additional dry weather flow separation and treatment projects are required, implement as needed.	Construction of dry weather flow separation and treatment projects, where identified. This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, 3) staff resources are identified and secured, and 4) permits required by regulatory agencies are secured.	Downstream reaches where persistent dry weather flows have been observed	Optional	TBD	T&SW with PWD
Trash Segregation						
CSD-59	If interim load reduction goals are not met and additional trash segregation projects are required, implement as needed.	Construction of trash segregation (Trash Guards, etc.) projects, where identified. This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, 3) staff resources are identified and secured, and 4) permits required by regulatory agencies are secured.	High-loading areas city-wide	Optional	TBD	T&SW with PWD

DSD= Development Services Department; PUD = Public Utilities Department; PWD = Public Works Department; T&SW = Transportation and Storm Water Division; WAMP = Watershed Asset Management Plan; “Refer to Section X” will be updated upon submittal of the City’s JRMP in June 2015; TBD = will be determined during the next fiscal year.

Table A-2 City of San Diego Annual Schedule

Construction
Ongoing Implementation/ O&M
As needed/Design

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
Jurisdictional Strategies																				
Development Planning																				
All Development Projects																				
CSD-1	Establish guidelines and standards for all development projects; provide technical support related to implementation of source control BMPs to minimize pollutant generation at each project and implement LID BMPs to maintain or restore hydrology of the area or implement easements to protect water quality, where applicable and feasible. Includes internal coordination and collaboration between City departments (DSD, PWD, and Engineering) to improve success and long-term benefits of BMPs.	City-wide	Prior to FY16	Ongoing																
CSD-1.1	Investigation and research of emerging technology.	City-wide	Prior to FY16	As Needed																
CSD-1.2	Approve and implement a green infrastructure policy.	City-wide	FY16 (Begin)	As Needed																
CSD-1.3	Develop Design Standards for Public LID BMPs.	City-wide	FY14-FY15	As Needed																
CSD-1.4	Outreach to impacted industry regarding minimum BMP requirement updates.	City-wide	FY15	As Needed																
CSD-2	Train staff on LID regulatory changes and LID practices.	City-wide	FY16		As Needed															
CSD-3	Amend municipal code and ordinances, including zoning ordinances, to facilitate and encourage LID opportunities to support compliance with the MS4 Permit and TMDLs in a reasonable manner. Ensure consistency with the City of San Diego's BMP Design Manual. Update the Storm Water Standards Manual accordingly.	City-wide	FY15	As Needed																
CSD-4	Create a manual that outlines right-of-way design standards.	City-wide	FY15	One time																
CSD-5	Provide technical education and outreach to the development community on the design and implementation requirements of the MS4 Permit and Water Quality Improvement Plan requirements.	City-wide	Prior to FY16	Ongoing																
Priority Development Projects (PDPs)																				
CSD-6	For PDPs, provide technical support to other City departments to ensure implementation of on-site structural BMPs to control pollutants and manage hydromodification by developing City wide storm water development standards and design guidelines.	City-wide	FY16		Ongoing															
CSD-6.1	Institute a program to verify and enforce maintenance and performance of treatment control BMPs.	City-wide	FY16		Ongoing															
CSD-7	Update BMP Design Manual procedures to determine nature and extent of storm water requirements applicable to development projects and to identify conditions of concern for selecting, designing, and maintaining appropriate structural BMPs.	City-wide	FY15	Cycle																

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-7.1	Amend BMP Design Manual for trash areas. Require full four-sided enclosure, siting away from storm drains and cover. Consider the retrofit requirement.	City-wide	FY15	One time																
CSD-7.2	Amend BMP Design Manual for animal-related facilities, such as such as animal shelters, "doggie day care" facilities, veterinary clinics, breeding, boarding and training facilities, groomers, and pet care stores.	City-wide	FY15	One time																
CSD-7.3	Amend BMP Design Manual for nurseries and garden centers.	City-wide	FY15	One time																
CSD-7.4	Amend BMP Design Manual for auto-related uses.	City-wide	FY15	One time																
CSD-8	Develop and administer an alternative compliance program for on-site structural BMP implementation (includes identifying Watershed Management Area Analysis [WMAA] candidate projects). Refer to Section 4.2.5.	City-wide	FY15	Ongoing																
CSD-8.1	Create a fund that allows habitat acquisition, protection enhancement, and restoration in conjunction with other cooperating entities including community groups, academic institutions, state county, and federal agencies, etc.	City-wide	Optional	If triggered, begin planning, acquiring funding and resources																
Construction Management																				
CSD-9	Coordinate with other City departments to promote and confirm a thorough understanding of requirements for implementing temporary BMPs that control sediment and other pollutants during the construction phase of projects. Included in that understanding are requirements to inspect at appropriate frequencies and effectively enforce requirements through process controlled by other City departments.	City-wide	FY16		Ongoing															
Existing Development																				
Commercial, Industrial, Municipal, and Residential Facilities and Areas																				
CSD-10	Administer a program to require implementation of minimum BMPs for existing development (commercial, industrial, municipal, and residential) that are specific to the facility, area types, and PGAs, as appropriate. Includes inspection of existing development at appropriate frequencies and using appropriate methods.	City-wide	FY16		Ongoing															
CSD-10.1	Update minimum BMPs for existing residential, commercial, and industrial development. Specific updates to BMPs include required street sweeping, catch basin cleaning, and maintenance of private roads and parking lots in targeted areas.	City-wide	FY15	Cycle																
CSD-10.2	Outreach to property managers and trash haulers to elevate the emphasis of power washing as a pollutant source.	City-wide Residential, commercial and industrial areas	FY15	Ongoing																
CSD-10.3	Implement property based inspections.	City-wide	Prior to FY16	Ongoing																
CSD-10.4	Review policies and procedures to ensure discharges from swimming pools meet permit requirements.	City-wide	FY15	As Needed																

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-11	Promote and encourage implementation of designated BMPs for residential and non-residential areas.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing																
CSD-11.1	Residential and Commercial BMP: Rain Barrel	City-wide Residential Areas	Prior to FY16	Ongoing																
CSD-11.2	Residential and Commercial BMP: Grass Replacement	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing																
CSD-11.3	Residential and Commercial BMP: Downspout Disconnect	City-wide Residential and Commercial Areas	FY16		Ongoing															
CSD-11.4	Residential and Commercial BMP: Microirrigation	City-wide Residential Areas	Prior to FY16	Ongoing																
CSD-11.5	Provide Onsite Water Conservation Surveys.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing																
MS4 Infrastructure																				
CSD-12	Implementation of operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, channels as allowed by resource agencies, detention basins, pump stations, etc.) for water quality improvement and for flood control risk management.	City-wide	FY16		Ongoing															
CSD-12.1	Proactively repair and replace MS4 components to provide source control from MS4 infrastructure.	City-wide	FY16		Ongoing															
CSD-12.2	Replacement of hard assets including storm drains and structures.	City-wide	FY16		Ongoing															
CSD-13	Coordinate with other City departments (PUD) to implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers.	City-wide	FY16		Ongoing															
CSD-13.1	Identify sewer leaks and areas for sewer pipe replacement prioritization.	City-wide	FY16		As Needed															
Roads, Street, and Parking Lots																				
CSD-14	Implement operation and maintenance activities for public streets, unpaved roads, paved roads, and paved highways.	City-wide	FY16		Ongoing															
Pesticide, Herbicides, and Fertilizer BMP Program																				
CSD-15	Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties. Includes education, permits, and certifications.	City-wide	FY16		Ongoing															
Retrofit and Rehabilitation in Areas of Existing Development																				
CSD-16	Develop and implement a strategy to identify candidate areas of existing development appropriate for retrofitting projects and facilitate the implementation of such projects.	City-wide	TBD																	
CSD-17	Develop and implement a strategy to identify candidate areas of existing development for stream, channel, or habitat rehabilitation projects and facilitate implementation of such projects.	City-wide	TBD																	
Illicit Discharge, Detection, and Elimination (IDDE) Program																				

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-18	Implement Illicit Discharge, Detection, and Elimination (IDDE) Program per the JRMP. Requirements include: maintaining an MS4 map, using municipal personnel and contractors to identify and report illicit discharges, maintaining a hotline for public reporting of illicit discharges, monitoring MS4 outfalls, and investigating and addressing any illicit discharges.	City-wide	Prior to FY16	Ongoing																
Public Education and Participation																				
CSD-19	Implement a public education and participation program to promote and encourage development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water prioritized by high-risk behaviors, pollutants of concern, and target audiences.	City-wide	Prior to FY16	Ongoing																
CSD-19.1	Continue implementation of a Pet Waste Program.	City-wide	Prior to FY16	Ongoing																
CSD-19.2	Promote and encourage implementation of designated BMPs in commercial and industrial areas.	City-wide Non-residential Areas	Prior to FY16	Ongoing																
CSD-19.3	Expand outreach to homeowners' association (HOA) common lands and HOA incentives.	City-wide	FY16		Ongoing															
CSD-19.4	Develop an outreach and training program for property managers responsible for HOAs and maintenance districts.	City-wide	FY16		Ongoing															
CSD-19.5	Enhance and expand trash cleanups through community-based organizations involving target audiences.	City-wide	FY16		Ongoing															
CSD-19.6	Improve consistency and content of websites to highlight enforceable conditions and reporting methods.	City-wide	Prior to FY16	Ongoing																
CSD-19.7	Enhance school and recreation-based education and outreach.	City-wide	FY15	Ongoing																
CSD-19.8	Develop education and outreach to reduce irrigation runoff.	City-wide	Prior to FY16	Ongoing																
CSD-19.9	Develop regional training for water-using mobile businesses.	City-wide	FY16		Ongoing															
CSD-19.10	Enhance education and outreach based on results of effectiveness survey and changing regulatory requirements.	City-wide	FY16		Ongoing															
CSD-19.11	Continue to promote and encourage implementation of Integrated Pest Management (IPM) for residents and businesses.	City-wide	Prior to FY16	Ongoing																
Enforcement Response Plan																				
CSD-20	Continue to implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management, and existing development in the Storm Water Code Enforcement Unit's Standard Operating Procedures (SOPs) - Enforcement Response Plan.	City-wide	Prior to FY16	Ongoing																
CSD-20.1	Increase enforcement of irrigation runoff.	City-wide	FY16		Ongoing															
CSD-20.2	Increase enforcement of water-using mobile businesses.	City-wide	FY16		Ongoing															
CSD-21	Increase enforcement of all minimum BMPs for existing residential, commercial, and industrial development.	City-wide	FY16		As needed															
CSD-22	Increase enforcement associated with property-based inspections.	City-wide	FY16		Ongoing															

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-23	Increase enforcement of sweeping and maintenance of private roads and parking lots in targeted areas.	City-wide	FY16		Ongoing															
CSD-24	Increase identification and enforcement of actionable erosion and slope stabilization issues on private property and require stabilization and repair.	City-wide	FY16		Ongoing															
Additional Nonstructural Strategies																				
CSD-25	Conduct a Comprehensive Benefits Analysis to identify benefits other than water quality that are applicable to each of the specific WQIP strategies.	City-wide	FY15	One time																
CSD-26	Address and clean up trash from transient encampments with collaboration from the Homeless Outreach Team.	City-wide	FY16		Ongoing															
CSD-27	Continue participating in source reduction initiatives.	City-wide	Prior to FY16	Ongoing																
CSD-27.1	Coordinate with Fleet Services to replace City-owned vehicle brake pads with copper-free brake pads as they become commercially available.	City-wide	FY18				Ongoing													
CSD-28	Proactively monitor for erosion, and complete minor repair and slope stabilization on municipal property.	City-wide	FY16		Ongoing															
CSD-29	Conduct special studies.	City-wide	FY16		Ongoing															
CSD-29.1	Participate in Reference Watershed Study.	Region-wide	Prior to FY16	One time																
CSD-29.2	Participate in Reference Beach Study.	Region-wide (San Diego River)	Prior to FY16	One time																
CSD-29.3	Conduct a Cost of Service Study.	City-wide	FY16		One time															
CSD-30	Conduct Sustainable Return on Investment (SROI) analysis to estimate strategies' co-benefits and impacts to the public and the private sector on a common scale.	City-wide	Optional	If triggered, begin planning, acquiring funding and resources																
CSD-31	Collaborate with the County, if a County-led regional social services effort is established, to provide sanitation and trash management for individuals experiencing homelessness and determine if the program is suitable and appropriate for jurisdictional needs to meet goals.	City-wide	Optional	If triggered, begin planning, acquiring funding and resources																
CSD-32	Participate in an assessment to determine if implementation of an urban tree canopy (UTC) program would benefit water quality and other City goals, where feasible.	City-wide	Optional	If triggered, begin planning, acquiring funding and resources																
CSD-33	Conduct a feasibility study to test Permeable Friction Course (PFC), a porous asphalt that overlays impermeable asphalt.	City-wide	Optional	If triggered, begin planning, acquiring funding and resources																
CSD-34	As opportunities arise and funding sources are identified, protect areas that are functioning naturally by avoiding impervious development and degradation on unpaved open space areas, creating permanent open space protections on undeveloped city-owned land, and accepting privately-owned undeveloped open areas.	City-wide	Optional	If triggered, begin planning, acquiring funding and resources																
CSD-35	Participate in a watershed council or group if one is established.	City-wide	Optional	If triggered, begin planning, acquiring funding and resources																
CSD-36	Prohibit introduction of invasive plants in new development and redevelopment projects.	City-wide	Prior to FY16	Ongoing																

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
Green Infrastructure																				
CSD-37	Bioretention at Allied Gardens Recreation Area.	San Diego River WMA	FY16																	
CSD-38	Bioretention at Famosa Slough.	San Diego River WMA	FY17																	
CSD-39	6 Vegetated Swales in Mission Trails Regional Park E. Fortuna Equestrian Staging Area	San Diego River WMA	FY17																	
CSD-40	20.1 acres of bioretention have been identified as potential opportunities for green infrastructure implementation on public parcels to treat an impervious drainage area of 522.33 acres with a total storage volume of 23.97 acre-feet.	San Diego River WMA	FY22																	
CSD-41	Cabrillo Heights Rain Garden	San Diego River WMA	Prior to FY16																	
Green Streets																				
CSD-42	43.61 acres of green streets (35.77 acres of bioretention and 7.84 acres of permeable pavement) have been identified as potential opportunities for green street projects to treat a total drainage area of 10,715.24 acres with a total storage volume of 88.02 acre-feet.	San Diego River WMA	FY24																	
Multiuse Treatment Areas																				
Infiltration and Detention Basins																				
CSD-43	Cleator Park	San Diego River WMA	FY19																	
CSD-44	Cabrillo Heights Park	San Diego River WMA	FY19																	
CSD-45	Presidio Hills Golf Course and Park	San Diego River WMA	FY20																	
CSD-46	Montgomery Field Airport	San Diego River WMA	FY20																	
CSD-47	Ocean Beach Athletic Park and Robb Field	San Diego River WMA	FY22																	
CSD-48	Lower North Shepherd Canyon	San Diego River WMA	FY20																	
CSD-49	Springall Academy	San Diego River WMA	FY21																	
CSD-50	Serra Mesa Park and upslope canyon	San Diego River WMA	FY21																	
Stream, Channel and Habitat Rehabilitation Projects																				
CSD-51	If interim load reduction goals are not met and additional stream, channel, and habitat rehabilitation projects are required, implement as needed.	Areas identified during feasibility studies	Optional	If triggered, begin planning (acquire funding and resources, conduct site feasibility analysis and site selection) to implement rehabilitation projects.																
Water Quality Improvement BMPs																				
Proprietary BMPs																				
CSD-52	3 Drain Inserts in Complex Street Green Mall.	San Diego River WMA	FY17																	
CSD-53	Park Ridge hydrodynamic separator	San Diego River WMA	FY17																	
CSD-54	El Capitan Reservoir	San Diego River WMA	Prior to FY16																	
CSD-55	Murray Reservoir	San Diego River WMA	Prior to FY16																	
CSD-56	San Vicente Reservoir	San Diego River WMA	Prior to FY16																	
CSD-57	Serra Mesa/Kearny Mesa Library	San Diego River WMA	Prior to FY16																	
Dry Weather Flow Separation and Treatment Projects																				

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-58	If interim load reduction goals are not met and additional dry weather flow separation and treatment projects are required, implement as needed.	Downstream reaches where persistent dry weather flows have been observed	Optional	If triggered, begin planning (acquire funding and resources, conduct site feasibility analysis and site selection) to implement dry weather flow separation projects.																
Trash Segregation																				
CSD-59	If interim load reduction goals are not met and additional trash segregation projects are required, implement as needed.	High-loading areas city-wide	Optional	If triggered, begin planning (acquire funding and resources, conduct site feasibility analysis and site selection) to implement trash segregation projects.																

Chapter 3 – Appendix C: Wet Weather Baseline Loads Quantification Methods & Values

For the Cities of El Cajon, La Mesa, Santee, and the County of San Diego, wet weather baseline loads for fecal coliform[3] were established using the Structural BMP Prioritization and Analysis Tool (SBPAT); a GIS-based water quality analysis tool used to quantify benefits, costs, uncertainties and potential risks associated with storm water quality projects.

For the City of San Diego, the model used incorporates a watershed loading model to estimate baseline water quality and flow conditions, a site-scale BMP optimization model, and a non-linear watershed-scale optimization model to assist with evaluating multiple BMP scenarios concurrently. The modeling approach builds on the information and modeling efforts that were completed during Phase I CLRP development. Existing Loading Simulation Program in C++ (LSPC) watershed models were updated and standardized in Phase II to (1) establish a level of consistency and comparability for areas with similar physical characteristics, and (2) provide reasonable assurance that the modeled existing condition is a representative baseline condition.

CITIES OF EL CAJON, LA MESA, SANTEE, AND THE COUNTY OF SAN DIEGO

The quantification/analysis module utilizes a stochastic Monte Carlo method to model water quality based on land use Event Mean Concentrations (EMCs)[4] coupled with continuous hydrologic simulations (produced using the USEPA SWMM model) to calculate annual loads. Since the previously established target load reductions (TLRs) from the Phase II CLRP which are used for this WQIP were developed using data from Water Year (WY) 2003, considered an average rainfall year for the Watershed, the WQIP analysis was also developed using rainfall from WY 2003 to maintain consistency. Several additional calibration checks were performed on the SBPAT model to evaluate its consistency with the Loading Simulation Program in C++ (LSPC) model that was used to develop the target load reductions. Specifically, water quality and hydrologic input parameters were evaluated, and these parameters were adjusted where warranted as described below.

INPUT PARAMETER UPDATES SINCE CLRP DEVELOPMENT

Land use EMCs for modeled pollutants selected for WQIP analysis were developed for the San Diego River (SDR) Watershed using storm water monitoring data collected by 1) the City of San Diego solely, and 2) the County of San Diego and the Copermittees of the San Diego Municipal Storm Water Permit as a group. The mean statistics were estimated using San Diego County datasets, but in order to develop more robust variability estimates, the standard deviation statistics were estimated using the coefficients of variation[5] from the Los Angeles County SBPAT default datasets, which have larger numbers of samples. For pollutants where no San Diego County specific EMC data were available, SBPAT default EMC statistics were used.

---

[3] Fecal coliform is utilized as a surrogate for all FIB since there is an acceptable database of both land use-based storm water concentrations and structural BMP performance for this constituent.

[4] An EMC is an *average* pollutant concentration for a storm water event, whereas instantaneous concentrations throughout a storm are more variable. Land use specific EMC data are used to in watershed models to characterize pollutant concentrations from different catchments which are comprised of various land use mixes.

[5] Coefficient of variation = standard deviation divided by the mean

Since the San Diego County EMC datasets were based on fewer storms, smaller drainage areas (and therefore a smaller diversity of sites within each land use category) and were collected over a three month period of time within a single season, they may not adequately capture the full variability across multiple storm sizes, antecedent conditions, and wet seasons. In order to address this issue for the WQIP analysis, fecal coliform (FC) land use EMCs were compared with the FC land use EMCs developed for other Southern California-based TMDL compliance plans (Beach Cities WMG 2014). When arithmetic estimates of the log mean differed by more than an order of magnitude, they were compared with arithmetic mean land use concentrations from the LSPC model calibrated for the San Diego Region, and the EMC statistics from the two datasets that were closer to LSPC's arithmetic means (calculated based on land use loads divided by runoff volumes) were selected for use in this WQIP analysis. This resulted in changes to commercial and open space FC EMCs. **Table 3C-** 1 below provides the EMCs for all land uses and pollutants used in the WQIP analysis.

Table 3C- 1. Proposed SBPAT EMCs for SLR and SDR Watersheds – Arithmetic Estimates of the Lognormal Summary Statistics (means with standard deviations in parentheses)

Land Use	TSS	TP	DP	NH3	NO3	TKN	Diss Cu	Tot Cu	Tot Pb	Diss Zn	Tot Zn	Fecal Col.
Rural Residential	2,523.76 (3,757.19)	1.59 (1.19)	0.12 (0.08)	0.11 (0.14)	1.50 (3.40)	2.65 (2.45)	4.20 (4.02)	8.36 (5.99)[a]	21.38 (31.41)	14.99 (30.63)	39.19 (34.01)[a]	6,684 (20,245)
Orchard	252.64 (163.89)	0.36 (0.16)	0.13 (0.10)	0.04 (0.04)	26.11 (88.27)	2.31 (1.09)	22.50 (17.50)	100.10 (74.8)	30.20 (34.30)	40.10 (49.10)	274.80 (147.30)	1,344 (3,410)
Single Family Residential	123.41 (183.72)	0.49 (0.37)	0.45 (0.29)	0.49 (0.64)	1.58 (3.59)	2.51 (2.33)	11.42 (10.93)	25.96 (18.6)	13.03 (19.15)	50.02 (102.22)	153.29 (133.04)	35,557 (107,700)
Commercial	127.68 (89.75)	0.32 (0.27)	0.29 (0.25)	1.21 (4.18)	0.55 (0.55)	3.44 (4.78)	16.62 (13.78)	54.84 (44.88)	14.40 (39.60)	224.40 (140.58)	483.7 (306.62)	51,600 (173,400)
Industrial	125.18 (118.15)	0.45 (0.47)	0.26 (0.25)	0.6 (0.95)	0.87 (0.96)	2.87 (2.33)	21.35 (20.78)	53.54 (56.95)	20.52 (58.92)	214.58 (271.47)	428.39 (388.85)	26,703 (34,515)
Education (Municipal)	132.11 (162.75)	0.46 (0.26)	0.26 (0.2)	0.4 (0.99)	0.61 (0.67)	1.71 (1.13)	5.58 (5.03)	12.02 (8.21)	7.43 (10.11)	73.13 (50.73)	174.1 (123.02)	2,148 (6,506)[b]
Transportation	77.80 (83.80)	0.68 (0.94)	0.56 (0.82)	0.37 (0.68)	0.74 (1.05)	1.84 (1.44)	32.40 (25.5)	52.20 (37.5)	9.20 (14.5)	222 (201.7)	292.90 (215.8)	1,680 (456)
Multi-family Residential	39.90 (51.3)	0.23 (0.21)	0.20 (0.19)	0.50 (0.74)	1.51 (3.06)	1.80 (1.24)	7.40 (5.70)	12.10 (5.60)	4.50 (7.80)	77.5 (84.1)	125.10 (101.10)	11,800 (23,700)
Agriculture (row crop)	999.2 (648.2)	3.34 (1.53)	1.41 (1.04)	1.65 (1.67)	34.40 (116.30)	7.32 (3.44)	22.50 (17.50)	100.10 (74.8)	30.20 (34.3)	40.10 (49.10)	274.80 (147.30)	60,300 (153,000)
Vacant / Open Space	216.60 (1482.8)	0.12 (0.31)	0.09 (0.27)	0.11 (0.25)	1.17 (0.79)	0.96 (0.9)	0.60 (1.90)	10.60 (24.4)	3.00 (13.10)	28.10 (12.90)	26.30 (69.50)	484 (806)

[a] SBPAT default SFR dissolved:total concentration ratio was applied to the Blossom Valley dissolved mean value to estimate Blossom Valley total mean value
[b] FC EMC COV is based on SFR SCCWRP datasets
Mean EMCs in shaded area are based on LA region default SBPAT datasets due to a lack of available San Diego data
Mean EMCs shaded in orange are updated for this WQIP

SBPAT's predicted annual discharge volume for WY 2003 was evaluated by comparing it with LSPC's prediction as well as a measured value based on the stream flow gauge on San Diego River at Fashion Valley (USGS 11023000). These values are shown in **Table 3C-2** below. SBPAT's saturated hydraulic conductivity (K_{sat}) and initial moisture deficit input parameter values were adjusted upward to their maximum values (within their reasonable ranges as reported in USDA (1996)) to decrease predicted runoff volumes to better match the measured volume. The revised SBPAT volume, also shown in **Table 3C-2,** is within 20% of the measured volume and 30% of the LSPC predicted volume.

Table 3C-2. Observed and modeled runoff volumes for WY 2003 at Fashion Valley stream flow gage

Analysis	WY 2003 Total Runoff (acre-feet)
USGS 1102300 stream flow gage at Fashion Valley on San Diego River[a]	20,000
Phase II LSPC model (with irrigation turned off)	18,700
SBPAT model prior to adjustments	28,100
SBPAT model after adjustments	24,000

[a] Dry weather flows were removed from analysis.

Table 3C-3. Updated FC land use EMCs – Arithmetic Estimates of the Lognormal Summary Statistics (means with standard deviations in parentheses)

Land Use	CLRP EMC	WQIP EMC
Commercial	791 [22,846]	51,600[a] [173,400]
Open Space	6,310 [1,310]	484[b] [806]

[a] Commercial fecal coliform EMC based on 2000-2005 SCCWRP Los Angeles region land use data (SCCWRP, 2007b). This EMC dataset is summarized in the SBPAT User's Guide (Geosyntec, 2012).

[b] Open space fecal coliform EMC statistics based on E. *coli* data (divided by 0.85 to adjust to fecal coliform) for Arroyo Sequit reference watershed, or 11 samples collected between December 2004 and April 2006. Data used by LA Regional Board for creek bacterial TMDLs and taken from (SCCCWRP, 2005) and (SCCWRP, 2007a).

Once the parameter adjustments described above were made, SBPAT's predicted annual FC load was divided by the SBPAT predicted annual volume to determine the corresponding average annual FC concentration at the watershed outlet for WY 2003. SBPAT's average concentration at the catchment outlets was then adjusted to account for effects of instream die-off in order to compare this predicted concentration with measured concentration. The adjustment factor was developed using the LSPC model by turning the die-off on and off. This adjusted SBPAT average concentration was compared with a corresponding value from the LSPC model (with die-off turned on), and with an arithmetic mean of measured concentration data taken from the SDR mass loading monitoring station (MLS) for the entire record (n=23, POR=2001-12). These values are shown in **Table 3C-4**.

Table 3C-4. FC concentration comparison

Dataset	Average FC Concentration (90% Confidence Interval in Parentheses) (MPN/100ml)
Measured data at SDR MLS (n=23, POR=2001-12)	15,400 (6,200 – 24,600)
LSPC model for WY 2003	6,600
SBPAT model for WY 2003 (adjusted with instream die-off for comparison)	23,800

Both LSPC and SBPAT's average concentration for the watershed outlet are within the 90% confidence interval of the measured data. Therefore, SBPAT's predicted annual load (where load is the product of volume and concentration, both of which were individually compared with measured data) is considered reliable for the purpose of this watershed analysis.

Baseline Load Credit for Implemented Development BMPs

Baseline loads assume 2009 land uses, therefore they include loads from development that occurred between the TMDL year (2003) and 2009. As such, structural BMPs that were implemented on development projects between the TMDL year (2003) and 2009 were considered as part of the overall pollutant load reduction achieved by the WQIP. Appendix E presents a list of these projects, a map with their locations, and describes how these features were modeled. It should be noted that no credit is given for BMPs to be implemented as mitigation to new development after 2009 as it is assumed that the loads mitigated by the BMPs will offset the additional loads generated by new development (i.e. no net decrease in pollutant load).

Baseline Load Breakdown

Figure 3C- 1 shows the estimated modeled breakdown of San Diego River wet weather watershed loads by jurisdiction. For the purposes of the baseline loading analysis, as well as subsequent BMP implementation analyses presented in this WQIP, land use loads attributable to federal and tribal land ownership are not considered part of the Participating Agencies' load since the Participating Agencies do not have jurisdiction over these lands. Similarly, loading from agricultural land uses is not considered part of the Participating Agencies' load because the TMDL identifies Conditional Waivers of Waste Discharge Requirements as the mechanism to address discharges from controllable non-point sources (SDRWQCB 2010, p. A47). Open space loading is also shown as a separate category here, consistent with the TMDL. However, it should be noted that this general land use category includes parks and other undeveloped areas that are located within the Participating Agencies' jurisdictional areas and that drain to or through the MS4s.

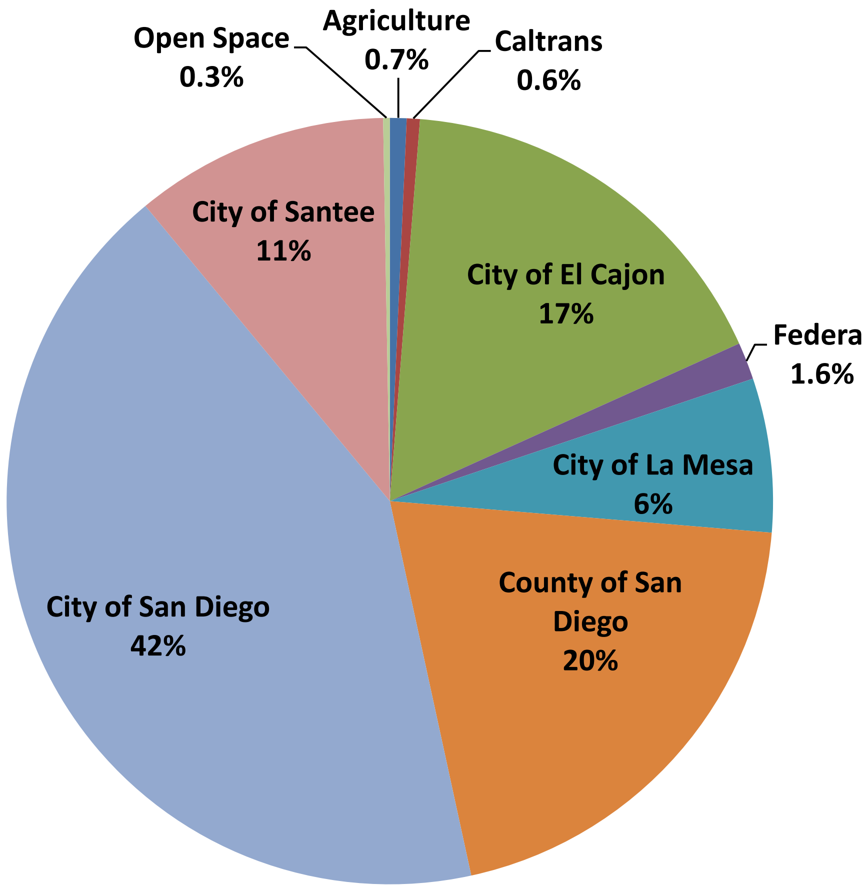


Figure 3C- 1. Wet weather FC modeled loads in the San Diego River Watershed, by land use/jurisdictional category, water year 2003

CITY OF SAN DIEGO

DETERMINATION OF TMDL REDUCTION OBJECTIVES

The first step in the load reduction analysis is the interpretation of the TMDLs and their associated numeric goals and WLAs and applying the watershed model for determining necessary pollutant load reductions to meet those objectives. Numeric goals were calculated for each parameter based on the difference between the modeled load and calculated TMDL load for Water Year (WY) 2003. This year represents typical wet and dry weather conditions and provides an appropriate benchmark to use in defining numeric goals and the resulting BMP implementation needs. Modeled loads above the TMDL load were considered as a required reduction and subtracted from the model baseline load to develop an instream load reduction target.

Each parameter has special considerations based on how the Basin Plan Water Quality Objectives (WQOs) are expressed as well as the associated TMDL requirements, and other regulatory requirements. Key compliance elements and the calculated numeric goals and reduction targets are presented in the following sections.

WQOS AND TMDL NUMERIC TARGETS

The Bacteria TMDL is expressed as both a concentration-based and load-based target. Determination of MS4 compliance, as described in the Basin Plan Amendment, is based on both receiving water conditions and measurements of bacteria loading from MS4 outfalls. The concentration-based receiving water component of the TMDL is reflected by the TMDL targets, which are separated into a dry weather component, based on the geometric mean WQOs, and a wet weather component, based on the single sample WQOs. These targets are used to generate "Receiving Water Limitations" in the TMDL, which means the MS4s are assigned much of the responsibility for attaining the TMDL targets (or, at a minimum, demonstrating that non-MS4 sources are responsible for non-attainment). The San Diego River watershed is subject to those targets assigned to freshwater creeks.

Fecal coliform was used to represent bacteria in the load reduction calculations. The TMDL load for fecal coliform was calculated by multiplying the WQOs by the daily modeled stream flow. Modeled daily loads greater than this threshold were flagged as an exceedance. Modeled daily loads were also classified as occurring on either wet days or dry days because of different compliance requirements. A wet day is defined as a day with at least 0.2 inch of rainfall plus the three following days. Any day not classified as a wet day was considered a dry day. For wet weather, the Bacteria TMDL specifies an allowable exceedance frequency of 22 percent based on reference conditions, while no exceedances are allowed during dry weather. For WY2003, the number of wet days was 42; therefore the number of allowable wet weather exceedance days was 9 (rounded). The allowable exceedance load for wet weather was calculated by summing the top 9 days with the highest modeled daily loads. This load was then subtracted from the modeled wet weather total for the year. The difference between the remaining modeled load and the TMDL load represents the load reduction required for wet weather.

For dry weather, the WQOs represent 30-day geometric mean concentrations that require interpretation for use in developing the associated TMDL load. For the CLRP, a 30-day period in July 2003 was selected for modeling the dry period as it best represents a period unimpacted by rainfall and dominated by dry urban runoff. The 30-day geometric mean concentrations for each parameter were assumed for each dry day during this period and multiplied by the daily modeled flows to calculate the TMDL load. The dry weather load reduction was simply the difference between the modeled existing load and the TMDL load for the total number of dry days.

TMDL Load Reduction Summary

Table 3C-5 presents the calculated wet loads and load reductions required based on the assumptions discussed above. The critical bacteria constituent is fecal coliform bacteria based on wet weather conditions. The assumption used in the CLRP is that by focusing on the critical pollutants for load reduction analyses, other pollutants will be addressed (many of the BMPs address multiple pollutants). Regardless, load reductions for the other pollutants are verified later in the analysis to ensure that necessary reductions are demonstrated.

Table 3C-5. Wet-weather pollutant loads and required reductions

Pollutant	Total Load	Non-Exceedance Load	Allowable Exceedance Load	Exceedance Load	Required Reduction
Fecal Coliform (Billion #/year)	1,494,873	64,568	912,229	518,076	34.7%
Enterococcus (Billion #/year)	10,734,720	65,267	7,643,082	3,026,371	28.2%

Chapter 3 – Appendix D: Wet Weather Non-Structural BMP Descriptions and Load Reduction Quantifications, Methods, and Calculations

Non-structural BMPs are management programs or activities designed to reduce or eliminate pollutant loading by addressing its source. The quantification methods differed slightly between the City of San Diego and the Cities of El Cajon, La Mesa, and Santee and the County of San Diego. The methods and results are described separately in this appendix.

CITIES OF EL CAJON, LA MESA, AND SANTEE AND THE COUNTY OF SAN DIEGO

To ensure that non-structural BMPs target the most significant sources of bacteria, the following factors were considered: (1) a sources' magnitude, prevalence, potential threat to public health and proximity to receiving water; (2) results from microbial tracking studies conducted in the watershed and region; and (3) best professional judgment.

The wet weather load reduction quantification approach involves similar steps for each of the Public-Private Partnership Programs included in this WQIP. The first step was to identify the source addressed by the program (e.g. bacteria in rooftop runoff). The next step was to calculate the targeted pollutant source area that the BMP will address (e.g. acres of rooftop). Once the targeted pollutant source area was calculated, the unit effectiveness of the selected BMP was modeled in SBPAT for a standard design (e.g. reduction of bacteria load per acre as a result of the implementation of a rain barrel. The potential load reduction benefit was then calculated by multiplying the unit effectiveness of the selected BMP by the targeted pollutant source area addressed. The following sections provide a brief description of the specific quantification approach for each wet weather Public-Private Partnership Program, along with relevant assumptions and assumption explanations. **Table 3D-1** provides a summary of wet weather non-structural BMPs and a quantification of water quality benefits.

Table 3D-1. Wet-weather Quantification of Water Quality Benefits (Not including City of San Diego)

BMP Name	Wet or Dry Weather	Land Use Targeted	Pollutant Generating Activity	Quantification Assumptions			Quantification Method	Expected Annual Reduction of MS4 Baseline Load[1,2] by 2031	
				Load Assumption	Units	Citation/Assumptions		Fecal Coliform (10 ^12 MPN and percent) Low Range	High Range
Potential Public Private Partnership Program	Wet Weather	Single Family Residential (SFR)	Residential Roofs	54,474	Parcels of Single Family Residential in Watershed	SANDAG Land Use and Parcel Data	(residential parcels in watershed) * (SFR rooftop area) * [(expected percent of residential area converted to rain barrels) * (annual load reduction per acre conversion to rain barrels) + (expected percent of SFR disconnected to lawns) * (annual load reduction per acre from disconnection to lawn)]	**75** **1.6%**	**710** **15%**
				1500 - 4500	Single Family Residential Rooftop Size	Range developed on a GIS assessment of 20 parcels per jurisdiction			
				0.090	10 ^12 MPN of fecal coliform reduced per impervious acre treated by rain barrels	Modeled in SBPAT using Santee rainfall data, assumed 0.2 inch design storm (equates to one 55 gallon barrel for each 500 sq.-ft roof area), 10-day drain time.			
				0.429	10 ^12 MPN of fecal coliform reduced per impervious acre treated by disconnection	Modeled in SBPAT using Santee rainfall data, assumed area receiving flow would have an infiltration rate of 0.15 in/hr. (C/B soils) and effective depression storage (including root zone) of 0.7 inches, and would be 1/4 the area of contributing flow			
				2.5-10%	Percent of Residential Area Converted to rain barrels	Conversion over 15 years, based on expected effectiveness of incentives program.			
				7.5-30%	Percent of Residential Area Converted to disconnected to pervious area.	Conversion over 15 years, based on expected effectiveness of incentives program.			
Redevelopment through Permit-Required LID Implementation	Wet Weather	All Land Uses covered under SUSMP	Urban development	0.135	10^12 MPN of fecal coliform reduced per Residential Acre Converted	Modeled in SBPAT using Santee rainfall data; Applied standard SUSMP-sized bioretention with underdrains to unit areas of various land uses.	Sum for all land uses of (Load Reduction per Acre Converted) * (Acres Converted per Year) * (Years to 2031) * (+ or - 20%)	**160** **3.4%**	**240** **5.2%**
				0.394	10^12 MPN of fecal coliform reduced per Commercial Acre Converted				
				0.155	10^12 MPN of fecal coliform reduced per Industrial Acre Converted				
				0.006	10^12 MPN of fecal coliform reduced per Education Acre Converted				
				0.002	10^12 MPN of fecal coliform reduced per Transportation Acre Converted				
				995	Acres Residential Converted per year (Land Use Redev. Rate = 0.18%)	Calculated by Extrapolating City of LA Redevelopment Rate From Ballona IP (rate shown in parentheses) to watershed area by land use			
				78.2	Acres Commercial Converted per year (Land Use Redev. Rate = 0.15%)				
				161	Acres Industrial Converted per year (Land Use Redev. Rate = 0.34%)				
				50.2	Acres Education Converted per year (Land Use Redev. Rate = 0.16%)				
				1105	Acres Transportation Converted per year (Land Use Redev. Rate = 2.7%)				
Wet Weather Total							**Total expected load reduction**	**235**	**950**
							% of average MS4 total load	**5.1%**	**20%**

1. The MS4 baseline load for wet weather was calculated in SBPAT and the 25th and 75th Percentiles of the annual load was used to create these ranges.
2. Load reductions do not include benefits from nonstructural BMPs in the City of San Diego.

Private-Public Partnership Program

Two main low impact development BMPs quantified for the incentive program are: 1) a rain barrel program and 2) a downspout disconnect program. The average performance, during wet weather, of these programs per rooftop acre was modeled in SBPAT for WY (2003), consistent with the baseline load calculations (see Section 3.3.1.1 for discussion). The area of implementation was based on land use information and a preliminary assessment of single-family residential homes in the watershed. The extent of single-family residential homes that will be converted to rain barrels was estimated to be 2.5-10% and amount of homes that will disconnect their downspouts was estimated to be 7.5-30% of all SFR homes in the Watershed over a 16 year period, based on the expected effectiveness of the given incentives program. Additional load reduction benefit may be achieved by expanding the program to commercial areas as well.

Figure 3C-2. Residential Rain Barrel and Downspout Disconnect Incentive Program

Benefits from the homes to be retrofitted with rain barrels were estimated by multiplying the area to receive rain barrels with the unit reduction that was modeled in SBPAT using Santee rainfall data, assuming a 0.2 inch design storm (equates to one 55 gallon barrel for each 500 sq.-ft. roof area) and a 10-day drain time.

Benefits from the homes to be treated by disconnecting downspouts were estimated by multiplying the area to receive disconnection with the unit reduction that was modeled in SBPAT using Santee rainfall data, assuming the area receiving flow would have an infiltration rate of 0.15 in/hr. (C/B soils) and effective depression storage (including root zone) of 0.7 inches, and would be 1/4 the area of contributing flow. This program can be implemented in other land uses such as commercial, for example.

Redevelopment through Permit-Required LID Implementation

This WQIP assumes that a portion of already developed areas in the watershed has been and will be redeveloped from when the TMDL was initiated to the end of the compliance period. This redevelopment is subject to the post-construction treatment requirements contained in the San Diego MS4 Permit (Provision E.3.b) and will therefore result in load reduction benefits. A Standard Urban Storm water Management Plan (SUSMP)-sized bioretention system with underdrains was modeled in SBPAT for residential, commercial, industrial, education, and transportation land uses during the TMDL Critical Water Year (2003) to give the bacteria load reductions per acre converted. The rate of redevelopment requiring SUMSP LID implementation for each of these land uses was extrapolated based on the rate analysis done for the Ballona Creek IP. During the 20 year compliance timeline this rate will result in redevelopment of approximately 6% of the MS4 area. For each land use, the load reductions per acre was multiplied by the land use specific redevelopment rate, the number of land use acres, and the number of years from when the TMDL was initiated to the end of the compliance period.

The City of San Diego

The purpose of this section is to summarize the extent to which each nonstructural BMP contributes to pollutant removal in the San Diego River watershed. The City of San Diego was able to quantify several types of BMPs that are effective at reducing bacteria loads. (HDR, 2014) These BMPs and their overall load reduction are discussed below.

Street Sweeping

Enhanced street sweeping activities provide direct, additional load reduction for specific pollutants. Sediment and other debris that collect on roadways, medians, and gutters are removed from the watershed with each sweeping, along with the associated mass of other pollutants. However, results indicated that street sweeping does little in terms of bacteria load reductions (HDR, 2014). Since bacteria are the only TMDL pollutant for San Diego River, this BMP is not recommended for the San Diego River watershed.

Catch Basin Cleaning

Enhanced catch basin cleaning programs provide direct, additional load reduction for specific pollutants. Sediment and other debris trapped in catch basins are removed from the collection system with each cleaning, along with the associated mass of other pollutants. However, results indicated that catch basin cleaning does little in terms of bacteria load reductions (HDR, 2014). Since bacteria are the only TMDL pollutant for San Diego River, this BMP is not recommended for the San Diego watershed.

Rain Barrels Incentive Program

Rain barrels act as mechanisms to temporarily detain and re-route runoff from otherwise directly connected impervious areas to nearby pervious areas or other vegetated areas such as rain gardens, swales, and the like. Due to the limited extent of implementation of this program, load reduction values are quite small. (HDR, 2014)

Downspout Disconnection Incentive Program

Downspout disconnections provide a similar watershed impact as rain barrels and downspout disconnections are modeled similarly. Implementation of this program is substantially greater than the rain barrel program, although the total load reduction numbers remain small. (HDR, 2014)

Irrigation Runoff Reduction

Irrigation runoff reduction was modeled as a turf conversion and irrigation efficiency program. Turf conversion transforms area from grasses that require regular irrigation to other, native pervious cover which would not require regular irrigation. The irrigation efficiency program sets the goal of eliminating irrigation overspray practices over the course of the 20-year implementation period. It should be noted that the impact of the elimination of irrigation overspray on dry weather pollutant load reductions in the City of San Diego is heavily muted due to the way in which dry weather flows are tabulated for this analysis. (HDR, 2014)

Summary of Modeled Nonstructural BMPs

Finally, all nonstructural BMPs were included in the baseline watershed model to determine the aggregate flow and pollutant load reduction. The combined estimates are presented in **Table 3D- 2**.

Table 3D- 2. San Diego River Watershed Bacteria Load Reduction for all Modeled Non-Structural Practices in the City of San Diego

Condition	Fecal Coliform (%)
Wet weather	0.37
Dry weather	45.65

Chapter 3 – Appendix E: Wet Weather Structural BMP Descriptions and Load Reduction Quantifications, Methods, and Calculations

Structural BMPs are engineered systems designed to remove pollutants by simple gravity settling of particulate pollutants, filtration, biological update, media absorption, or any other physical, biological or chemical process. Two types of structural BMPs have been proposed for implementation and modeled for this WQIP: distributed and regional. Distributed structural BMPs are implemented at the neighborhood, parcel or site scale and can include green streets, rainwater harvesting and other low-impact development solutions. Regional structural BMPs are implemented to treat sub-watershed or catchment scale drainage areas and include structures such as subsurface flow wetlands, infiltration basins and constructed wetlands.

The quantification methods differed slightly between the City of San Diego and the Cities of El Cajon, La Mesa, and Santee and the County of San Diego. The methods and results are described separately in this appendix.

Cities of El Cajon, La Mesa, and Santee and the County of San Diego - Load Reduction Methods Information for all Wet Weather Structural BMPs

Load reductions for structural BMPs during wet weather were calculated using SBPAT as described in Appendix C. In general, design criteria for each selected BMP were first defined considering site constraints (in particular, acreage available for each BMP footprint), BMP performance data, and local regulations. For example, for regional BMPs, if there was not adequate space to provide full SUSMP-level treatment, estimated load reductions were based on available area (publicly owned) and benefits were calculated accordingly. Once a BMP was identified and design criteria defined for each feasible BMP opportunity site, SBPAT was used to evaluate the impact of implementing this suite of BMPs on water quality in the region. Details of the methodology and specific design criteria for regional versus distributed BMPs are discussed in the following sections.

Locations for distributed and regional BMPs were identified using the SBPAT catchment prioritization step, which orders catchments within the Watershed based on their potential to generate the highest pollutant loads during wet weather events. This allows identification of locations within the Watershed that offer the greatest potential benefits in terms of load reductions through implementation of BMPs. Consistent with the goal of prioritizing strategies with a multi-pollutant benefit, this catchment prioritization analysis was conducted considering nitrogen and phosphorus (using total suspended solids as a proxy)[6], in addition to the HPWQC.

Implemented Distributed Structural BMPs

Baseline loads in the WQIP included loads from development that occurred between the TMDL year (2003) and 2009, since the WQIP baseline load was developed using 2009 land use data. As such, structural BMPs that were implemented between the TMDL year (2003) and 2009 as mitigation to

[6] The SBPAT catchment prioritization step does not include an option for phosphorus. Because of this, TSS was used as a proxy for phosphorus, since the majority of phosphorus is associated with solids. The load reduction analysis step in SBPAT does include phosphorus, so no proxy was necessary for this portion of the analysis.

this anticipated development were considered as part of the overall pollutant load reduction to be achieved by the WQIP. A map with their locations is shown in **Table 3E-1.**

No credit is given in the WQIP for BMPs to be implemented as mitigation to new development after 2009 as it is assumed that the loads mitigated by the BMPs will offset the additional loads generated by new development (i.e. no net decrease in pollutant load). Refer to Appendix C where the role of implemented structural BMPs in the WQIP's baseline load calculations is discussed.

Load Reduction Quantification Methods – Specific Design Criteria

- Distributed BMPs were modeled as bioretention and bioretention swales with under drains[7] according to their infiltration capacity. Design criteria for quantifying the distributed parameters were developed using the following assumptions:
- Distributed BMPs within a catchment would be implemented to treat 25 percent of the MS4 area within a given catchment;
- Four (4) percent of the contributing area would be required for treating full SUSMP rainfall depth of 0.75 inches from the contributing area with distributed BMPs. This assumption was based on previous experiences with implementation of similar distributed BMPs;
- For catchments where sufficient land was not available, the design storm was taken to be a fraction of this 0.75 inch storm according to what percent of the contributing area was potentially available for BMP installation;
- Other design criteria for bioretention:
    - Design Volume: governed by available space and contributing area
    - Retention Depth: 12 inches
    - Infiltration Rate: governed by soil type.
- Other design criteria for bioretention swale with under drains:
    - Design Flow Rate: governed by available space and contributing area
    - Hydraulic Residence Time: 10 min
    - Longitudinal Slope: 0.03 ft./ft.
    - Manning's Roughness Coefficient: 0.25
- Water Quality Flow Depth: 4 inches
- Retention Depth: 2 inches

[7] Bioretention-type BMPs are landscaped shallow depressions that capture and filter storm water runoff. These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, plantings, and, optionally, a subsurface gravel reservoir layer.

- Infiltration Rate: governed by soil type.

Distributed BMPs were grouped according to ranges in sizing criteria, and each group was modeled once using the mean sizing criteria for the group to limit the number of runs in SBPAT. Model results, including pollutant removal and costs, were summed to determine the overall impact of the distributed BMPs. These estimated load reductions are presented in **Table 3E-1.**

Locations and Descriptions of Implemented Distributed BMPs

The locations of the implemented distributed BMPs are identified in **Figure 3E-1** and their descriptions are provided in **Table 3E-1.**

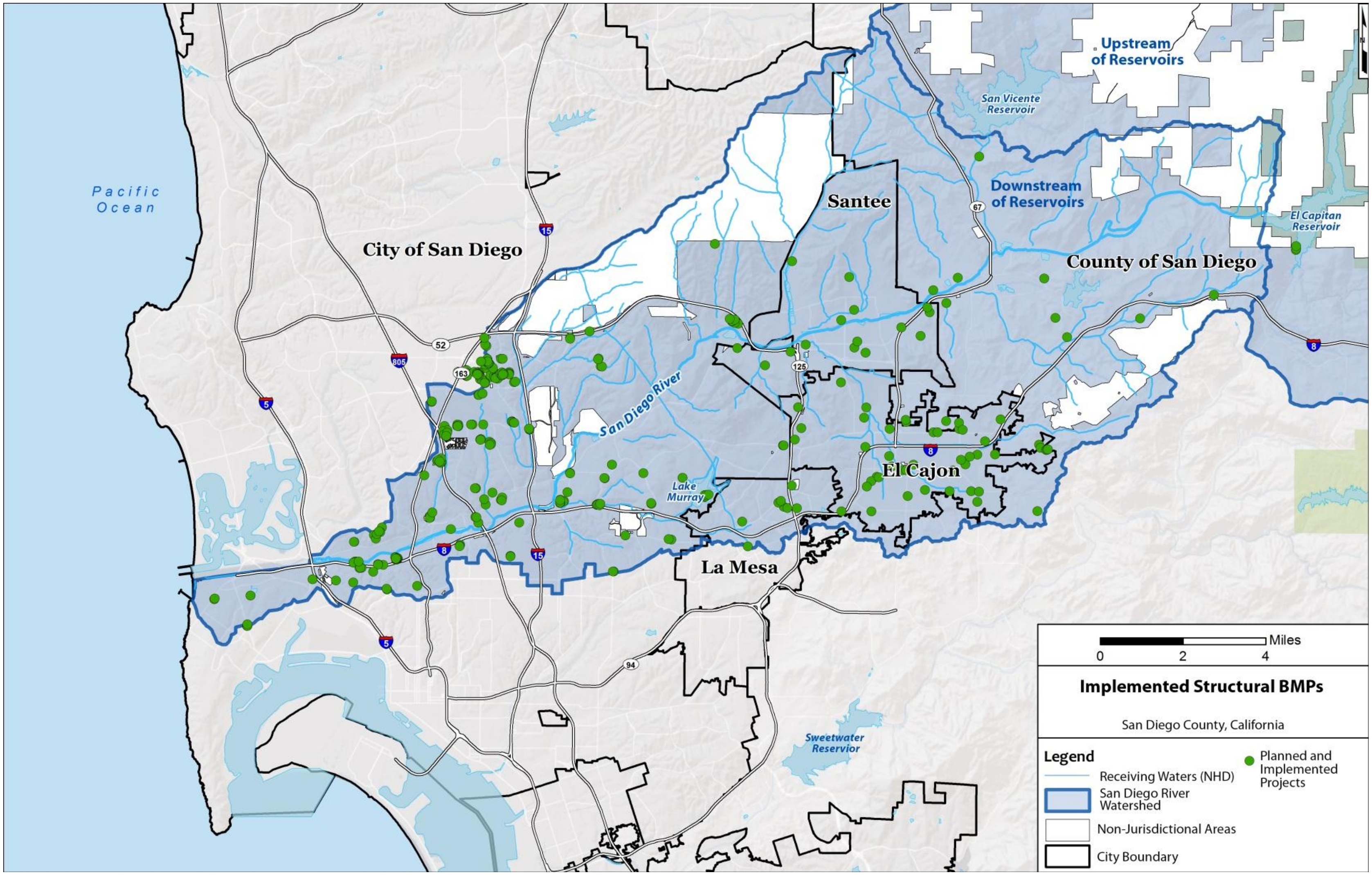


Figure 3E-1. San Diego River Watershed Implemented Distributed Structural BMPs

Table 3E-1. Descriptions of Implemented Distributed Structural BMPs

Jurisdiction	BMP Location	BMPs Implemented	Assumed Drainage Area (acres)	Catchment ID	Baseline Land Use (2009)
County of San Diego	9410 Adlai Terrace, Lakeside	Extended Detention Basin	9.0	1078	SF Residential
County of San Diego	Canita Lomas and Liberatore Lane, El Cajon	Subsurface Infiltration	20.0	1460	SF Residential
County of San Diego	420 Hart Dr, El Cajon and PO Box 1507, Cardiff	Grass Swale	0.5	1476	MF Residential
County of San Diego	9108 Lake Valley Road, Lakeside	Vegetated Filter Strip	1.0	1067	Institutional/Education
County of San Diego	Laurel Canyon Rd a Vista Laurel Pl, Lakeside	Bioretention and Grass Swale	5.5	1175	SF Residential
County of San Diego	9728 Marilla Drive, Lakeside	Bioretention Swale	4.4	1096	SF Residential
County of San Diego	1178 Persimmon Ave, El Cajon	Grass Swale	1.0	1474	MF Residential
County of San Diego	14878 Olde Highway 80, Lakeside	Permeable Paving, Porous Concrete	2.0	1050	Institutional/Education
County of San Diego	15724 Olde Highway 80, El Cajon	Bioretention Swale	1.0	1041	Rural Residential
County of San Diego	10007 Riverford Road, Lakeside	Bioretention Swale	3.0	1188	Industrial
County of San Diego	11905 Riverside Drive, Lakeside	Wet pond	76.0	1187	MF Residential
County of San Diego	Woodside Avenue Extended Detention Basin	Detention basin	301	1185	MF Residential
City of El Cajon	1501 East Washington Ave, El Cajon	detention basin and filter inserts	0.6	4498	Commercial

Jurisdiction	BMP Location	BMPs Implemented	Assumed Drainage Area (acres)	Catchment ID	Baseline Land Use (2009)
City of El Cajon	327/359 El Cajon Blvd, El Cajon	detention basins and inlet filters	1.9	4496	Commercial
City of El Cajon	245 E. Main St. El Cajon	downspout filters	0.1	4501	Commercial
City of El Cajon	1062 N. Second St, El Cajon	grass filter strip	0.6	4513	Commercial
City of El Cajon	605 W. Lexington Ave, El Cajon	gravel filter, rock energy dissipater, and bio-detention basin	0.2	4496	Commercial
City of El Cajon	1401/1409 East Main St, El Cajon	hydrodynamic separation system, inlet filters, and underground detention box	4.0	4484	Commercial
City of El Cajon	442/444 El Cajon Blvd, El Cajon	pervious swale and media filter vaults	0.2	4495	Commercial
City of El Cajon	335/355 North Second St, El Cajon	vegetated swale and outlet filter	0.5	4483	Commercial
City of El Cajon	1190 N. Second St., El Cajon	grass filter strip	0.2	4513	SF Residential
City of El Cajon	1032 Broadway, El Cajon	inlet filter and grass buffer strip	0.3	4502	Commercial
City of El Cajon	343 E Main St, El Cajon	vegetated swales and filter inserts	0.3	4501	Commercial
City of El Cajon	938 E. Washington Ave, El Cajon	pervious swale	0.4	4501	Commercial
City of El Cajon	1301 N. Marshall Ave, El Cajon	gravel infiltration basin	0.4	4510	Commercial
City of El Cajon	608 Sandra Lane, El Cajon	grass-lined channel	0.4	4489	SF Residential
City of El Cajon	1090 Broadway, El Cajon	grass filter strip and inlet filter inserts	0.4	4513	Commercial

Jurisdiction	BMP Location	BMPs Implemented	Assumed Drainage Area (acres)	Catchment ID	Baseline Land Use (2009)
City of El Cajon	613 Sandra Lane, El Cajon	detention basin	0.5	4489	SF Residential
City of El Cajon	403/431 Wisconsin Lane, El Cajon	sand media filter, underground detention basin, and inlet filter	0.5	4487	SF Residential
City of El Cajon	1470 E. Madison Ave, El Cajon	Pervious concrete swale	0.6	4484	Commercial
City of El Cajon	475/487 Foundation Lane, El Cajon	vegetated swale and inlet filter	0.6	4482	SF Residential
City of El Cajon	635 Sandra Lane , El Cajon	Detention basin	0.6	4489	SF Residential
City of El Cajon	1700 E. Main St, El Cajon	Vegetated swales, inlet filter, and infiltration basin	0.6	4507	Commercial
City of El Cajon	1108/1116 Anita Lee Lane, El Cajon	Grassy swales and curb outlet filters	0.6	4494	SF Residential
City of El Cajon	670 El Cajon Blvd, El Cajon	Underground detention pipe and hydrodynamic separator	0.7	4495	MF Residential
City of El Cajon	1273/1275 E. Main St, El Cajon	Vegetated swale and porous pavement,	0.7	4483	Commercial
City of El Cajon	912/930 Jamacha Rd, El Cajon	Infiltration system, vegetated swale, and storm drain inlet filters	0.8	4497	MF Residential
City of El Cajon	1341 E Main St, El Cajon	vegetated swales, gravel infiltration areas, and inlet filter inserts	0.8	4483	Commercial
City of El Cajon	1380 El Cajon Blvd, El Cajon	underground detention system	0.9	4493	Commercial

Jurisdiction	BMP Location	BMPs Implemented	Assumed Drainage Area (acres)	Catchment ID	Baseline Land Use (2009)
City of El Cajon	1326/1350 Wendell Cutting Ct, El Cajon	vegetated swales, underground detention, and inlet filter	1.0	4508	SF Residential
City of El Cajon	2095 East Madison Ave, El Cajon	biofilters and detention basin	1.0	4489	Commercial
City of El Cajon	1539 E. Main Street, El Cajon	underground detention pipe, pervious swale, and inlet filters	1.1	4508	MF Residential
City of El Cajon	2000/2010 Gillespie Way, El Cajon	detention area in parking lot, vegetated swale, and filter inserts	1.7	4504	Industrial
City of El Cajon	1225/1285 East Washington Ave, El Cajon	Biofilters for each new housing unit (perimeter)	1.8	4479	SF Residential
City of El Cajon	2766 Navajo Rd., El Cajon	Hydrodynamic separation system and underground detention box	2.5	4240	Institutional/Education
City of El Cajon	Grossmont College Drive, El Cajon	hydrodynamic separation system and detention area	2.7	4244	Institutional/Education
City of El Cajon	1630/1632 E Madison Ave, El Cajon	vegetated detention basin and inlet filters	4.1	4484	Institutional/Education
City of El Cajon	198 W Main St, El Cajon	vegetated swales, hydrodynamic separator system, trash enclosure dry wells, and trench drain, downspout, inlet filters	4.7	4496	Commercial

Jurisdiction	BMP Location	BMPs Implemented	Assumed Drainage Area (acres)	Catchment ID	Baseline Land Use (2009)
City of El Cajon	1001 W. Bradley Ave, El Cajon	pervious swales, inlet filter, and detention basin	4.8	4510	Industrial
City of El Cajon	2062/2096 Ingamac Way Ave, El Cajon	extended detention basin and grassy swales	4.9	4489	SF Residential
City of El Cajon	1435 E. Washington Ave, El Cajon	vegetated swale, two extended detention basin, and storm drain inlet filters	6.1	4498	SF Residential
City of El Cajon	Anjuli Ct, El Cajon	Hydrodynamics separator system	6.4	4241	SF Residential
City of El Cajon	965 Arnele Ave, El Cajon	vegetated bioswales, pervious buffer strip, and bioretention swale.	6.9	4511	Commercial
City of El Cajon	298 Fletcher Pkwy, El Cajon	inlet filters, CDS hydrodynamic separator units, and filtration strip next to Garden Center	8.3	4502	Commercial
City of El Cajon	1935/1941 Granite Hills Dr., El Cajon	detention basin and vegetated channel	9.1	4484	SF Residential
City of El Cajon	189 Roanoke Rd, El Cajon	vegetated swales and storm drain inlet filters	10.7	4500	Institutional/Education
City of La Mesa	8085 University Avenue, La Mesa	Vegetated Swale, Vortex Separator	1.0	5294	Commercial
City of La Mesa	8010 Parkway Dr., La Mesa	Media Filter	10.5	5291	Commercial
City of La Mesa	8860/8870 Center Dr., La Mesa	Media Filter, Bioswale	3.2	5288	MF Residential

Jurisdiction	BMP Location	BMPs Implemented	Assumed Drainage Area (acres)	Catchment ID	Baseline Land Use (2009)
City of La Mesa	8727/8655 Fletcher Parkway, La Mesa	Media Filter, Drainage inserts	7.0	5287	SF Residential
City of La Mesa	9001 Wakarusa St., La Mesa	Wetland/Detention Area	3.6	5454	Institutional/Education
City of La Mesa	8881 Dallas St., La Mesa	Bioswale, Media Filter	2.7	5285	Institutional/Education
City of La Mesa	5555 Grossmont center Dr., La Mesa	Media Filter	15.0	5288	Commercial
City of La Mesa	8725 Fletcher Parkway, La Mesa	Media Filter	0.5	5287	Transportation
City of Santee	Aubrey Glen, Hiser Road and Mission Gorge Road	Hydrodynamic Separator System	8.0	3247	MF Residential
City of Santee	Autowerks, APN: 383-112-53	Drainage inserts and grass swales	2.5	3251	Commercial
City of Santee	Autumn wood II, APN: 381-681-20	Hydrodynamic Separator System	10.0	3237	MF Residential
City of Santee	Boys and Girls Club, 8820 Tamberley Way	Grassy swale, drainage inserts.	1.0	3802	Institutional/Education
City of Santee	Cabins at Lake 7, APN: 378 020 49, 376 010 07	Wet pond	20.0	3200	Institutional/Education
City of Santee	Chapparel (Mission View Estates), West of Mesa Road	Bioswales and media filter	2.0	3250	MF Residential
City of Santee	Ciraolo Industrial Building, APN: 381-540-10 and 11	Inlet filters, grass swale, downspout filters	2.0	3262	Industrial
City of Santee	Hartford Insurance, APN: 381-050-59	Vegetated swale, rocky swale, and drainage inserts	6.0	3258	Commercial

Jurisdiction	BMP Location	BMPs Implemented	Assumed Drainage Area (acres)	Catchment ID	Baseline Land Use (2009)
City of Santee	Morningside, APN: 384-081-16	Hydrodynamic Separator System	6.0	3258	MF Residential
City of Santee	Rayo Wholesale, Rayo II, 11495 Woodside Avenue	Grass swale, Grassy detention basin with sand cone filter	3.0	3264	Industrial
City of Santee	Town Center Community Park, APN: 381-050-51, 52, and 381-051-06, 07	Media Filter, bioswales, buffer strips, inlet filters	12	3207	Institutional/Education
City of Santee	Toyota, APN: 383-124-11	Extended detention basin, bioretention, inlet filters	3.0	3255	Commercial
Caltrans	SR 52 Unit 5A	Bioswales	9.8		Transportation
Caltrans	SR 52 Unit 5A	Detention Basin	9.3		Transportation
Caltrans	SR 52 : 52/15 Separation To Mast Boulevard	Bioswales	4		Transportation
Caltrans	SR 52: Cuyamaca Street To Magnolia Avenue	Bioswales	21.5		Transportation
Caltrans	SR 52: Cuyamaca Street To Magnolia Avenue	Detention Basin	9.2		Transportation

Load Reduction Quantifications

The estimated load reductions for the modeled implemented distributed BMPs are presented in **Table 3E-2.**

Table 3E-2. Estimated Load Reductions from Distributed BMPs

Distributed BMPs	Water Quality (FC Load) Benefits (10^12 MPN reduction/year) [Low – High][a]
Implemented Distributed Projects	53 [29 – 62]
Potential Distributed Projects	397 [214 – 463]

[a] Load reductions are for the County of San Diego, and Cities of El Cajon, Santee, and La Mesa.

Stream Enhancement/Restoration Projects

Stream enhancement/restoration projects, implemented from 2003 and through future proposed projects, were incorporated into the CLRP's load reduction estimates. The intent is not to design these projects to be inundated with untreated water, but to acknowledge the benefits these sites achieve when stormwater comes in contact with these sites. Wet weather benefits for these projects are estimated based on analysis of the project features. However, future flow and bacteria monitoring data should be used to confirm or revise these assumed benefits. The following potential net pollutant load reduction mechanisms were quantified for stream restoration projects:

- Increased volume reductions
- Increased hydraulic residence time
- Increased settleable solids
- Increase in decay coefficient to account for plant assimilative capacity.

Based on project features for each project, a low and high range of benefits are estimated using the two alternatives discussed below. The low and high values from the 4 estimates are used to estimate the load reductions for the project:

- For alternatives, the design flow rate and design volume of both the restored channel and the pre-project channel are assumed considering general water quality design guidelines and typical sediment resuspension velocities.
- For the first alternative, SBPAT BMP performance algorithms- which are based on hydrologic capture calculations conducted using SWMM- and effluent water quality data are used to estimate benefits:
    - A wetlands algorithm is used to estimate benefits associated with enhanced and/or created vegetation;
    - An infiltration algorithm is used to estimate benefits associated with volume reductions.

- For the second alternative, the change in volume reductions, first order decay coefficients, and load reductions associated with settleable solids are estimated based on system design features and a focused literature review.
- For the purpose of quantifying load reductions, it is assumed that restoration projects address dry weather and small storm flows predominantly. If the project is located on a floodplain bench and is only inundated in larger storm events, then benefits should not be claimed for the purpose of summing effective load reductions for comparison to the TLR.

Figure 3E-2 shows locations and **Table 3E-3** presents a summary of the WY 2003 FC benefits for stream restoration projects.

Table 3E-3. Estimated Load Reductions from Stream Enhancement/Restoration Projects

Location/Name	Water Quality (FIB-FC Load) Benefits (10^12 MPN reduction/year)[a]
Forester Creek	55 [13 - 96]
Woodglen Vista Creek	4 [1 - 6]
Las Colinas Channel	2 [0 - 3]
Alvarado Channel Restoration	6 [2 - 11]
Totals	67 [16 - 117]

[a] Load reductions are for the Cities of Santee and La Mesa.

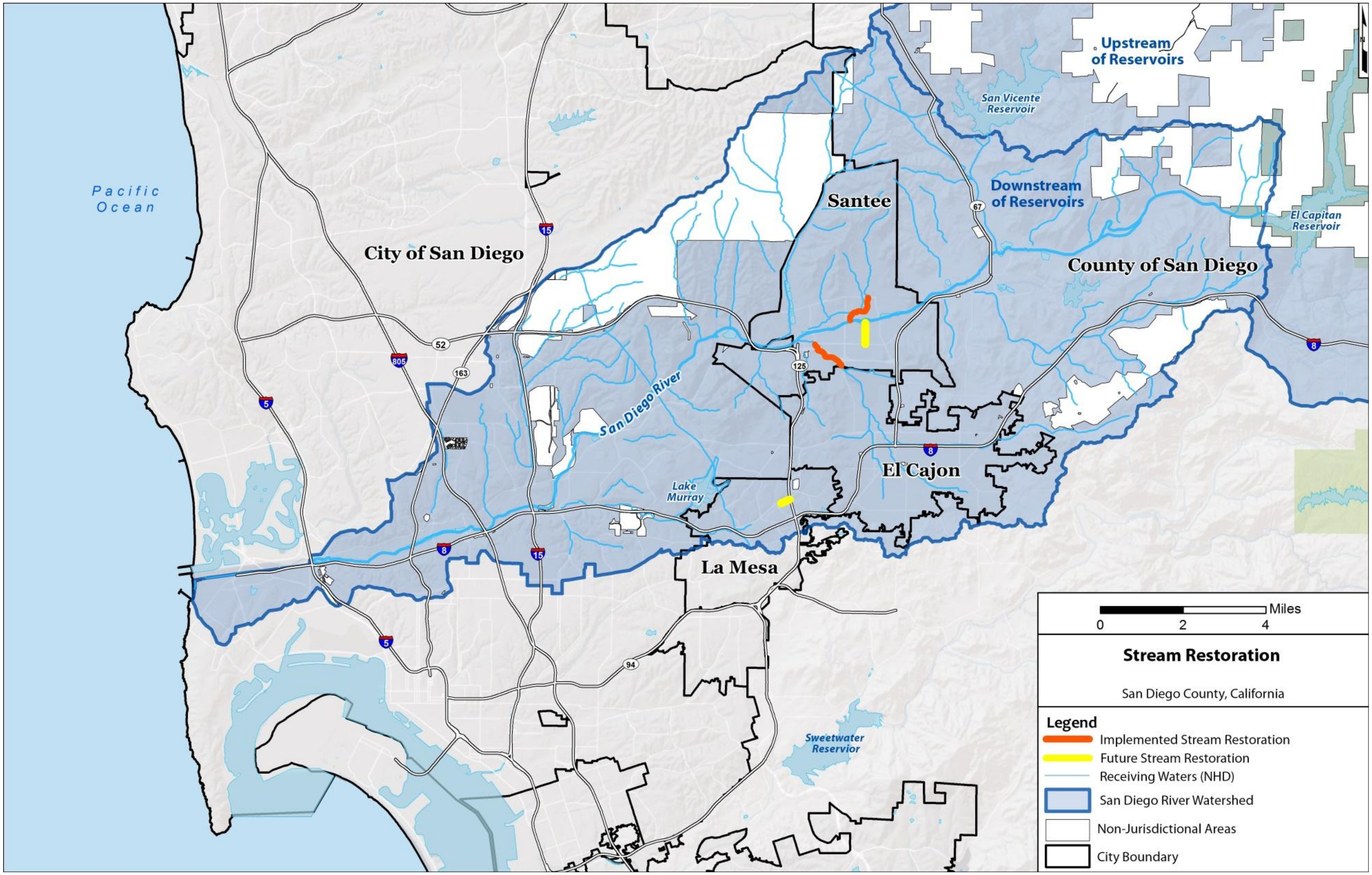


Figure 3E-2. Stream Restoration Projects for San Diego River Watershed

Proposed (Optional) Distributed Structural BMPs

The methods for quantifying load reductions for the proposed (optional) distributed structural BMPs are the same as those described for the implemented distributed BMPs above.

Catchment Prioritization Methods

Specific catchments within the watershed were identified as preferred locations for distributed structural BMPs. The San Diego River Watershed, downstream of the San Vicente and El Capitan reservoirs, was divided into 531 subcatchments. Using SBPAT, a catchment prioritization index (CPI) score was calculated for each catchment in the San Diego River Watershed. This score is based on the potential for each catchment to contribute pollutant loads, and can therefore be used to focus BMP efforts. The end result is a map of the entire watershed, highlighting the locations where BMPs can be installed with the greatest likelihood to improve water quality or reduce bacteria discharges.

Each catchment was given a normalized, unit-less CPI score between 1 and 5, with 5 representing the highest priority. For a more detailed explanation of the CPI calculation, see Step 1 of the SBPAT User's Guide (Geosyntec 2008). The following is a brief summary of the key elements of this step:

- Pollutant-specific CPI scores were calculated for each land use within a catchment as the product of land use specific pollutant EMCs, 85th-percentile precipitation, and runoff coefficients. These scores were then weighted by the area of each land use category within the catchment. Data used for each land use type is included in Appendix C.
- Individual pollutant CPI scores for each catchment were combined into an integrated CPI score.
- CPI scores were then further refined based on whether a catchment drained to an impaired water body, or a water body with an assigned TMDL. Weights of two and three, respectively, were assigned for catchments draining to impaired water bodies and water bodies with assigned TMDLs.

Results of the CPI analysis for the HPWQC and a combination of the HPWQC and nutrients are shown in **Figure 3E-3** and **Figure 3E-4.**

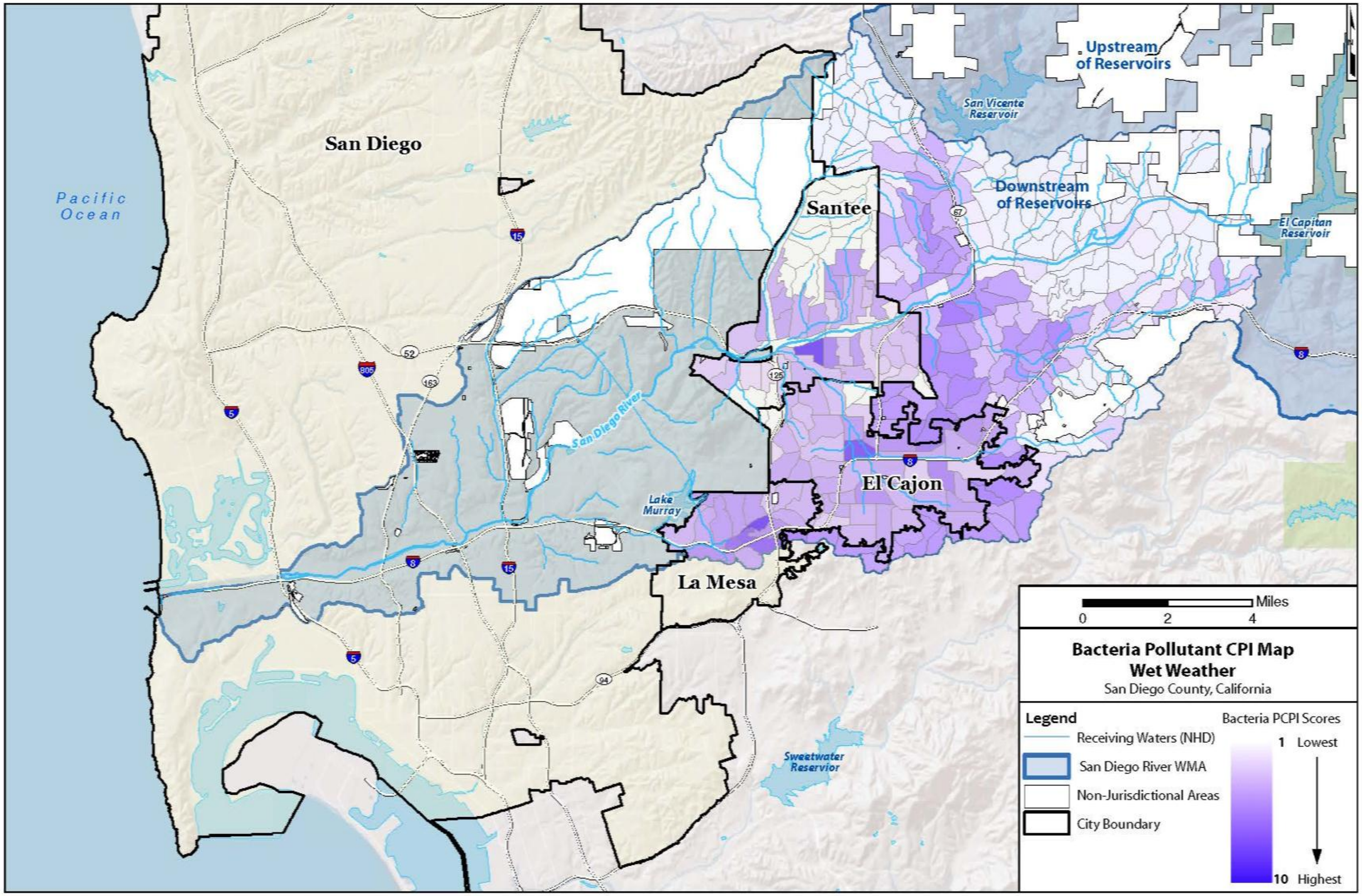


Figure 3E-3. CPI Map for HPWQC

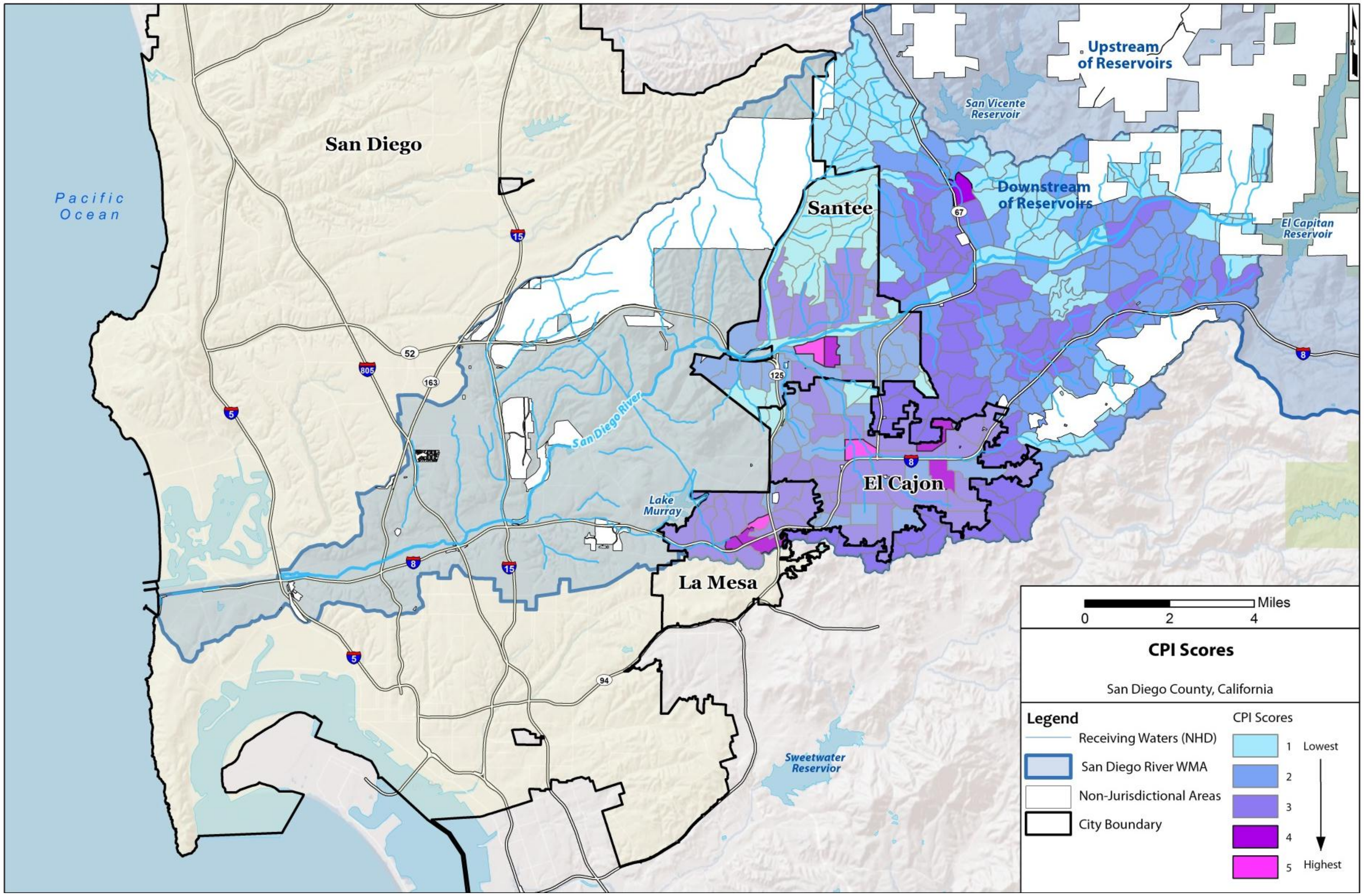


Figure 3E-4. Integrated CPI Map for HPWQC and Nutrients

Catchments were selected as potential locations for future distributed BMPs if they had a CPI score of 3 or higher and had greater than 50 percent of Participating Agency area with the catchment. These catchments were then screened for potential distributed BMP opportunities, based on the presence of non-travelled public rights of ways (ROWs) within the high priority catchments. Based on random sampling of ROWs within the high priority catchments, and using best professional judgment, 40 percent of each sampled individual ROW was identified to be non-travelled and 10 percent of the non-travelled ROW area was assumed, on average, to be suitable for a BMP retrofit. Given the above two findings, four percent of the ROW area within high priority catchments was assumed to be suitable for a distributed BMP retrofit.

Distributed BMP types for retrofits within high priority catchments were selected based on the feasibility of infiltration (i.e., green BMPs) within the retrofit area. Retrofit area is considered feasible for infiltration if more than 50 percent of the retrofit area is categorized as NRCS A, B, or C type soils. The following guidelines were used for identifying candidate distributed BMPs:

- *Infiltration feasible*: Assumed that 50 percent of the drainage area would be treated with infiltration BMPs and the remaining 50 percent would be treated with a non-infiltration BMP.
- *Infiltration infeasible*: Treated with non-infiltration BMPs.

This WQIP assumes that bioretention type BMPs will be implemented for infiltration feasible sites and bioretention swales with underdrain type BMPs will be implemented for infiltration infeasible sites. While designing and implementing site specific distributed BMPs as part of the implementation plan, different BMPs may be selected provided the pollutant reductions achieved through the implemented projects will be equal to or greater than those modeled in this report. A map showing proposed catchments for distributed structural BMPs is shown in **Figure 3E-5** and load reduction are summarized in **Table 3E-4.**

Table 3E-4. Water Quality Benefits from Proposed Distributed Structural BMPs

BMP Type	FIB-FC load reduction % of Average Municipal Land Use Load)
	Average [Low-High]
Potential Public Private Partnership Program	8.5% [1.6% - 15%]
Redevelopment through Permit-Required LID Implementation	4.3% [3.4% - 5.1%]
Implemented Projects	1.1% [0.6% - 1.3%]
Future Projects	8.6% [4.6% - 10%]

[a] Load reductions are for the County of San Diego, and Cities of El Cajon, Santee, and La Mesa.

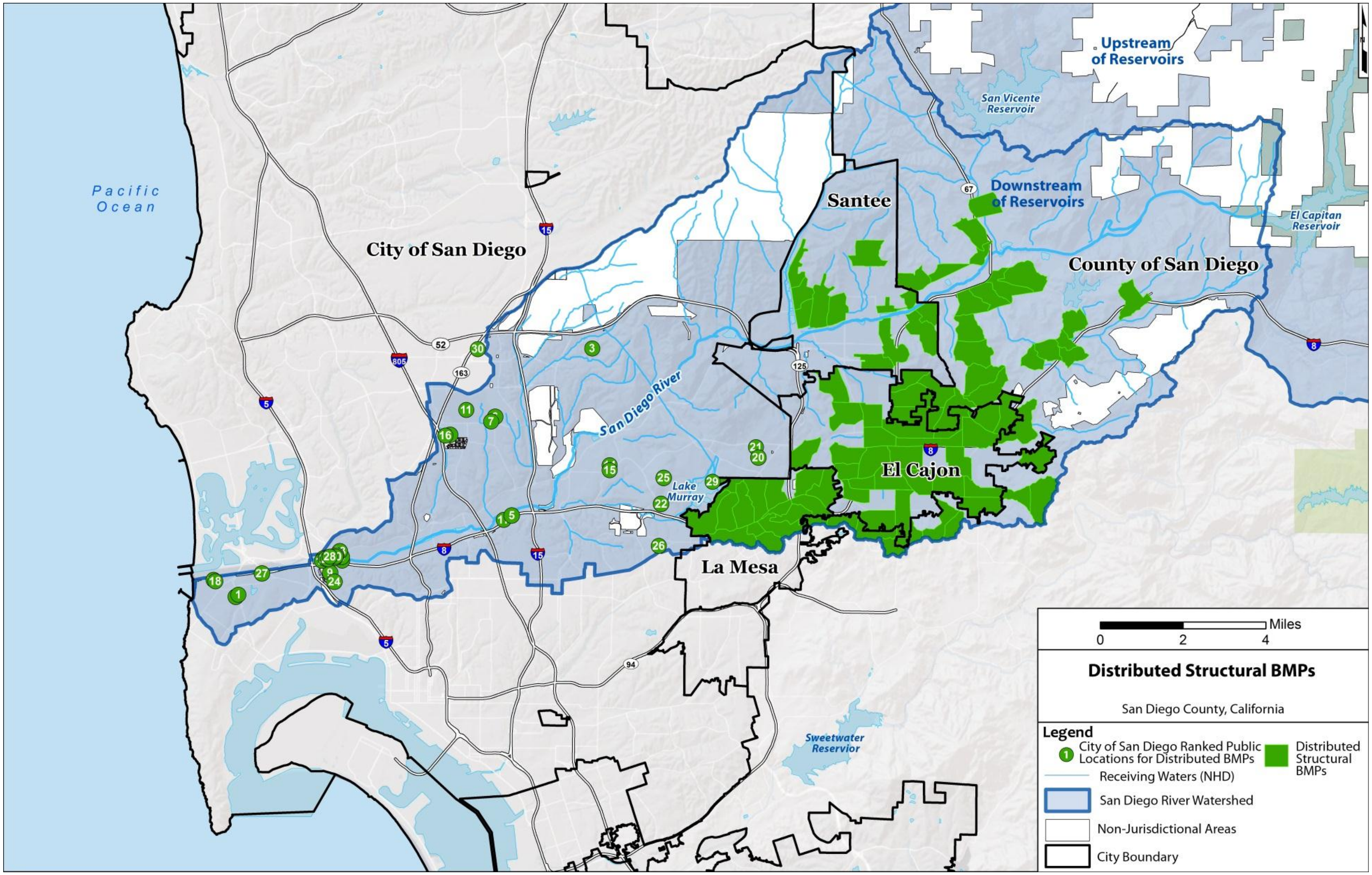


Figure 3E-5. Proposed Catchments for Implementation of (Optional) Distributed Structural BMPs

Proposed Regional Structural BMPs

BMP design criteria for each specific project were developed using the following generalized design criteria:

Infiltration Basin Design Criteria:

- Drawdown time: 48 hours
- Infiltration rate: Per San Diego County treatment BMP design guidelines (County 2011), typical soil infiltration rates based on the NRCS soil texture were used with a factor of safety of two (2)
- Design volume: determined by space available for the BMP
- Depth: governed by the drawdown time and infiltration rate.

Subsurface Flow (SSF) Wetland Design Criteria:

- Hydraulic residence time: 24 hours
- Depth of wetland: 3-4 feet
- Porosity: 0.35-0.4
- Target equalization basin drawdown time: 48 hours
- Design volume: governed by the design depth and space available
- Treatment flow rate: governed by volume and hydraulic residence time.

Wetland/Wet Pond Design Criteria:

- Permanent pool hydraulic residence time: 24 hours
- Permanent pool depth: 4-5 feet
- Permanent pool volume: governed by space available and depth.

Design criteria specific to each project is presented in their respective BMP sheets, which are included below.

Once design criteria were established, SBPAT was used to determine the pollutant reduction that could be achieved through the implementation of these BMPs. This modeling analysis includes continuous hydrologic simulation of runoff quantities and BMP volume capture, as well as stochastic Monte Carlo calculation of pollutant load reduction based on BMP effluent concentrations. See the SBPAT Guidance Manual for further information (Geosyntec 2008).

Catchment Prioritization Methods

A “nodal” catchment prioritization index, or NCPI, is an area-weighted CPI that is based on upstream catchment CPI scores. In other words, use of NCPI allows identification of catchments that are downstream of multiple, hydrologically linked high-priority catchments that may be utilized for potential regional BMP implementation. Using the downstream catchment attribute, an NCPI score for each catchment was computed using an area-weighted average of the CPI scores for tributary catchments. Results of the NCPI analysis are shown in **Figure 3E-6.**

After the catchments were prioritized, Geosyntec performed a desktop level screening of available public parcels in areas that would receive flows with higher estimated pollutant loading. Jurisdictions also provided parcels for screening. The desktop level screening took into consideration soil types, distance to receiving water, MS4 location, elevation, and surrounding land uses.

Site specific regional BMPs for the screened parcels were selected considering the following criteria:

- *BMP Performance*: Which BMP type is most effective at reducing concentrations of bacteria, nitrogen (nitrate), and phosphorous at this parcel?
- *Site-specific Constraints*: Which BMP type is feasible on the parcel given the location, parcel ownership, and physical characteristics of the site?
- *Costs*: Which BMP type is most cost-effective, both in capital expenditures and expected annual operations and maintenance costs?

The BMPs selected for pollutant removal modeling and cost estimation included subsurface flow wetlands, wetland/wet ponds, and infiltration basins, since these are the only structural BMP technologies capable of removing significant loads of FIB, nitrogen (nitrate), and phosphorous. **Figure 3E-7** shows a map of locations for the candidate regional structural BMPs.

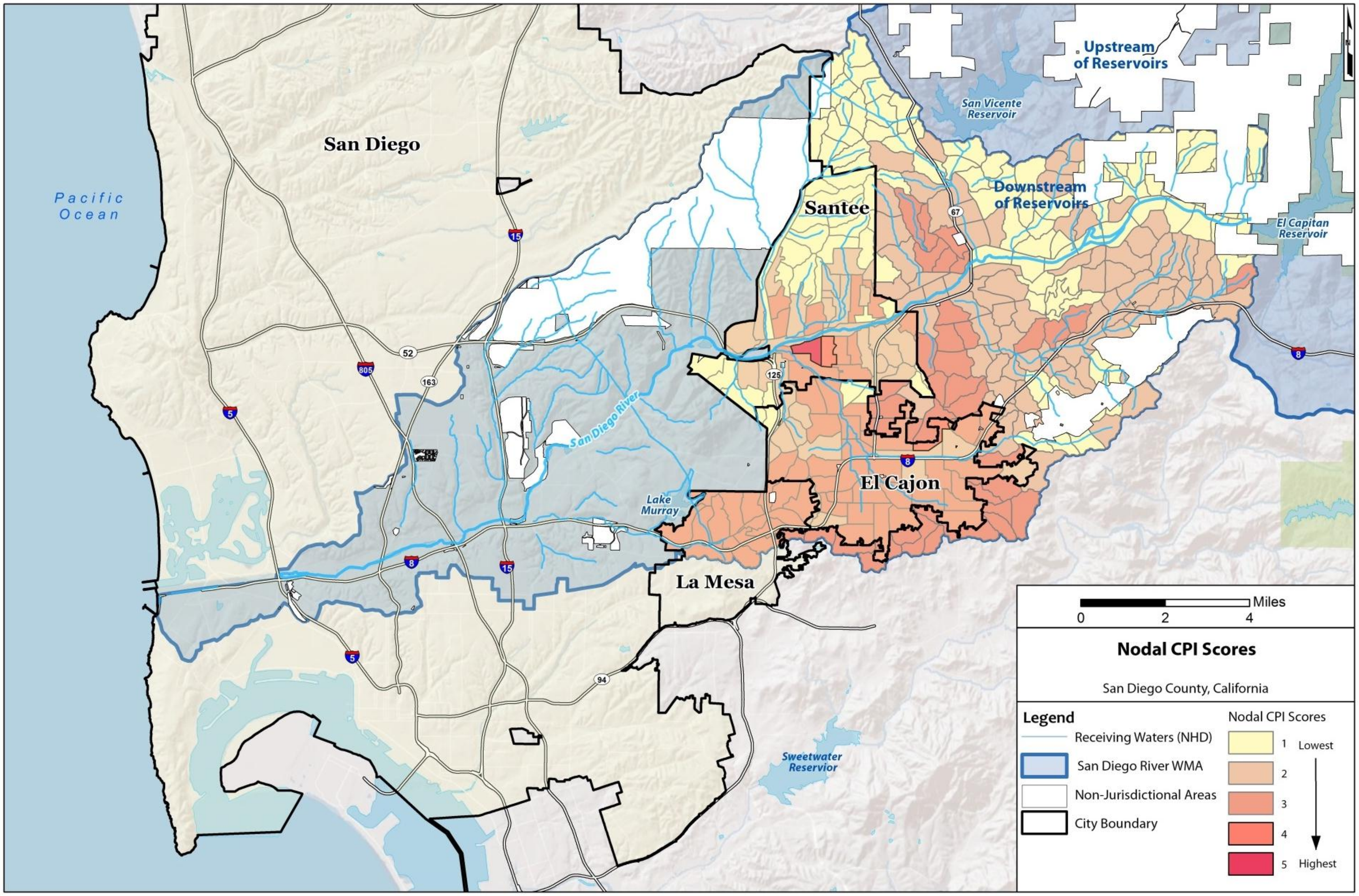


Figure 3E-6. Integrated NCPI Map for Bacteria and Nutrients

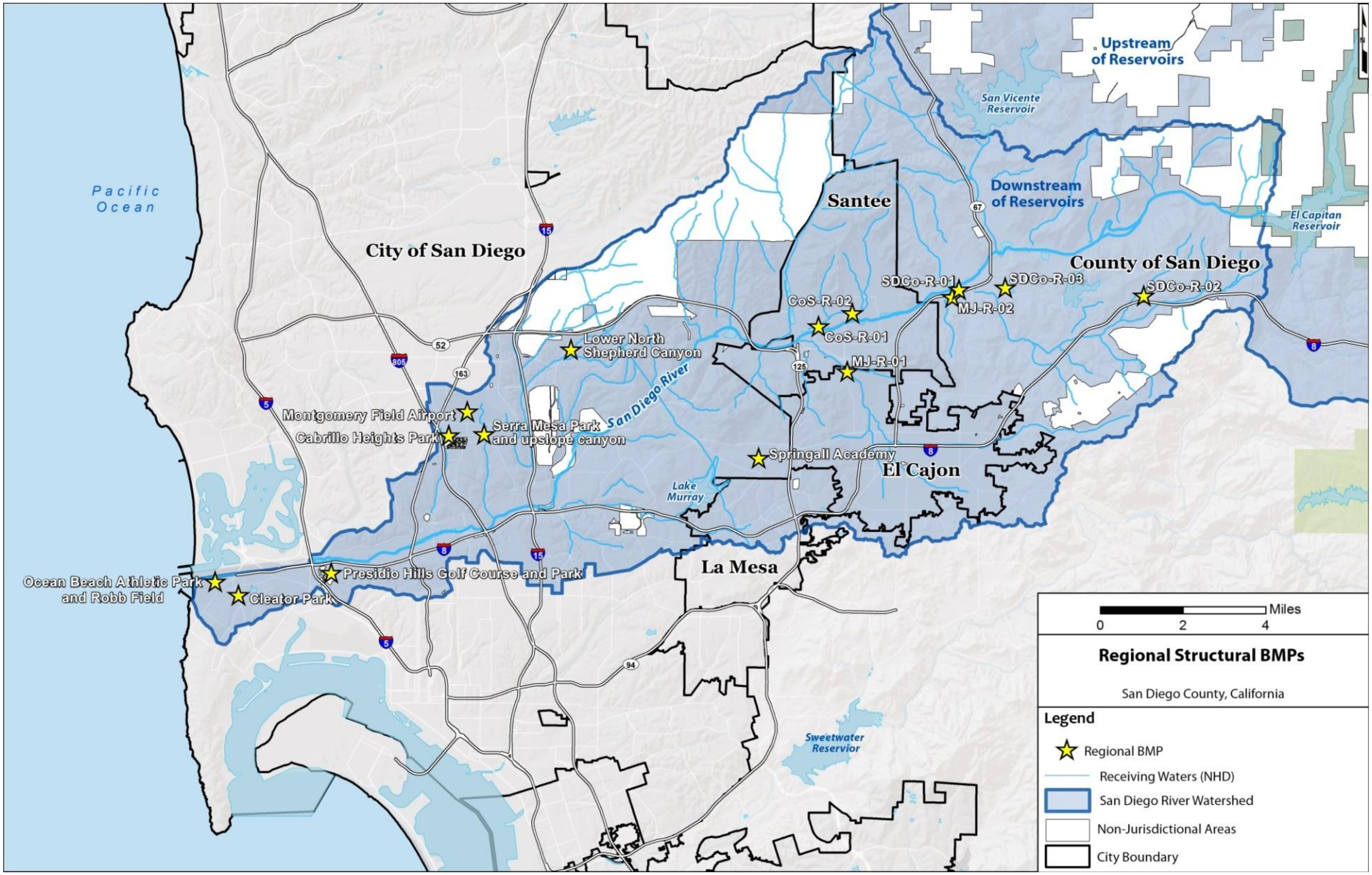


Figure 3E-7. Locations of Proposed Regional Structural BMPs

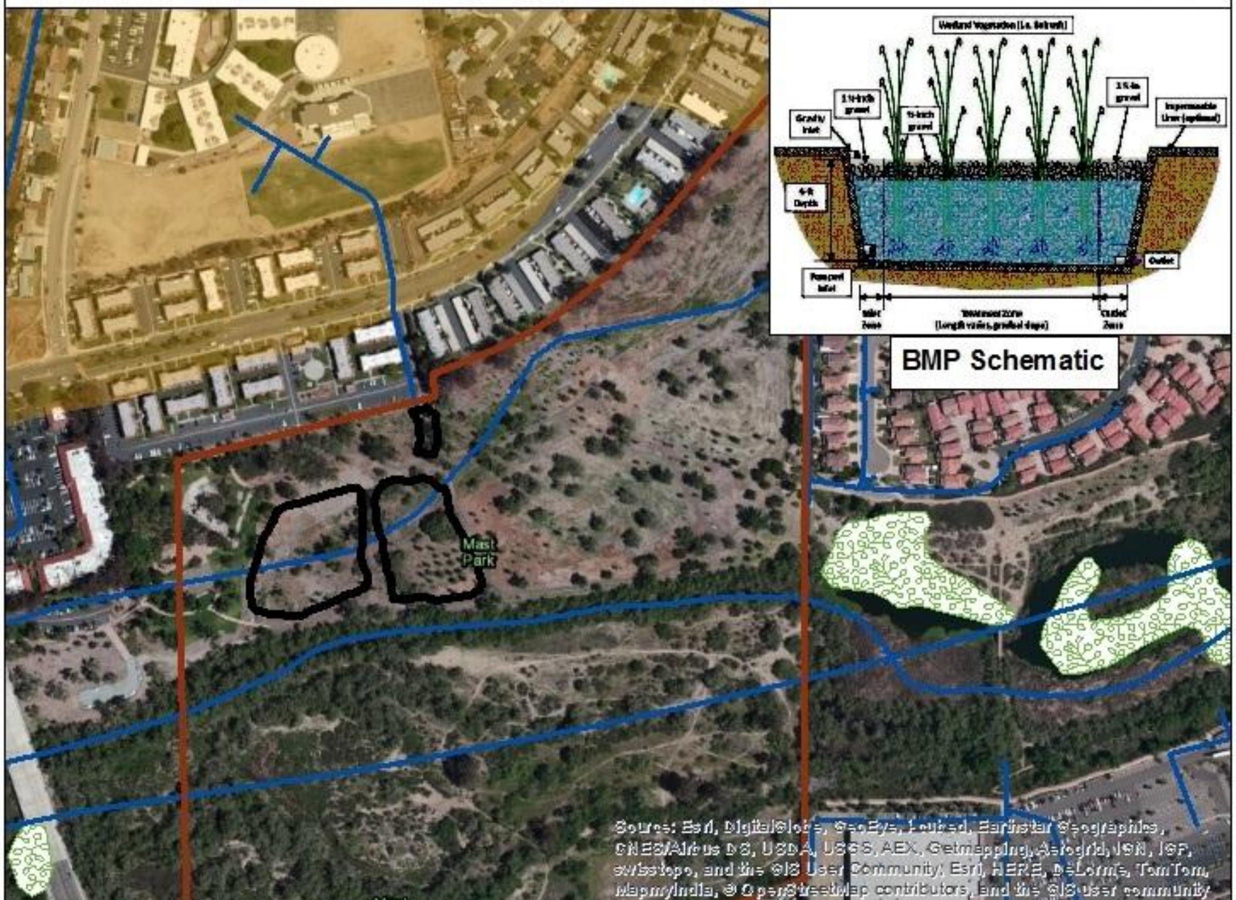
The proposed regional BMPs are listed in **Table 3E-5**, and design criteria specific to each project is presented in their respective BMP sheets, included as **Figure 3E-8 - Figure 3E-14.**

Table 3E-5. List of Proposed Regional BMPs

Figure #	Name	BMP Type
D8	CoS-R-01	SSF Wetlands
D9	CoS-R-02	SSF Wetlands
D10	MJ-R-01	Gross Solids and Trash Removal
D11	MJ-R-02	Infiltration Basin
D12	SDCo-R-01	66% Wetpond and 33% SSF Wetland
D13	SDCo-R-02	Subsurface Infiltration
D14	SDCo-R-03	Constructed Wetland

San Diego River Watershed Management Area
Water Quality Implementation Plan
Regional BMP Identification and Constraints

CoS-R-01 **October 2014**



Parcel Information

Owner : City of Santee
Jurisdiction: City of Santee
Constraints in Parcel: High Groundwater
Current Land Use: Park

Project Name: TBD

BMP Information

BMP Proposed: SSF Wetlands
Constraints in Footprint: High Groundwater
Tributary Area: ~ 573 acres;
Diversion from San Diego River = No
BMP Footprint Area: ~3 acres
Equalization Basin: Volume:173,000 cubic feet; Depth: 4 feet
Treatment Flow Rate: 1.0 cfs; Hydraulic Residence Time: 24 hours

LEGEND

BMP Footprint
Parcel Boundary
Storm Drains/Streams
Wetlands (National Wetlands Inventory)
Low Permeability Soils (NRCS Type D)

N

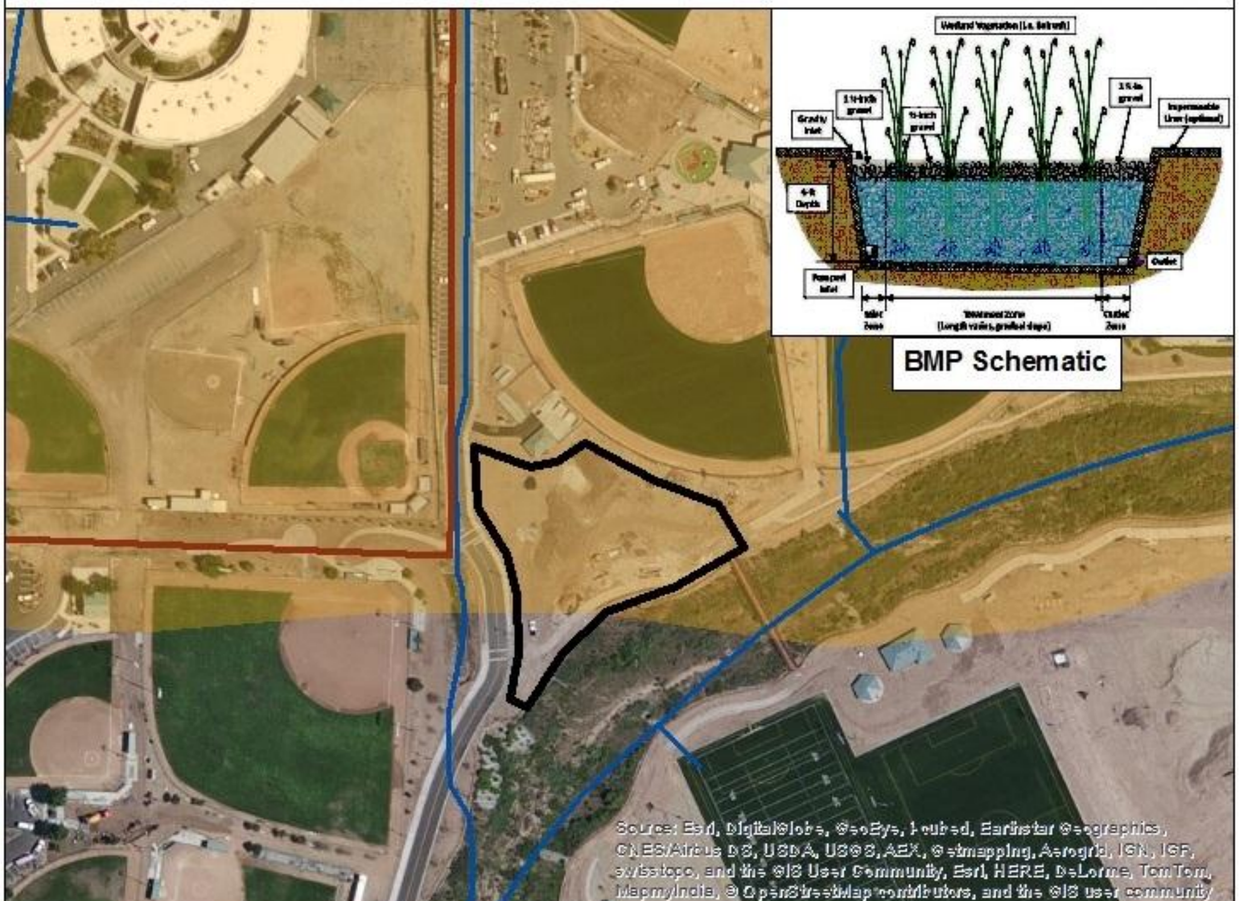
400 200 0 400 Feet

DATA SOURCES: ESRI; SANDAG; SANGIS; USGS

Figure 3E-8. Regional BMP CoS-R-01

San Diego River Watershed Management Area
Water Quality Improvement Plan
Regional BMP Identification and Constraints

CoS-R-02 | **October 2014**



Parcel Information

Owner : City of Santee
Jurisdiction: City of Santee
Constraints in Parcel: Low Permeable Soils; High Groundwater
Current Land Use: Park and Sports Fields

Project Name: TBD

BMP Information

BMP Proposed: SSF Wetlands
Constraints in Footprint: High Groundwater; Low Permeable Soils
Tributary Area: ~ 100 acres;
Diversion from Wood Glen Vista Creek = No
BMP Footprint Area: ~1.3 acres
Equalization Basin: Volume:170,000 cubic feet; Depth: 4 feet
Treatment Flow Rate: 0.4 cfs; Hydraulic Residence Time: 24 hours

LEGEND

- BMP Footprint
- Parcel Boundary
- Storm Drains/Streams
- Wetlands (National Wetlands Inventory)
- Low Permeability Soils (NRCS Type D)

N

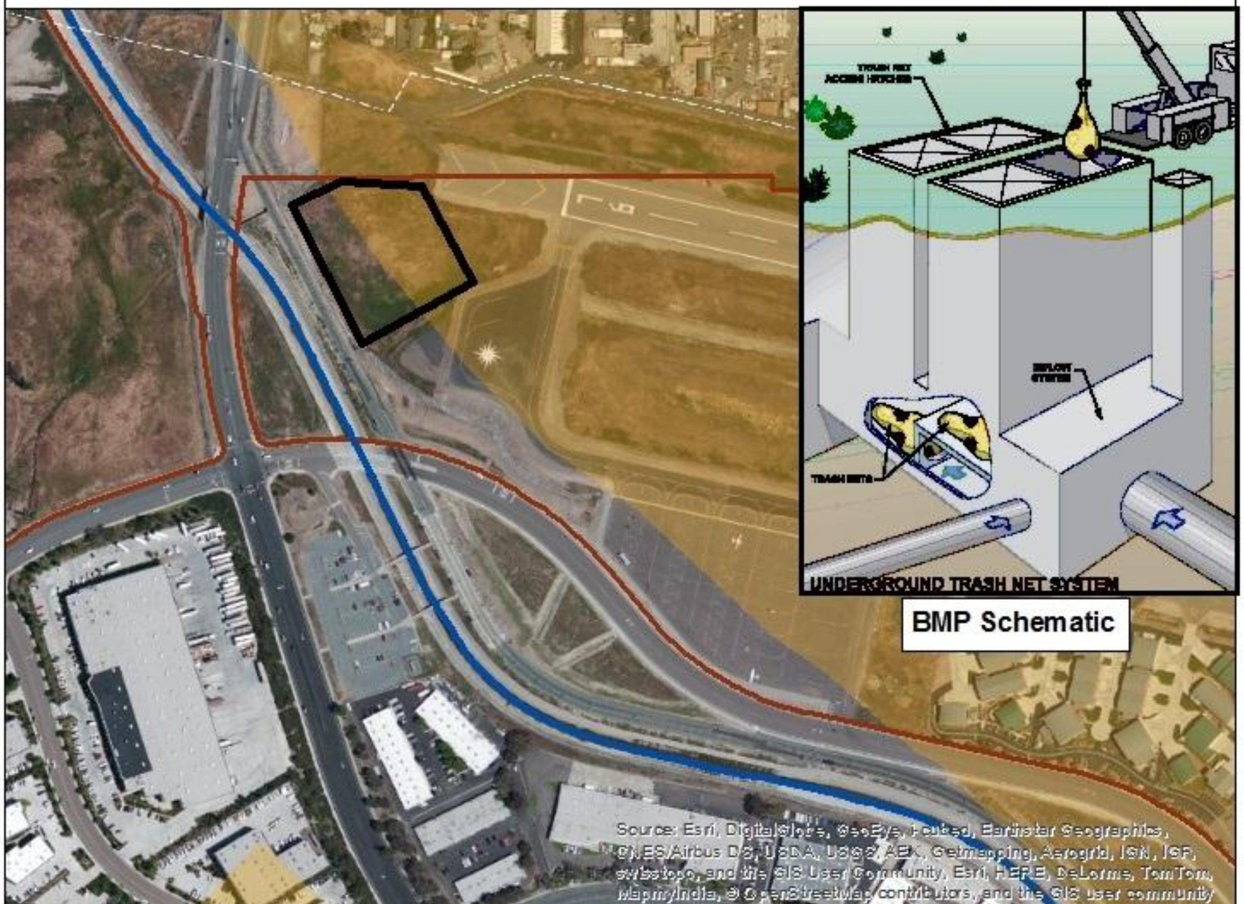
200 100 0 200 Feet

DATA SOURCES: ESRI; SANDAG; SANGIS; USGS

Figure 3E-9. Regional BMP CoS-R-02

San Diego River Watershed Management Area
Water Quality Improvement Plan
Regional BMP Identification and Constraints

MJ-R-01 October 2014



Parcel Information

Owner : County of San Diego
Jurisdiction: City of El Cajon
Constraints in Parcel: Low permeable soils
Current Land Use: Vacant Space

Project Name: TBD

BMP Information

BMP Proposed: Gross Solids and Trash Removal
Constraints in Footprint: Low permeable soils
Tributary Area: ~ 14,509 acres;
Diversion from Forrester Creek = Yes
BMP Footprint Area: ~ 2.5 acres
Diversion Flow Rate: 100 cfs
Treatment Flow Rate: 25 cfs

LEGEND

- BMP Footprint
- Parcel Boundary
- Storm Drains/Streams
- Wetlands (National Wetlands Inventory)
- Low Permeability Soils (NRCS Type D)

N

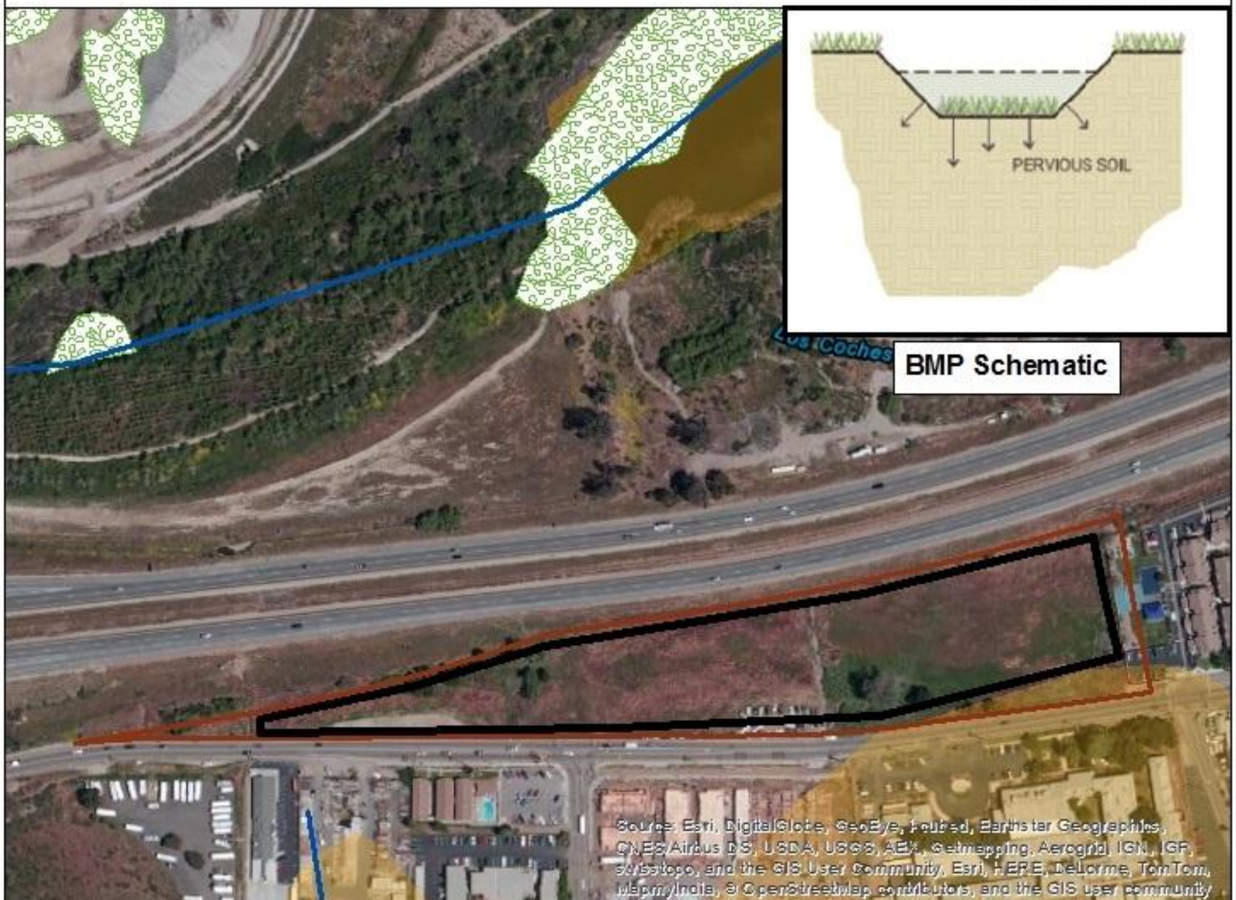
400 200 0 400 Feet

DATA SOURCES: ESRI; SANDAG; SANGIS; USGS

Figure 3E-10. Regional BMP MJ-R-01

San Diego River Watershed Management Area
Water Quality Improvement Plan
Regional BMP Identification and Constraints

MJ-R-02 — **October 2014**



Parcel Information

Owner : City of San Diego
Jurisdiction: County of San Diego
Constraints in Parcel: Low Permeable Soils
Current Land Use: Vacant Space
Future Land Use: Vegetated Infiltration Basin

Project Name: TBD

BMP Information

BMP Proposed: Infiltration Basin
Constraints in Footprint: None
Tributary Area: ~ 514 acres
Diversion from San Diego River = No
BMP Footprint Area: ~5.8 acres
Water Quality, Depth: 3 Feet; Volume: 13.1 acre-feet
Infiltration Rate Assumed: 0.75 in/hr

LEGEND

- BMP Footprint
- Parcel Boundary
- Storm Drains/Streams
- Wetlands (National Wetlands Inventory)
- Low Permeability Soils (NRCS Type D)

N

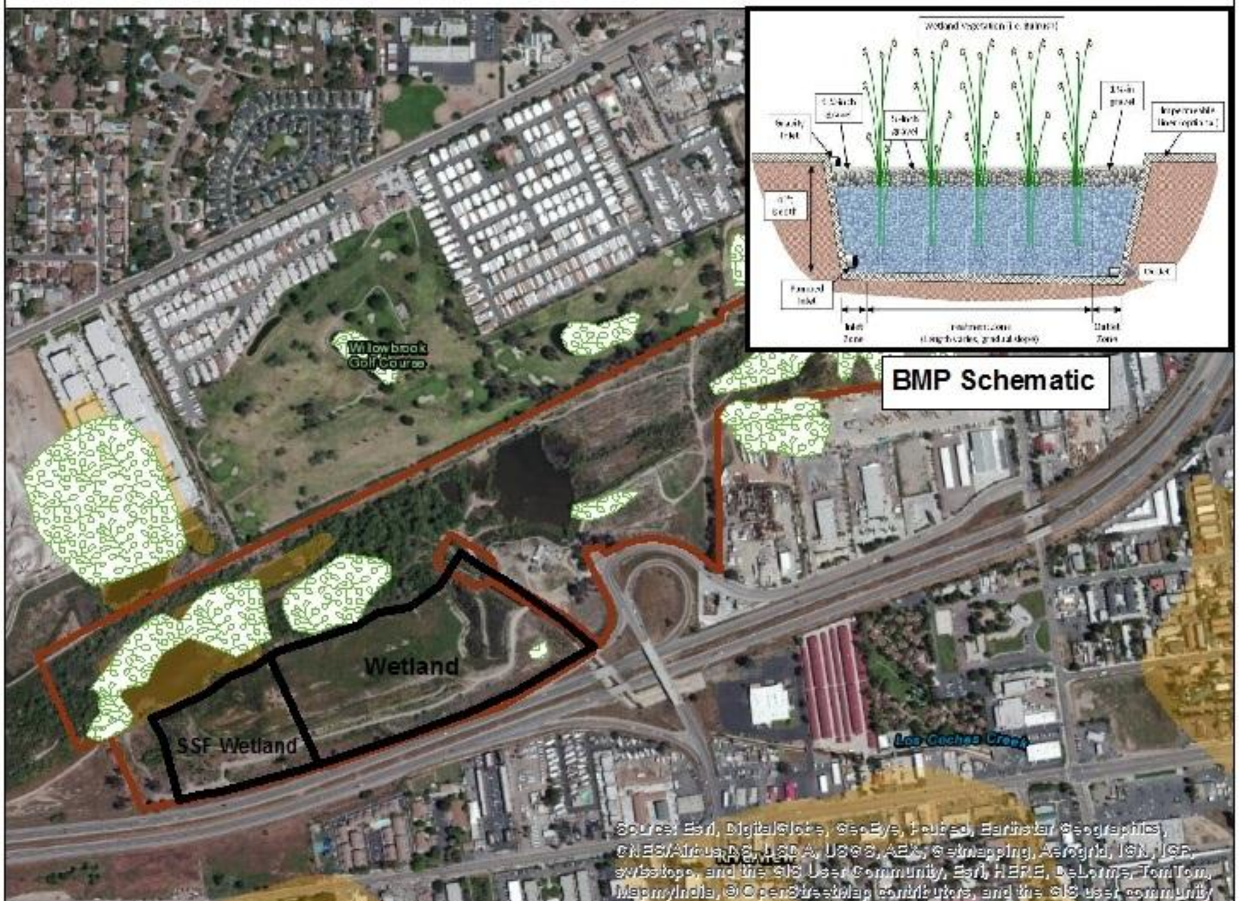
300 150 0 300 Feet

DATA SOURCES: ESRI; SANDAG; SANGIS; USGS

Figure 3E-11. Regional BMP MJ-R-02

San Diego River Watershed Management Area
Water Quality Improvement Plan
Regional BMP Identification and Constraints

SDCo-R-01 October 2014



Parcel Information
Owner : Lakesides River Park Conservancy
Jurisdiction: County of San Diego
Constraints in Parcel: Wetlands, Low Permeable Soils
Current Land Use: Vacant - Open Space
Note: Concrete lined channel within the BMP footprint will be removed during BMP Implementation

Project Name: TBD

BMP Information
BMP Proposed: 66% Wetpond and 33% SSF Wetland
Constraints in Footprint: Wetlands, High Groundwater
Tributary Area: ~ 29,850 acres;
Diversion from San Diego River = Yes
BMP Footprint Area: ~30 acres
Wet Pond: Volume: 2,308,680 cubic feet; HRT: 24 hours
SSF Wetland: Treatment Flow Rate: 6 cfs; HRT: 24 hours

LEGEND
BMP Footprint
Parcel Boundary
Storm Drains/Streams
Wetlands (National Wetlands Inventory)
Low Permeability Soils (NRCS Type D)

N

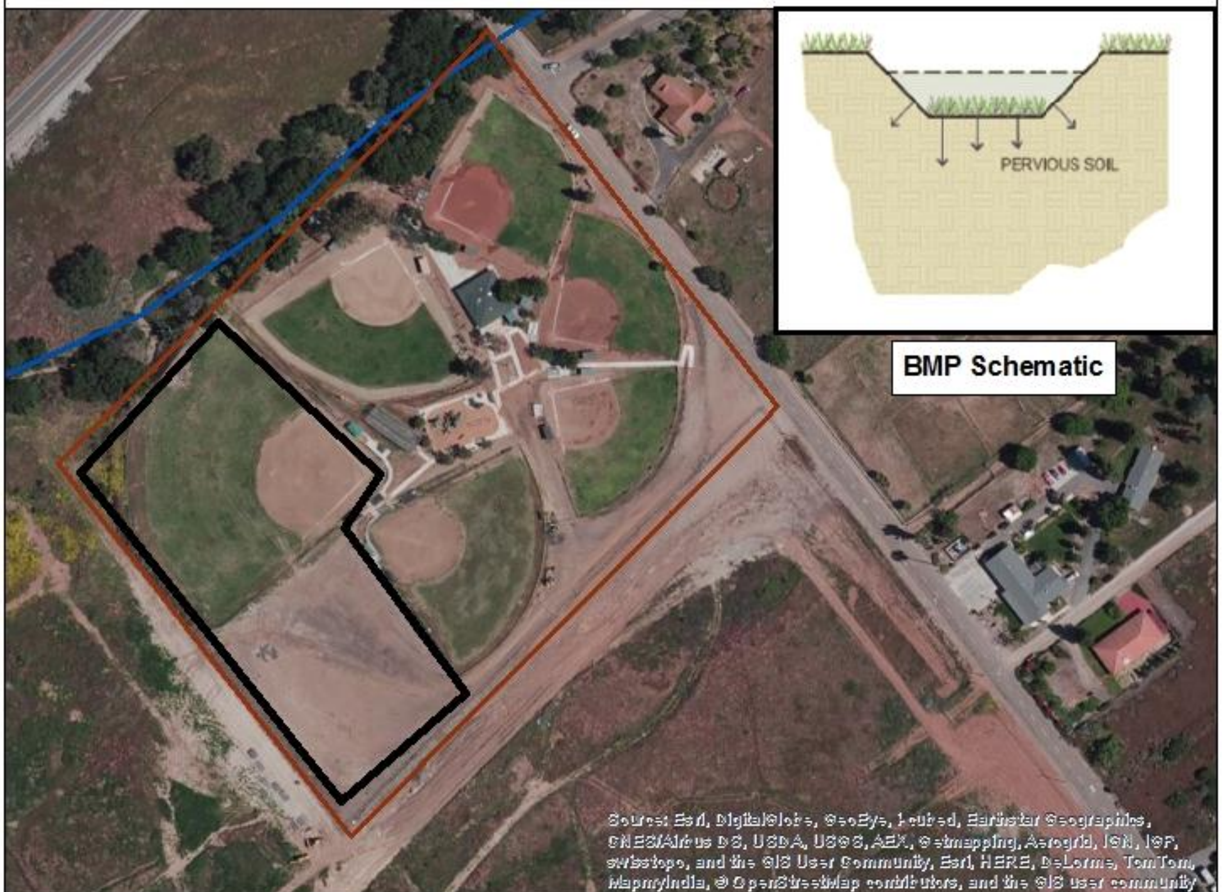
800 400 0 800 Feet

DATA SOURCES: ESRI; SANDAG; SANGIS; USGS

Figure 3E-12. Regional BMP SDCo-R-01

San Diego River Watershed Management Area
Water Quality Improvement Plan
Regional BMP Identification and Constraints

SDCo-R-02 — **October 2014**



Parcel Information
Owner : County of San Diego
Jurisdiction: County of San Diego
Constraints in Parcel: None
Current Land Use: Baseball Fields

Project Name: TBD

BMP Information
BMP Proposed: Infiltration Basin
Constraints in Footprint: None
Tributary Area: ~ 943 acres;
Diversion from Creek = Yes
BMP Footprint: ~ 3 acres
Water Quality; Depth: 4 Feet; Volume: ~300,000 cubic feet
Infiltration Rate Assumed: 1 in/hr

LEGEND
BMP Footprint
Parcel Boundary
Storm Drains/Streams
Wetlands (National Wetlands Inventory)
Low Permeability Soils (NRCS Type D)

N

200 100 0 200 Feet

DATA SOURCES: ESRI; SANDAG; SANGIS; USGS

Figure 3E-13. Regional BMP SDCo-R-02

San Diego River Watershed Management Area
Water Quality Improvement Plan
Regional BMP Identification and Constraints

SDCo-R-03 — **October 2014**

Parcel Information

Owner : County of San Diego
Jurisdiction: County of San Diego
Constraints in Parcel: Low Permeable Soils, Wetlands
Current Land Use: Park

Project Name: Lindo Lake Park

BMP Information

BMP Proposed: Enhanced Constructed Wetland
Constraints in Footprint: Low Permeable Soils, Wetlands
BMP Footprint: ~ 11.3 acres
Water Quality Depth: 4 Feet
Hydraulic Residence Time: 24 hours

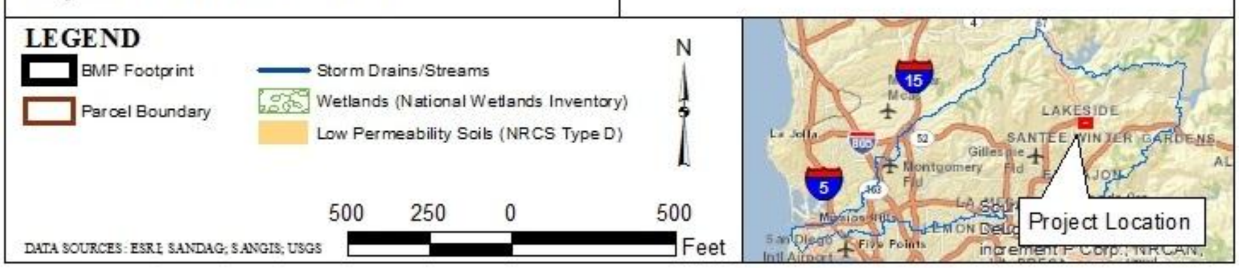


Figure 3E-14. Regional BMP SDCo-R-03

Load Reduction Quantifications

The estimated load reductions for the proposed regional structural BMPs are presented in **Table 3E-6.**

Table 3E-6. Estimated Load Reductions from Regional BMPs

Location/Name	Water Quality (FIB-FC Load) Benefits (10^12 MPN reduction/year)	FC Load Reduction (% of Average Municipal Land Use Load)
	Water Year 2003 [Low - High]	
SDCo-R-01	128 [92 - 145]	2.8% [2.0% - 3.1%]
SDCo-R-02	14 [10 - 16]	0.3% [0.2% - 0.3%]
SDCo-R-03	55 [33 - 64]	1.2% [0.7% - 1.4%]
CoS-R-01	20 [11 - 24]	0.4% [0.2% - 0.5%]
CoS-R-02	6 [4 - 7]	0.1% [0.1% - 0.2%]
MJ-R-01	166 [77 - 198]	3.6% [1.7% - 4.3%]
MJ-R-02	36 [21 - 42]	0.8% [0.5% - 0.9%]
Totals	**425 [247 - 496]**	**9.2% [5.3%-11%]**

Water Quality Benefits and Summary of Estimated Load Reductions

The following sections will describe the benefits expected to result from implementation of the proposed BMPs, including the results of load reduction analyses for the HPWQC and other constituents.

Load Reduction Adjustment Analysis

To improve the reliability of load reduction estimates relative to target load reduction, an analysis was performed to account for overlapping load reductions between structural BMPs. For example, if a given area has both distributed and regional structural BMPs proposed, the estimated load reductions were not assumed to be additive, but rather limited to the lowest effluent concentrations achieved by any structural BMP. Each BMP in the proposed plan was evaluated to identify overlapping load reductions, which were then removed from the total reported benefits to allow a comparison with the target load reduction.

The following assumptions were used for performing the load reduction adjustment analysis:

- Load reductions are uniformly distributed based on the ratio of baseline uncontrolled load.
- Structural BMPs were either categorized as an effluent-based BMP (i.e., BMPs that provide load reduction via treatment only, not volume reduction) or as a volume-reduction BMP (i.e., BMPs that operate on volume reduction primarily).
- For volume-reduction BMPs the overlapping benefits in the captured runoff volume were estimated using the upstream non-overlapping benefits in the captured runoff and the percent load reduction achieved by the BMP.
- For effluent-based BMPs the overlapping benefits in the captured runoff volume were estimated using the upstream non-overlapping benefits in the captured runoff and the total load reduction achieved by the BMP.
- Non-overlapping benefits associated with upstream BMPs in the bypass runoff volume (runoff that exceeds upstream structural BMP design criteria) were considered non-overlapping benefits for the BMP being analyzed.

This load reduction adjustment analysis is an approximate process intended to improve the interpretation of load reduction estimates for use in planning-level assessment of the likelihood of compliance. The degree of precision is intended to be consistent with the degrees of uncertainty relative to sources of loading, BMP performance, ultimate BMP design, interim versus ultimate condition and other factors.

Estimated Load Reductions for HPWQC

Table 3E-7 below shows the summary of predicted wet weather load reductions from each BMP type proposed for implementation within the San Diego River Watershed (for all jurisdictions except the City of San Diego) by 2031 as well as the estimated TLR to meet the HPWQC final numeric goal. The table presents the average, low, and high ranges of estimated load reduction. Ranges reflect variability in baseline pollutant loading (e.g., land use EMCs) as well as variability in BMP effectiveness and are represented by the 25th and 75th percentile prediction estimates. Quantification of BMP benefits for this WQIP was assessed based on a number of parameters that have inherent uncertainties and natural variability. Parameters which carry significant uncertainty include storm precipitation, rainfall-runoff response, land uses, infrastructure conditions, EMC data, BMP design and efficiency, site-specific constraints, and cost data. While assessment of potential compliance incorporates a probabilistic assessment, it is recognized that as new data become available, these parameters may change. Furthermore, any translation of BMP performance (in terms of load reduction) to TMDL compliance metrics adds additional uncertainty to the analysis.

Table 3E-7. Summary of Wet Weather Load Reductions from WQIP Analysis

BMP Category[1]	FC Load Reduction (% of Average Municipal Land Use Load) 2003 WY Load [Low-High Range]
Programmatic Strategies	10% [9.2%– 11%]
Potential Public Private Partnership Program	8.5% [1.6% - 15%]
Redevelopment through Permit-Required LID Implementation	4.3% [3.4% - 5.1%]
Distributed Structural BMPs	9.7% [5.2% – 11%]
Regional Structural BMPs	9.2% [5.3% - 11%]
Stream Restoration/Enhancement Projects	1.4% [0.3% - 2.5%]
Load Reduction Adjustment	-4.0% [-1.6% - -5.8%]
Load Reduction Sum	39% [24% - 50%]
Target Load Reduction	34.7%

[1] Load reductions are for the County of San Diego, and Cities of El Cajon, Santee, and La Mesa.

Other Water Resources Benefits

In addition to the reductions in loading of the HPWQC and other key constituents of concern, the strategies proposed in this WQIP are expected to provide a number of other water resource benefits, including mitigation of physical and biological impairments. More specifically, these benefits include:

- Beneficial Use[9] of Urban Runoff: Water that is captured and stored in BMPs has the potential to be beneficially harvested and used and thus offset demand for potable water, a critical need within San Diego County.
- Recreation: Larger regional BMPs have the potential to include multi-use elements. In final design of these BMPs there is the opportunity to include features such as trails and bike paths, based on community needs, project partnerships, and site appropriateness that are mutually beneficial to water quality. Distributed BMPs proposed in this WQIP were envisioned as "green streets", which can enhance the vitality of a commercial or residential avenue and improve the overall quality of life in a neighborhood.
- Wildlife Habitat: In addition to their water quality benefits, BMPs such as regional subsurface flow wetlands may provide additional wetland habitat throughout the San Diego River Watershed that may attract native species.
- Urban Heat Islands: Distributed green streets BMPs may mitigate urban heat island effects (i.e., increased runoff temperatures) by increasing pervious, vegetated areas within heavily urbanized portions of the Watershed.

- Educational Opportunities: Non-structural BMP programs such as Irrigation Runoff Reduction, the Pet Waste Program, and Animal Facilities Management provide the opportunity for public outreach and educational programs that will target behavioral changes, sustainable control at (and avoidance of) the "source", as well as increased public awareness of and investment in water quality improvement projects.

City of San Diego - Load Reduction Methods Information for all Wet Weather Structural BMPs

Watershed modeling simulates the filling, draining, and pollutant removal dynamics of BMPs. These BMPs are broken down into four categories based on the availability of land: (1) centralized BMPs on public land, (2) distributed BMPs on public land, (3) green streets, and (4) centralized BMPs on acquired private land. SUSTAIN was used to model BMP performance and provide cost-benefit optimization within representative catchments. During optimization, BMP sizing was adjusted to optimize the treatment of upstream impervious areas and consider the 85th percentile storm event consistent with existing structural BMP programs. The City of San Diego prioritized jurisdictional catchments by calculating Composite Water Quality Scores for wet and dry weather.

Several analyses were run with a series of scenarios to quantify the effectiveness of each of the structural BMPs on public land first using the SUSTAIN model. The purpose of this section is to summarize the extent to which structural BMPs contribute to pollutant removal in the watershed.

Centralized BMPs on Public Land

The centralized structural BMPs on public parcels incorporated in the model consisted mostly of detention and infiltration facilities. These features were largely located on soils with low infiltration capacities in the San Diego River watershed.

The City also currently operates five low flow diversion facilities within the San Diego River watershed. These were included in the baseline model of existing conditions and are therefore not included within the flow and pollutant load estimates. Based on review of information on these diversions and communications with City staff, a cumulative diverted flow rate of 2.8 cubic feet per second (cfs) was assumed in the model for these facilities, with individual facility locations and diversion rates represented appropriately.

Distributed BMPs on Public Land

Both bioretention and permeable pavement were considered for implementation of distributed BMPs on public parcels. Parcels were screened to identify the opportunity for implementation, accounting for feasibility constraints such as site slope. Both bioretention and permeable pavement options were configured with and without underdrains depending on the underlying soils. For instance, Hydrologic Soil Group B areas were modeled without underdrains and Hydrologic Soil Group C and D areas were modeled with underdrains.

Green Streets

The modeling shows that even the maximum deployment of nonstructural BMPs and centralized and distributed structural BMPs on public land provide only modest pollutant load reductions, well below those needed to meet the WLA reduction requirements. While the above BMPs represent the lowest cost BMPs for pollutant load reduction, more expensive structural solutions will be required to meet these requirements. The two alternatives considered for this study include green streets and centralized structural BMPs on acquired private land (discussed in the following sub-section). Implementing green streets involves constructing structural BMPs, such as bioretention and permeable pavement in the rights of way of various streets. Although they are more expensive than the previously mentioned BMPs, green streets are very efficient at removing pollutant loads in watersheds because of their proximity to pollutant generating surfaces and their location in the existing surface conveyance infrastructure of the stormwater collection system. Additional advantages of green streets include the fact that they are located in the right of way (and therefore have no land acquisition costs) and are more conveniently accessed for maintenance activities.

A detailed desktop analysis was performed throughout the watershed to evaluate the opportunities for retrofitting existing rights-of-way to green streets. The latest information on road coverage, road type, potential drainage area, soil types, and construction infeasibility was combined to identify the number of potential green streets miles in the watershed. The findings of this analysis were then loaded into SUSTAIN, which comprehensively evaluated and optimized the cost and pollutant removal effectiveness for numerous different combinations of green streets. For the San Diego River Watershed, the implementation of green streets provides sufficient load reductions for the critical pollutant to achieve compliance with WLA targets. Although green streets are expected to provide dry weather load reductions, non-structural BMPs provided 100% load reduction during dry weather so no additional benefits for green streets were quantified in the model.

Centralized BMPs on Acquired Private Land

Due to the high cost of land acquisition associated with centralized structural BMPs on acquired private land, these BMPs are considered a last resort for implementation to meet necessary load reductions. Therefore, not until other BMP options are exhausted will centralized BMPs on private land be considered for the City. This gives much needed time for investigation of other more cost-effective BMP alternatives prior to implementation. For instance, research of nonstructural BMPs not presently modeled may provide definitive results for load reductions that can be later incorporated within the modeling analyses and provide a reduction in lieu of the necessity for centralized structural BMPs on private land. Alternatively, implementation of green streets discussed in the previous section may provide a viable alternative should changes in road redevelopment procedures be achieved. Therefore, centralized structural BMPs on private land are meant to be a placeholder in the CLRP with an attempt to quantify the costs of meeting the load reduction targets beyond what can be presently quantified with nonstructural BMPs and structural BMPs on public land.

Unlike the green streets optimization, which was based upon a detailed desktop analysis of BMP opportunities, the optimization of centralized BMPs on private land was founded on a higher level planning analysis due to the unknown locations and availability of private land acquisition. Specific spatial and climatic characteristics of each individual subwatershed were loaded into SUSTAIN and hypothetical BMPs were simulated with a fixed drainage area necessary to capture the design storm. The optimization analysis included numerous combinations of BMP location and size scenarios to develop a cost effectiveness curve, as an alternative to the green streets approach. For the San Diego River

Watershed, the implementation of centralized BMPs on private land provides sufficient load reductions for the critical pollutant to achieve compliance with WLA targets.

Table 3E-8 below shows the summary of predicted load reductions from the programs described above within the San Diego River Watershed the City of San Diego by 2031.

Table 3E-8. San Diego River Watershed Wet Weather Bacteria Load Reductions for the City of San Diego

Condition	Fecal Coliform (%)
Wet weather	34.70
Dry weather[1]	100.0

[1]Dry weather flow and load reductions reflect only runoff in urban subwatershed.

CHAPTER 3 – APPENDIX F: DRY WEATHER LOAD REDUCTIONS

Dry weather load reductions were calculated using a tiered approach. First, the quantifiable nonstructural BMP load reductions were estimated then the gap between these aggressive source control programs and the TMDL required reduction level was filled using dry weather structural solutions when necessary.

The dry weather load reduction quantification approach involves similar steps for the suite of dry weather nonstructural BMPs included in this WQIP (including irrigation runoff reduction and commercial/industrial good housekeeping). The first step was to calculate the load generated by the targeted pollutant source that the BMP will address, by using a percentage of the total Participating Agency pollutant baseline load[8] which was taken from source tracking studies. Once the targeted pollutant source load was calculated, the potential load reduction benefit was calculated using the estimated effectiveness of the selected BMP. These values were based on literature when available, and if not, on best professional judgment. In both cases, predicted levels of uncertainty are high. The following sections provide a brief description of the specific quantification approach for each dry weather nonstructural BMP, along with relevant assumptions and assumption explanations.

Additionally, some dry weather structural controls may also be implemented to achieve the TMDL required reduction levels. These dry weather structural BMPs may include but are not limited to: low flow diversions to sewers, storm drain lining, catch basin dry wells, street gutter permeable pavement, bioretention swales, regional BMPs, etc.

Table 3F-1 provides a summary of the dry weather quantification results and corresponding assumptions and references. The following sections provide a brief description of the specific quantification approach for each dry weather nonstructural BMP, along with relevant assumptions and assumption explanations.

Irrigation Runoff Reduction and Good Landscaping Practices

The portion of the Participating Agency average dry weather FIB load resulting from commercial and residential runoff was estimated using the best professional judgment of Geosyntec Consultants. Based on findings from the San Diego River source tracking study (Weston 2009a), 59-80 percent of commercial and residential runoff is from irrigation. The implementation of this BMP is estimated to reduce irrigation runoff from commercial and residential areas by 25 to 50 percent as found by Berg et al. (2009) in a study in Orange County.

Commercial/Industrial Good Housekeeping

The dry weather loading of fecal coliform from commercial activities runoff was determined using the same approach as for irrigation runoff. The runoff load attributed to commercial areas was estimated using the best professional judgment of Geosyntec Consultants. The San Diego River

[8] The baseline load was assumed to be proportional to the flow (i.e. if x% of the flow was from irrigation runoff than, x% of the load was from irrigation runoff).

study found that 15-27 percent of commercial flows are from commercial activities targeted by good housekeeping, such as dumpster leaks and wash-down. The reduction achieved through enhancements was based on the current rate of inspection coverage and effectiveness found in the San Diego County JURMP annual report.

ADDITIONAL DRY WEATHER BENEFITS

In addition to the non-storm water flow reduction strategies described above, various pollutant source control BMPs that are being used for wet weather compliance will also have pollutant reduction benefits during dry weather. These BMPs will include the following program enhancements (i.e., beyond the Permit minimum), with an emphasis on those BMPs that most effectively target urban storm water bacteria sources:

- Street and median sweeping;
- MS4 cleaning;
- Education/outreach and inspection/enforcement to target specific known sources of bacteria and fecal waste, such as:
    - Commercial and food outlets (wash down practices, dumpster and grease trap management, etc.),
    - Pet owners,
    - Equestrian owners/recreators and owners of rural farm animals, and
    - Septic owners; and
- Good landscaping practices.

San Diego River Summary of Dry Weather Quantification of Water Quality Benefits

Table 3F-1. San Diego River Summary of Dry Weather Quantification of Water Quality Benefits

BMP Name	Wet or Dry Weather	Land Use Targeted	Pollutant Generating Activity	Quantification Assumptions			Quantification Method	Expected Annual Reduction of MS4 Baseline Load[1] by 2021	
				Load Assumption	Units	Citation/Assumptions		Fecal Coliform (percent) Low Range	Fecal Coliform (percent) High Range
Irrigation Runoff Reduction Enhancements (Incentatives, outreach, and education)	Dry Weather	Residential and Commercial	Irrigation runoff, fertilizers/compost, soil and decaying plant matter, green waste	2.8	10 ^12 Monthly Average MS4 FIB-FC dry-weather load in watershed excluding city of San Digeo areas	Calculated by TMDL model, which was calibrated to monitoring data	(monthly bacteria load) * (12 months per year) * (percent bacteria from runoff) * (percent of runoff from irrigation) * (expected behavior change)	7.4%	33%
				50-80%	Percent of MS4 dry-weather flows (and fecal bacteria loads) from commercial and residential runoff	Best Professional Judgement			
				59-80%	Percent of commercial and residential runoff load generated residential and commercial from irrigation	San Diego River Source ID study, 2009			
				25-50%	Percent reduction in irrigation runoff from irrigation control incentives	Orange County irrigation runoff study, 2004			
Commercial/Industrial Good Housekeeping Enhancements (Inspection, enforcement, outreach)	Dry Weather and Wet Weather	Commercial and Industrial	Dumpsters, outdoor garbage areas, garbage trucks, grease bins, outdoor dining/fast food, washwater	2.8	10 ^12 Monthly Average MS4 FIB-FC dry-weather load in watershed excluding city of San Digeo areas	Calculated by TMDL model, which was calibrated to monitoring data	(monthly bacteria load) * (12 months per year) * (percent bacteria from runoff) * (percent of runoff from commercial activities) * (increase in inspection) * (expected behavior change)	0.7%	5.4%
				25-40%	Percent of MS4 dry-weather flows (and fecal bacteria loads) from commercial and indsutrial runoff	Best Professional Judgement			
				15-27%	Percent of commercial and industrial runoff load generated from commercial and industrial activities	San Diego River Source ID study, 2009			
				25-50%	Percent of commercial and industrial area covered by increased inspection	San Diego County JURMP			
				75-100%	Percent reduction in bacteria loads from enhanced inspections	San Diego County JURMP			
Dry Weather Structural BMPs (low flow diversions to sewers, stormdrain lining, catch basin dry wells, street gutter permeable pavement, bioretention swales, regional BMPs)	Dry Weather and Wet Weather	All Land uses	All Nonstormwater Flows	69.4%	Percent reduction of MS4 FIB-FC dry-weather load to comply with the MS4 permit	San Diego MS4 Permit, Attachment E	(MS4 required percent reduction) - (estimated percent reduction achieved by nonstructural BMPs)	61%	31%
Dry Weather Total							**% of average MS4 total load (33.6 10^12 MPN)**	**69.4%**	**69.4%**

1. Load reductions do not include benefits from nonstructural BMPs in the City of San Diego.

CITY OF SAN DIEGO DRY WEATHER LOAD REDUCTIONS

For the City of San Diego for dry weather, the methodology used in CLRP Phase II development to quantify load reductions was applied. The pollutant and flow reduction benefits from several nonstructural BMPs such as street sweeping, catch basin cleaning, rain barrels incentive program, downspout disconnections incentive program, and irrigation runoff reduction practices can be estimated using quantitative methods. Some of these methods, such as street sweeping and catch basin cleaning, do not address the HPWQC specifically, but have other pollutant removal benefits. The City implements a rigorous program of prioritization and assessment to determine the most effective way to utilize these non-structural strategies within the watershed. It should be noted that the impact of irrigation runoff reduction, modeled as a turf conversion and irrigation efficiency program, on dry weather pollutant load reductions in the City of San Diego is heavily muted due to the way in which dry weather flows are tabulated for this analysis as described in the CLRP Phase II.

In addition to those BMPs modeled above, the Phase I CLRP identified a number of additional nonstructural BMPs that, although they have the potential for significant pollutant reduction, lack the data necessary for model representation (Geosyntec Consultants, 2012). These pollution protection measures often seek to change behaviors at residential, commercial, and industrial sites to reduce exposure of pollutants to rainfall. While these practices have been demonstrated to be effective in places where they have been pioneered in western U.S. communities (Caraco and Schueler 1999), quantification of benefits in terms of load reductions attributed to these BMPs are challenging and often require extensive survey and monitoring information to gauge performance (Los Angeles County 2010).

With the number of non-modeled, nonstructural BMPs included in the Phase I CLRP, some pollutant load reductions are expected. For the purposes of benefit analyses and justification of funding for these BMPs, the collective load reduction for all non-modeled, nonstructural BMPs are assumed to be 10 percent, for both wet and dry conditions. This assumption represents a conservative estimate that is comparable to the load reductions associated with non-structural BMPs that can be modeled. This assumption will be assessed in the future as BMPs are implemented and focused monitoring studies are performed to attempt to evaluate performance. As the WQIP is updated in the future throughout the implementation period, the modeling system can be updated over time as data become available for quantifying the effectiveness of additional nonstructural BMPs.

The following table provides an estimate of dry weather load reductions by BMP type and indicates that nonstructural BMPs provided 100% of the required load reduction during dry weather.

Table 3F-2. Summary of Dry Weather Load Reductions for the City of San Diego

Condition	Non-structural (not modeled)	Non-structural (modeled)	Centralized on Public	Distributed on Public	Green Streets	Centralized on Acquired Private Land	Total[b]
Dry[a] weather	10.0%	90.0%	-	-	-	N/A	**100.%**

[a] Dry weather flow and load reductions reflect only runoff in urban sub-watershed.
[b] The load reduction analysis and scheduling of BMPs was performed for final targets only. Interim targets and associated schedules will further evaluated through an adaptive process as BMPs are implemented and their effectiveness is assessed.

Structural solutions for the San Diego River watershed included centralized and distributed BMPs on public land, green streets, and centralized BMPs on acquired public land (if necessary to meet the required load reduction). Although centralized BMPs on public land and green streets are expected to provide dry weather load reductions, nonstructural BMPs provided 100% load reduction during dry weather so no additional benefits for structural BMPs were quantified.

The City also currently operates five low flow diversion facilities within the San Diego River watershed. These were included in the baseline model of existing conditions and are therefore not included within the flow and pollutant load estimates for dry weather. Based on review of information on these diversions and communications with City staff, a cumulative diverted flow rate of 2.8 cubic feet per second (cfs) was assumed in the model for these facilities, with individual facility locations and diversion rates represented appropriately.

Chapter 3 – Appendix G: Optional Watershed Management Area Analysis (WMAA) Candidate Projects

Table 3G- 1. El Cajon: San Diego River Watershed Management Area Assessment Projects List

Project Identifier	Watershed Management Area	Hydrologic Area (HA)	Hydrologic Subarea (HSA)	Jurisdiction	Project Name	Ownership		Project Location				Project Origination/Originator		Project Category	Specific Project Type
						Type	Owner Information	Address	APN	Latitude	Longitude	Name	Contact Information		
SDR-10	San Diego River	Lower San Diego	El Cajon	El Cajon	MJ-R-D-1	Public	San Diego County	N. Marshall Ave. and Cuyamaca St., El Cajon, CA	3871900800	1882196.91	6336553.33	S.D. County, City Of San Diego, City of La Mesa, City of El Cajon, City of Santee		Regional BMPs	Gross Solids and Trash Removal

Table 3G-2. City of San Diego: San Diego River Watershed Management Area Assessment Project List

Project Identifier	Watershed Management Area	Jurisdiction	Ownership	Project Location				Project Size & Parameters				Other Notes
			Owner Information	Address	APN	Latitude (X-Coordinate)	Longitude (Y- Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)	Project Footprint (acres)	Parameters (with units as necessary)	
Public Parcels Identified as Suitable for Further Assessment to Determine Feasibility of Retrofitting with Green Infrastructure												
Parcels on this list that are 0.25 acres or greater have been assessed using broad assumptions necessary for computer modeling and were found to be potentially effective as an opportunity for contributing to load reduction goals. Considerable further assessment would be required before determining any of these sites to be viable retrofit sites for implementation of Green Infrastructure. That assessment includes verifying public ownership, determining if land use agreements and financing can be established, assessing feasibility based upon further investigation of physical site constraints at a project design level, and determining that construction and necessary approvals, including approvals from regulatory agencies other than the City of San Diego, can be completed within the time constraints in the Municipal Storm Water Permit that pertain to Alternative Compliance.												
1	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4365400600	6271960.61690000000	1858885.13726000000	TBD	8.43	TBD	TBD	TBD
2	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4365400700	6271959.81782000000	1859293.03247000000	TBD	3.91	TBD	TBD	TBD
3	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4210305400	6291729.82911000000	1875381.08817000000	TBD	4.07	TBD	TBD	TBD
4	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4411600400	6263428.84682000000	1855426.39730000000	TBD	7.68	TBD	TBD	TBD
5	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4821705000	6339801.31690000000	1875760.30229000000	TBD	1.22	TBD	TBD	TBD
6	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4830212800	6340225.66102000000	1876652.51839000000	TBD	0.92	TBD	TBD	TBD
7	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4498608300	6258864.54200000000	1855043.39600000000	TBD	1.57	TBD	TBD	TBD
8	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4313202100	6278852.82234000000	1866133.79441000000	TBD	1.58	TBD	TBD	TBD
9	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4212910200	6290284.19036000000	1874074.87660000000	TBD	1.63	TBD	TBD	TBD
10	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3822601200	6349893.72700000000	1891724.34900000000	TBD	7.84	TBD	TBD	TBD
11	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4491100800	6258923.84207000000	1853753.85700000000	TBD	3.80	TBD	TBD	TBD
12	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4631110100	6312244.38913000000	1865532.18088000000	TBD	0.23	TBD	TBD	TBD
13	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3690402300	6289856.34251000000	1884716.71162000000	TBD	4.32	TBD	TBD	TBD
14	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4210305600	6292567.83850000000	1875157.25309000000	TBD	3.60	TBD	TBD	TBD
15	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4426212000	6271214.16355000000	1855369.84926000000	TBD	1.73	TBD	TBD	TBD
16	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4821902100	6338457.74796000000	1872745.29350000000	TBD	1.68	TBD	TBD	TBD
17	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3870300500	6342314.66959000000	1881981.04938000000	TBD	0.88	TBD	TBD	TBD
18	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3941410600	6355018.57753000000	1892436.00776000000	TBD	0.17	TBD	TBD	TBD
19	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4365400800	6271268.62875000000	1859124.10526000000	TBD	1.39	TBD	TBD	TBD
20	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4210305500	6292202.78233000000	1875304.80864000000	TBD	3.17	TBD	TBD	TBD
21	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4498700300	6260981.53292000000	1854769.59111000000	TBD	6.16	TBD	TBD	TBD
22	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4332501600	6294188.80695000000	1865293.28405000000	TBD	132.19	TBD	TBD	TBD
23	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3941410700	6355025.47597000000	1892389.32099000000	TBD	0.17	TBD	TBD	TBD
24	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4640901300	6320460.93349000000	1864753.29555000000	TBD	0.48	TBD	TBD	TBD
25	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4210400700	6285991.12254000000	1874972.35651000000	TBD	0.69	TBD	TBD	TBD
26	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4415900500	6264267.50968000000	1856432.59103000000	TBD	5.23	TBD	TBD	TBD
27	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4210306100	6291246.94719000000	1875814.34568000000	TBD	14.23	TBD	TBD	TBD
28	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3734900600	6304064.40091000000	1885160.24024000000	TBD	5.24	TBD	TBD	TBD
29	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4210306000	6291854.30037000000	1876419.91264000000	TBD	99.22	TBD	TBD	TBD
30	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4212901100	6287850.14331000000	1877338.88703000000	TBD	409.77	TBD	TBD	TBD
31	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4640700900	6319937.71057000000	1864931.80787000000	TBD	2.27	TBD	TBD	TBD

Project Identifier	Watershed Management Area	Jurisdiction	Ownership	Project Location				Project Size & Parameters				Other Notes
			Owner Information	Address	APN	Latitude (X-Coordinate)	Longitude (Y- Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)	Project Footprint (acres)	Parameters (with units as necessary)	
32	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4210500100	6286133.58650000000	1874150.64150000000	TBD	11.35	TBD	TBD	TBD
33	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4425200800	6270702.20031000000	1856524.21687000000	TBD	11.90	TBD	TBD	TBD
34	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6724900500	6306195.90236000000	1869360.48157000000	TBD	0.52	TBD	TBD	TBD
35	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3562310300	6285679.78309000000	1880196.67901000000	TBD	1.33	TBD	TBD	TBD
36	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4367300500	6272175.03471000000	1858241.73568000000	TBD	18.93	TBD	TBD	TBD
37	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4312900200	6278823.67800000000	1867469.96914000000	TBD	0.22	TBD	TBD	TBD
38	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4495910300	6260495.09176000000	1850354.07084000000	TBD	0.26	TBD	TBD	TBD
39	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4494721300	6260320.56442000000	1850616.08091000000	TBD	0.23	TBD	TBD	TBD
40	San Diego River	City of San Diego	CITY OF SAN DIEGO (OCEAN BEACH RECREATION CENTER)	TBD	4484020800	6255666.55073000000	1852339.12233000000	TBD	1.23	TBD	TBD	TBD
41	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4446503600	6280232.33314000000	1853728.47389000000	TBD	0.45	TBD	TBD	TBD
42	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4495821800	6260245.76160000000	1849447.82320000000	TBD	0.13	TBD	TBD	TBD
43	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480230200	6253699.18708000000	1854690.32675000000	TBD	0.17	TBD	TBD	TBD
44	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480210200	6253562.15184000000	1854338.51592000000	TBD	0.29	TBD	TBD	TBD
45	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3690402200	6289474.02403000000	1885098.78900000000	TBD	1.78	TBD	TBD	TBD
46	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3921202000	6355379.75839000000	1896091.09117000000	TBD	0.66	TBD	TBD	TBD
47	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3690402500	6289738.99394000000	1885217.57139000000	TBD	3.30	TBD	TBD	TBD
48	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4212900900	6284861.04809000000	1876285.71277000000	TBD	4.64	TBD	TBD	TBD
49	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4905920200	6325682.31916000000	1863837.62462000000	TBD	0.19	TBD	TBD	TBD
50	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4641500500	6317490.68047000000	1864623.66893000000	TBD	3.74	TBD	TBD	TBD
51	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4365200600	6271142.44352000000	1859047.80426000000	TBD	0.43	TBD	TBD	TBD
52	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4213201100	6285346.12043000000	1874037.59826000000	TBD	2.48	TBD	TBD	TBD
53	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4381504100	6287165.54078000000	1858468.04078000000	TBD	0.05	TBD	TBD	TBD
54	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4212050700	6288077.35470000000	1873946.75638000000	TBD	0.34	TBD	TBD	TBD
55	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4332501900	6293802.54477000000	1863818.43052000000	TBD	0.75	TBD	TBD	TBD
56	San Diego River	City of San Diego	HOUSING AUTHORITY CITY OF SAN DIEGO	TBD	4410904300	6259836.56184000000	1855650.37597000000	TBD	30.18	TBD	TBD	TBD
57	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4365300700	6271285.86682000000	1858506.99406000000	TBD	3.59	TBD	TBD	TBD
58	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4481421500	6255760.59837000000	1855602.76543000000	TBD	4.72	TBD	TBD	TBD
59	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4483011200	6255031.53413000000	1852488.22504000000	TBD	0.31	TBD	TBD	TBD
60	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4483011300	6254970.71662000000	1852531.09105000000	TBD	0.17	TBD	TBD	TBD
61	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4405621400	6294451.46966000000	1858174.02469000000	TBD	0.19	TBD	TBD	TBD
62	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3690402400	6290053.71214000000	1884529.00398000000	TBD	0.12	TBD	TBD	TBD
63	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4292600500	6296323.32065000000	1870275.17901000000	TBD	0.94	TBD	TBD	TBD
64	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4406401500	6297100.41175000000	1858428.57650000000	TBD	1.61	TBD	TBD	TBD
65	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6724900400	6306327.73599000000	1869653.82859000000	TBD	3.81	TBD	TBD	TBD

Project Identifier	Watershed Management Area	Jurisdiction	Ownership	Project Location				Project Size & Parameters				Other Notes
			Owner Information	Address	APN	Latitude (X-Coordinate)	Longitude (Y- Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)	Project Footprint (acres)	Parameters (with units as necessary)	
66	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3734825700	6305446.72610000000	1885079.04244000000	TBD	0.05	TBD	TBD	TBD
67	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3691702400	6290461.04004000000	1879145.59875000000	TBD	4.38	TBD	TBD	TBD
68	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3920903300	6354563.85941000000	1896080.45007000000	TBD	11.43	TBD	TBD	TBD
69	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4571910900	6329229.84314000000	1872215.84076000000	TBD	0.06	TBD	TBD	TBD
70	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4488000100	6255963.33149000000	1855387.22038000000	TBD	2.24	TBD	TBD	TBD
71	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4631150200	6312874.15265000000	1865311.84055000000	TBD	0.20	TBD	TBD	TBD
72	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4480310400	6253701.82783000000	1855277.48305000000	TBD	2.29	TBD	TBD	TBD
73	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4406302100	6297336.59475000000	1857832.31025000000	TBD	0.13	TBD	TBD	TBD
74	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3920820500	6355272.81129000000	1896450.04317000000	TBD	0.95	TBD	TBD	TBD
75	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3690401800	6290155.86150000000	1884841.55675000000	TBD	2.26	TBD	TBD	TBD
76	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4571911000	6329230.68418000000	1872290.35859000000	TBD	0.05	TBD	TBD	TBD
77	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4413702100	6263016.97365000000	1855507.62373000000	TBD	0.31	TBD	TBD	TBD
78	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4571910800	6329229.09547000000	1872152.76529000000	TBD	0.09	TBD	TBD	TBD
79	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480233300	6253708.41501000000	1854889.23835000000	TBD	0.07	TBD	TBD	TBD
80	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6723000100	6306309.53263000000	1870229.29455000000	TBD	10.00	TBD	TBD	TBD
81	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480233100	6253747.05150000000	1854860.55682000000	TBD	0.09	TBD	TBD	TBD
82	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3830800500	6329701.97900000000	1885454.06300000000	TBD	0.56	TBD	TBD	TBD
83	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4213920100	6295098.51652000000	1879029.44163000000	TBD	2.51	TBD	TBD	TBD
84	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4415303800	6266415.00735000000	1857123.35748000000	TBD	0.35	TBD	TBD	TBD
85	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3921202100	6355446.89802000000	1896472.95302000000	TBD	0.18	TBD	TBD	TBD
86	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4562311800	6313898.75734000000	1875835.44960000000	TBD	0.14	TBD	TBD	TBD
87	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480230300	6253730.23269000000	1854666.11273000000	TBD	0.09	TBD	TBD	TBD
88	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3690401400	6289290.36376000000	1884800.26081000000	TBD	1.94	TBD	TBD	TBD
89	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4213920300	6295050.33905000000	1878608.69189000000	TBD	1.87	TBD	TBD	TBD
90	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4213330400	6295808.35125000000	1875844.90741000000	TBD	1.20	TBD	TBD	TBD
91	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4366700600	6269821.54600000000	1858353.65900000000	TBD	3.88	TBD	TBD	TBD
92	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4365200300	6270925.14225000000	1858614.33333000000	TBD	2.05	TBD	TBD	TBD
93	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480101700	6253469.27706000000	1853841.89713000000	TBD	1.59	TBD	TBD	TBD
94	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4673502300	6312536.28806000000	1859990.29226000000	TBD	1.57	TBD	TBD	TBD
95	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4391803100	6292003.03464000000	1859796.73346000000	TBD	0.08	TBD	TBD	TBD
96	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3921103000	6355080.12545000000	1894998.70528000000	TBD	0.03	TBD	TBD	TBD
97	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3562130800	6285671.42832000000	1880808.74547000000	TBD	1.77	TBD	TBD	TBD
98	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6730400100	6313197.82211000000	1868679.51397000000	TBD	10.69	TBD	TBD	TBD
99	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6720803600	6309440.61130000000	1871513.55714000000	TBD	0.13	TBD	TBD	TBD
100	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6720802100	6309247.09533000000	1871323.72432000000	TBD	0.16	TBD	TBD	TBD
101	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4213920400	6295037.38844000000	1878368.61079000000	TBD	2.04	TBD	TBD	TBD
102	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4332500500	6292768.98840000000	1863328.69635000000	TBD	2.95	TBD	TBD	TBD

Project Identifier	Watershed Management Area	Jurisdiction	Ownership	Project Location					Project Size & Parameters				Other Notes
			Owner Information	Address	APN	Latitude (X-Coordinate)	Longitude (Y- Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)	Project Footprint (acres)	Parameters (with units as necessary)		
103	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3690401900	6289956.23750000000	1885008.15675000000	TBD	0.86	TBD	TBD	TBD
104	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6720704900	6309804.62783000000	1871882.58726000000	TBD	0.13	TBD	TBD	TBD
105	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4495910100	6260481.40736000000	1850483.58587000000	TBD	0.47	TBD	TBD	TBD
106	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480411900	6253967.48379000000	1855498.86086000000	TBD	0.42	TBD	TBD	TBD
107	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4392402800	6292006.20419000000	1859730.17894000000	TBD	0.07	TBD	TBD	TBD
108	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4870602500	6337670.66060000000	1871061.19595000000	TBD	1.12	TBD	TBD	TBD
109	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4674022400	6310442.05814000000	1858330.76174000000	TBD	0.12	TBD	TBD	TBD
110	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6720804300	6309620.77999000000	1871697.63665000000	TBD	0.13	TBD	TBD	TBD
111	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3871214800	6340834.31327000000	1878064.50841000000	TBD	0.25	TBD	TBD	TBD
112	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4366011000	6272889.10345000000	1859503.09661000000	TBD	0.32	TBD	TBD	TBD
113	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4674022500	6310443.18963000000	1858381.19714000000	TBD	0.12	TBD	TBD	TBD
114	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4415900600	6263915.25927000000	1856024.57909000000	TBD	5.55	TBD	TBD	TBD
115	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3830501500	6321576.30802000000	1886091.55834000000	TBD	19.83	TBD	TBD	TBD
116	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6740400100	6319421.21863000000	1868148.00000000000	TBD	0.49	TBD	TBD	TBD
117	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4830212700	6340556.01913000000	1877394.80076000000	TBD	0.15	TBD	TBD	TBD
118	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4480503600	6254577.81300000000	1855776.05200000000	TBD	1.00	TBD	TBD	TBD
119	San Diego River	City of San Diego	HOUSING AUTHORITY CITY OF SAN DIEGO	TBD	4411330100	6261951.48942000000	1856430.35004000000	TBD	0.53	TBD	TBD	TBD
120	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4405622900	6294888.89840000000	1858466.19678000000	TBD	1.46	TBD	TBD	TBD
121	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4213920200	6295077.95999000000	1878798.82755000000	TBD	1.67	TBD	TBD	TBD
122	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4332501300	6294341.45586000000	1866324.12220000000	TBD	81.07	TBD	TBD	TBD
123	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4415900400	6265417.40896000000	1856122.64545000000	TBD	69.11	TBD	TBD	TBD
124	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4674022300	6310440.91429000000	1858279.77033000000	TBD	0.12	TBD	TBD	TBD
125	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3690840500	6294037.67374000000	1884851.16667000000	TBD	7.57	TBD	TBD	TBD
126	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4364902000	6270654.93519000000	1858667.67901000000	TBD	0.11	TBD	TBD	TBD
127	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480220100	6253572.02370000000	1854949.79630000000	TBD	0.61	TBD	TBD	TBD
128	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6722702500	6307300.34738000000	1869232.44538000000	TBD	0.52	TBD	TBD	TBD
129	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3733022600	6301507.47354000000	1885150.07590000000	TBD	1.48	TBD	TBD	TBD
130	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4446901500	6282879.18699000000	1853393.90323000000	TBD	0.15	TBD	TBD	TBD
131	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4372911600	6281036.42990000000	1860056.26831000000	TBD	0.31	TBD	TBD	TBD
132	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4366900700	6270371.00000000000	1858512.65800000000	TBD	2.52	TBD	TBD	TBD
133	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4673601300	6313088.10930000000	1860503.49485000000	TBD	0.11	TBD	TBD	TBD
134	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480230100	6253631.08645000000	1854745.01676000000	TBD	0.40	TBD	TBD	TBD
135	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4681612700	6316028.85707000000	1860901.74285000000	TBD	0.22	TBD	TBD	TBD
136	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4394413700	6293575.62045000000	1858445.33155000000	TBD	0.15	TBD	TBD	TBD
137	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4332304600	6291814.77395000000	1863537.82652000000	TBD	2.35	TBD	TBD	TBD
138	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4622102900	6308564.81932000000	1865254.06555000000	TBD	4.02	TBD	TBD	TBD

Project Identifier	Watershed Management Area	Jurisdiction	Ownership	Project Location				Project Size & Parameters				Other Notes
			Owner Information	Address	APN	Latitude (X-Coordinate)	Longitude (Y- Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)	Project Footprint (acres)	Parameters (with units as necessary)	
139	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4494720200	6260267.76877000000	1850650.71282000000	TBD	0.06	TBD	TBD	TBD
140	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480233400	6253689.11331000000	1854902.72886000000	TBD	0.08	TBD	TBD	TBD
141	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4586230100	6306150.05787000000	1867911.12374000000	TBD	0.73	TBD	TBD	TBD
142	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3735212800	6305183.90224000000	1886762.04497000000	TBD	0.16	TBD	TBD	TBD
143	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4422601900	6269417.11896000000	1856255.53774000000	TBD	0.09	TBD	TBD	TBD
144	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4394413600	6293574.78400000000	1858395.33598000000	TBD	0.15	TBD	TBD	TBD
145	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480210100	6253524.17471000000	1854285.49230000000	TBD	0.14	TBD	TBD	TBD
146	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480210400	6253552.32944000000	1854558.38742000000	TBD	0.32	TBD	TBD	TBD
147	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480210300	6253530.73423000000	1854453.20193000000	TBD	0.19	TBD	TBD	TBD
148	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4366601900	6269173.06771000000	1857962.88617000000	TBD	0.72	TBD	TBD	TBD
149	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4332303400	6291498.56307000000	1863079.31481000000	TBD	18.01	TBD	TBD	TBD
150	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4400313700	6299555.90072000000	1862888.94314000000	TBD	0.14	TBD	TBD	TBD
151	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3735004900	6303410.14495000000	1886765.03210000000	TBD	0.24	TBD	TBD	TBD
152	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4681700700	6314310.33009000000	1860315.32716000000	TBD	0.02	TBD	TBD	TBD
153	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3660814900	6323908.98108000000	1888514.07648000000	TBD	0.16	TBD	TBD	TBD
154	San Diego River	City of San Diego	CITY OF SAN DIEGO TR	TBD	4480233200	6253726.41679000000	1854875.74090000000	TBD	0.08	TBD	TBD	TBD
155	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4482302200	6256565.36122000000	1854564.37184000000	TBD	0.15	TBD	TBD	TBD
156	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4484211200	6256726.71361000000	1853674.35503000000	TBD	0.18	TBD	TBD	TBD
157	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3920810300	6354844.07132000000	1896530.61115000000	TBD	0.52	TBD	TBD	TBD
158	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4641500300	6317607.83356000000	1864865.33360000000	TBD	0.23	TBD	TBD	TBD
159	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6721203600	6308575.21401000000	1870690.59846000000	TBD	0.19	TBD	TBD	TBD
160	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6721303300	6308793.20165000000	1870904.81496000000	TBD	0.16	TBD	TBD	TBD
161	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4620511900	6309027.48574000000	1867188.01852000000	TBD	0.04	TBD	TBD	TBD
162	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6721300200	6309031.96128000000	1871125.51034000000	TBD	0.14	TBD	TBD	TBD
163	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4415810900	6266916.57254000000	1856500.37432000000	TBD	0.01	TBD	TBD	TBD
164	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4446901600	6282931.73301000000	1853394.16435000000	TBD	0.16	TBD	TBD	TBD
165	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3710310400	6310651.98763000000	1878510.00185000000	TBD	0.15	TBD	TBD	TBD
166	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	6770360900	6283662.03979000000	1868621.46220000000	TBD	0.14	TBD	TBD	TBD
167	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	3660503200	6329521.56912000000	1898594.50349000000	TBD	4.59	TBD	TBD	TBD
168	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4411821900	6263482.47362000000	1856195.71176000000	TBD	0.04	TBD	TBD	TBD
169	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	4400111700	6297774.14941000000	1862842.38430000000	TBD	0.02	TBD	TBD	TBD

Public Parcels Identified as Suitable for Further Assessment to Determine Feasibility of Retrofitting

Parcels on this list have been assessed using broad assumptions necessary for computer modeling and were found to be potentially effective as an opportunity for contributing to load reduction goals. Considerable further assessment would be required before determining any of these sites to be viable retrofit. That assessment includes verifying public ownership, determining if land use agreements and financing can be established, assessing feasibility based upon further investigation of physical site constraints at a project design level, and determining that construction and necessary approvals, including approvals from regulatory agencies other than the City of San Diego, can be completed within the time constraints in the Municipal Storm Water Permit that pertain to Alternative Compliance.

N/A	N/A	City of San Diego	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Canyon Site

Project Identifier	Watershed Management Area	Jurisdiction	Ownership	Project Location				Project Size & Parameters				Other Notes
			Owner Information	Address	APN	Latitude (X-Coordinate)	Longitude (Y- Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)	Project Footprint (acres)	Parameters (with units as necessary)	
Project Concept for Green Streets Retrofits – Quantity and Location of Suitable City Streets To-Be-Determined												
The City of San Diego is in the process of identifying potential public street locations that could feasibly be retrofitted with Green Infrastructure and provide a meaningful contribution to pollutant load reduction goals. As locations become verified for feasibility and effectiveness, funding mechanisms under an Alternate Compliance program could potentially be used to fill gaps in construction and maintenance funding necessary for the project to go forward. This is pending the ability to establish suitable legal mechanisms and verify that approvals and construction can be completed within the time constraints in the Municipal Storm Water Permit that pertain to Alternative Compliance.												
170	San Diego River	City of San Diego	CITY OF SAN DIEGO	TBD	N/A	N/A	N/A	TBD	89	TBD	TBD	Green Street TBD

Table 3G-3. County of San Diego: San Diego River Watershed Management Area Assessment Project List

Project Identifier	Watershed Management Area	Jurisdiction	Project Name	Ownership		Project Location				Project Category	Specific Project Type
				Type	Owner Information	Address	APN	Latitude	Longitude		
SDR-2	San Diego River	SAN DIEGO	Shepherd Canyon Wetlands Restoration, 6+ Acres		CITY OF SAN DIEGO	N/A	3730715500	1883859.653	6302019.348		
SDR-3	San Diego River	SAN DIEGO	Ruffin Canyon, Free Land from Church, Wetland-Water Filtration		ROMAN CATHOLIC BISHOP OF SAN DIEGO	GLENCOLUM DR	4290101000	1873409.984	6290364.132		
SDR-4	San Diego River	SAN DIEGO	Qualcomm Parking Lot		CITY OF SAN DIEGO	Qualcomm parking lot	4332501600	1865894.05	6294328.208		
SDR-5	San Diego River	SAN DIEGO	St. Columba church canyon area	Private	St. Columba Church	3327 Glencolum Drive, San Diego 92123 The above address is the church address, but the canyon is between the church parking area and Gramercy Drive	4290111000	1873045.19	6290152.379	Stream or Riparian Rehabilitation	Drainage area rehabilitation/restoration
SDR-6	San Diego River	SAN DIEGO	Library Canyon Creek	Public	City of San Diego	9020 Village Glen DriveSan Diego, CA 92123	4210302200	1874517.998	6290493.141	Stream or Riparian Rehabilitation	Creek restoration
SDR-1	San Diego River	S.D. COUNTY	Lakeside Conservancy Treatment Wetlands	Public/ Private Partnership	Stephanie Gaines 858-694-3493	Lakeside River Park Conservancy 12108 Industry Rd, Lakeside 92040	3822503200	1892675.312	6350636.749	Regional BMP's	Subsurface Treatment Wetlands
SDR-11	San Diego River	S.D. COUNTY	MJ-R-D-4	Public	CITY OF S.D.	WOODSIDE AVE AND SUMMERSUN LANE, LAKESIDE	3822601200	1891735.691	6349833.62	Groundwater Recharge Projects	VEGETATED INFILTRATION BASIN
SDR-7	San Diego River	S.D. COUNTY	Lakeside Conservancy Treatment Wetlands	Public/ Private Partnership	Stephanie Gaines 858-694-3493	Lakeside River Park Conservancy 12108 Industry Rd, Lakeside 92040	3822503200	1892675.312	6350636.749	Regional BMP's	Subsurface Treatment Wetlands, REMOVE CONCRETE CHANNEL
SDR-10	San Diego River	EL CAJON	MJ-R-D-1	Public	S.D. COUNTY	N. MARSHALL AVE. AND CUYAMACA ST., EL CAJON, CA	3871900800	1882196.908	6336553.331	Regional BMP's	GROSS SOLIDS AND TRASH REMOVAL
SDR-12	San Diego River	EL CAJON	WING AVENUE FLOOD CONTROL IMPROVEMENTS	Public	S.D. COUNTY	WING AVE. AND BRADLEY AVE., EL CAJON	3871900800	1878741.197	6341639.357	Stream or Riperian Rehabilitation	CHANNEL WIDENING, DEEPENING, AND STABILIZATION
SDR-8	San Diego River	S.D. COUNTY	FLINN SPRINGS AT OAK CREEK	Public/ Private Partnership	S.D. COUNTY	FLINN SPRINGS RD AND OAK CREEK RD	3960700700	1892443.175	6374288.121	Regional BMP's	REGIONAL BMP
SDR-9	San Diego River	S.D. COUNTY	SDCO-R-D-2	Public	S.D. COUNTY	FLINN SPRINGS RD AND OAK CREEK RD	3960700300	1892183.914	6374271.571	Groundwater Recharge Projects	SUBSURFACE INFILTRATION
SDR-16	San Diego River	S.D. COUNTY	SDA7 BASIN 050525	Public	FISHBAUGH THOMAS A&ROBIN M	70 FT NW OF ARMENTROUT LN	4024300400	1889269.405	6403009.319	Regional BMP's	BASIN TREATMENT
SDR-13	San Diego River	S.D. COUNTY	SDA7 BASIN 010303	Public	N/A	2400 ALPINE BLVD	4034100800	1884428.875	6404094.705	Regional BMP's	BASIN TREATMENT
SDR-14	San Diego River	S.D. COUNTY	SDA7 BASIN 010317	Public	BRAR CHAMKAUR S&SUKHWINDER K	ALPINE BLVD AND VICTORIA, ALPINE	4040316700	1883968.114	6407286.83	Regional BMP's	BASIN TREATMENT
SDR-15	San Diego River	S.D. COUNTY	SDA7 IN-LINE TREATMENT 010643	Public	S.D. COUNTY	200 FT NE OF FLO DR AND ARNOLD WY	N/A	1884453.626	6401193.025	Regional BMP's	IN-LINE TREATMENT
SDR-17	San Diego River	S.D. COUNTY	SDA7 BASIN OR IN-LINE TREATMENT 011240	Public	POST ROSE M	ARNOLD WAY N OF HARBISON CANYON RD	4034511200	1886662.471	6390044.085	Regional BMP's	BASIN OR IN-LINE TREATMENT
SDR-18	San Diego River	S.D. COUNTY	SDA7 BASIN OR IN-LINE TREATMENT 010840	Public	LAFOND FAMILY TRUST A 08-06- 80	100 FT S OF ALPINE BLVD (OFF RAMP FROM I-8 EAST BOUND)	4033811600	1885189.049	6397590.795	Regional BMP's	BASIN OR IN-LINE TREATMENT
SDG-40	San Diego River	S.D. COUNTY	Coleman Creek Rehabilitation	Public	County of San Diego	Coleman Creek located along Julian Road and Coleman Circle	2910404100	1971849.985	6452903.195	Stream Rehabilitation	Filtration in the stream bed

CHAPTER 3 – APPENDIX H: SAN DIEGO RIVER WATERSHED MANAGEMENT AREA ANALYSIS

Geosyntec consultants

3990 Old Town Avenue, Suite A-101
San Diego, California 92110
PH 619.297.1530
www.geosyntec.com

Memorandum

Date: June 17, 2015

To: Sheri McPherson, Project Manager, County of San Diego

Gladys Gonzalez, Land Use Environmental Planner II, County of San Diego

From: Venkat Gummadi and Trevor Alsop, Geosyntec Consultants

Laura Henry, RICK Engineering

Subject: Regional Watershed Management Area Analysis Hydromodification Exemption Analysis – Memorandum to Document Factors of Safety Contract No. 537081; Task Order No. 23

---

1. BACKGROUND

The Draft Regional Watershed Management Area Analysis (WMAA) that was submitted to the San Diego Regional Water Quality Control Board in January 2015 included analyses to evaluate hydromodification exemptions in accordance with the Regional MS4 Permit provision B.3.b.(4)(c) for the following receiving water bodies:

- Major River Reaches
  - Otay River from Outfall at San Diego Bay to Interstate 805;
  - San Diego River from Pacific Ocean to confluence with San Vicente Creek;
  - San Dieguito River from upstream edge of the railroad crossing to Lake Hodges Dam;
  - San Luis Rey River from Pacific Ocean to upstream river limit of Basin Plan subwatershed 903.1 upstream of Bonsall and near Interstate 15; and
  - Sweetwater River from San Diego Bay to Sweetwater Reservoir Dam.

- Stabilized Conveyance Systems Draining to Exempt Water Bodies
  - Methodology for exemption stabilized conveyance systems; and
  - Forester Creek stabilized reach from the confluence with the San Diego River to Prospect Avenue.

This memorandum summarizes the implicit factors of safety used while performing the hydromodification exemption analysis.

2. MAJOR RIVER REACHES

Hydromodification impacts can be caused due to increase in flows, changes in sediment transport capacity and changes in sediment supply to the streams. In order to evaluate the cumulative impacts due to development and determine if hydromodification exemption could be recommended, an erosion potential (Ep) analysis was used to evaluate the increase in flows and changes in sediment transport capacity to the selected receiving waters for the built-out condition. In addition, sediment supply potential (Sp) analysis was used to evaluate the changes in sediment supply. The implicit factors of safety in each analysis are presented as follows:

1.1 Erosion Potential:

The analysis conducted to evaluate the Ep metric for the selected water bodies has three fundamental implicit (non-quantified) factors of safety including:

1. The analysis assumes all impervious area in the watershed is directly connected impervious area. In actuality, some portion of these impervious areas will sheet flow through pervious areas prior to discharging to the streams. This dispersion will result in attenuation of flow rates and durations that are not accounted for while estimating the sediment transport capacity of the built-out condition. This conservative assumption provides an implicit factor of safety.

2. New priority development projects, including projects that are proposed to be exempt from hydromodification management requirements through the Regional WMAA study, must implement retention BMPs to the extent feasible if participation in alternative compliance is not selected or allowed. This requirement will result in attenuation of flow rates and durations that are not accounted for while estimating the sediment transport capacity of the built-out condition. This conservative assumption provides an implicit factor of safety.

3. Redevelopment priority development projects in the watershed that do not directly discharge to the exempt river reach must mitigate flows to the pre-developed condition. This will result in over mitigation of flow rates and durations for redevelopment projects which are not accounted for while estimating the sediment transport capacity of the built-out condition. This conservative assumption provides an implicit factor of safety.

If the above three factors were quantified in the analysis, it is anticipated that the resultant Ep would be smaller than the Ep reported in the Regional WMAA.

1.2 Sediment Supply:

The Technical Advisory Committee, formed to provide input on the development of the 2011 San Diego County Final Hydromodification Management Plan, indicated (based on field observations and years of historical perspective) that the above river reaches have very low gradients, were depositional (aggrading), have very wide floodplain areas when in the natural condition, and that the effects of cumulative watershed impacts to these reaches are minimal provided that outfalls to the rivers have properly sized energy dissipation, and hence could be exempt from hydromodification management.

Since these river systems are depositional, they can support some losses in sediment supply as these systems seek equilibrium prior to experiencing hydromodification. Available literature consulted for this analysis indicates that having less than a 10% reduction in sediment supply for an equilibrated system is unlikely to instigate, as an independent condition, significant channel changes. Based on the analysis performed in Regional WMAA, the losses in sediment supply was estimated to be less than 7% (30% factor; Appendix B.1.1.3); and when considering these rivers to be depositional, provides an implicit factor of safety.

3. STABILIZED CONVEYANCE SYSTEMS DRAINING TO EXEMPT WATER BODIES

To qualify for exemption, an engineered stabilized conveyance system must meet the following criteria:

- It must be demonstrated that shear stress in the engineered conveyance system will be less than critical shear stress when the system conveys the 10-year flow rate determined based on the Hawley & Bledsoe 2011 equation presented in "How do flow peaks and durations change in suburbanizing semi-arid watersheds? A southern California case study," (Hawley, R.J., and Bledsoe, B.P. 2011). Critical shear stress shall be determined from

> "Stability Thresholds for Stream Restoration Materials" (Fischenich 2001) or similar published data.

This means that an engineered stabilized conveyance system could be exempt if it will be non-erosive in the range of flows relevant to hydromodification management. Determination that the conveyance system is non-erosive would be established when the shear stress in the conveyance system at Q_{10} (determined using specific procedures relevant for hydromodification management different from flood control Q_{10}, herein "HMP Q_{10}") is less than critical shear stress. A "stabilized" channel means an engineered channel stabilized with materials other than concrete (e.g., riprap, turf reinforcement mat, vegetation, including rehabilitated channels). Critical shear stress (the maximum shear stress the stabilizing material can tolerate without movement) for such channels can be determined from reference sources. When the shear stress in the conveyance system is less than critical shear stress, there is no excess shear stress or "work" (i.e., erosion) occurring in the system.

This criteria is conservative because it requires shear stress be evaluated at a flow rate relevant to hydromodification management, and <u>no</u> excess shear stress (i.e., no work, no erosion) to occur at the study flow rate. This is a significant change from the exemption criteria for stable, unlined channels that was presented in the Final HMP, which only required evaluation of the channel capacity and did not require evaluation of shear stress in the channel.

For Forester Creek, recommended for exemption in the Regional WMAA and San Diego River WMAA, the upper range of geomorphically-effective flows based on procedures presented in the referenced Hawley & Bledsoe paper was 836 cfs, and the HMP Q_{10} was 2,120 cfs based on the Hawley & Bledsoe equation. Forester creek can convey approximately 2,150 cfs before critical shear stress is reached in the cross section that is expected to be the most sensitive (i.e., the cross section with a combination of narrow geometry and steep slope that is expected to experience the greatest shear stress at any given flow rate).

Forester Creek is stabilized with vegetation, and therefore would have a relatively low allowable shear stress compared to other stabilizing materials. The same exemption study process would be applied for channels stabilized with other materials such as riprap, which can tolerate greater shear stress than vegetation.

In addition to the criteria to determine that a conveyance system is stable, the Regional WMAA sets limitations on the use of the exemption: it is only for engineered conveyance systems that are stabilized, no natural channels, and the engineered conveyance system must continue uninterrupted to an exempt water body.

* * * * *

San Diego River
Watershed Management Area Analysis

Lake Henshaw

October 3, 2014

Prepared for:
San Diego County Copermittees

Prepared by:

Geosyntec consultants
engineers | scientists | innovators

RICK Engineering Company

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

%	percent
>	greater than
<	less than
BMP	Best Management Practice
CB	Coarse Bedrock
CEG	Certified Engineering Geologist
CIP	Capital Improvement Project
CLRP	Comprehensive Load Reduction Plan
CSI	Coarse Sedimentary Impermeable
CSP	Coarse Sedimentary Permeable
E_P	Erosion Potential
ET	Evapotranspiration
FB	Fine Bedrock
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
FSI	Fine Sedimentary Impermeable
FSP	Fine Sedimentary Permeable
GIS	Geographic Information System
GLU	Geomorphic Landscape Unit
HA	Hydrologic Area
HCP	Hydromodification Control Plan
HMP	Hydromodification Management Plan
HRU	Hydrologic Response Unit
HSA	Hydrologic Sub Area
HSG	Hydrologic Soil Group
IRWM	Integrated Regional Water Management
JURMP	Jurisdictional Urban Runoff Management Plan
LDW	Land Development Workgroup
LID	Low Impact Development
MAP	Mean Annual Precipitation

ACRONYMS AND ABBREVIATIONS continued

MHPA	Multiple Habitat Planning Area
MS4	Municipal Separate Storm Sewer System
MSCP	Multiple Species Conservation Program
NED	National Elevation Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Service
PDP	Priority Development Project
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
SCAMP	Southern California Aerial Mapping Project
SCCWRP	Southern California Coastal Water Research Project
SD	San Diego
SDRWQCB	San Diego Regional Water Quality Control Board
S_P	Sediment Supply Potential
SSURGO	Soil Survey Geographic Database
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WMA	Watershed Management Area
WMAA	Watershed Management Area Analysis
WQIP	Water Quality Improvement Plan
WURMP	Watershed Urban Runoff Management Plan

1. Introduction

1.1. Background

On May 8, 2013 the California Regional Water Quality Control Board, San Diego Region adopted Order No. R9-2013-0001; NPDES No. CAS 0109266, 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 (Regional MS4 Permit). The Regional MS4 Permit, which became effective on June 27, 2013, replaces the previous MS4 Permits that covered portions of the Counties of San Diego, Orange, and Riverside within the San Diego Region. There were two main goals for the Regional MS4 Permit:

1. To have more consistent implementation, as well as improve inter-agency communication (particularly in the case of watersheds that cross jurisdictional boundaries), and minimize resources spent on the permit renewal process.
2. To establish requirements that focused on the achievement of water quality improvement goals and outcomes rather than completing specific actions, thereby giving the Copermittees more control over how their water quality programs are implemented.

To achieve the second goal, the Regional MS4 Permit requires that Water Quality Improvement Plans (WQIPs) be developed for each Watershed Management Area (WMA) within the San Diego Region. As part of the development of WQIPs, the Regional MS4 Permit provides Copermittees an option to perform a Watershed Management Area Analysis (WMAA) through which watershed-specific requirements for structural BMP implementation for Priority Development Projects can be developed for each WMA. This report presents the Copermittees' approach and results for the regional elements of the WMAA developed for the San Diego County area.

1.2. Watershed Management Area Analysis (WMAA)

The Regional MS4 Permit, through inclusion of the WMAA, provides an optional pathway for Copermittees to develop an integrated approach for their land development programs by promoting evaluation of multiple strategies for water quality improvement and development of watershed-scale solutions for improving overall water quality in the watershed. The WMAA comprises the following three components as indicated in the Regional MS4 Permit:

1. Perform analysis and develop Geographic Information System (GIS) layers (maps) by gathering information pertaining to the physical characteristics of the WMA (referred to herein as WMA Characterization). This includes, for example, identifying potential areas of coarse sediment supply, present and anticipated future land uses, and locations of physical structures within receiving streams and upland areas that affect the watershed hydrology (such as bridges, culverts, and flood management basins).
2. Using the WMA Characterization results, compile a list of candidate projects that could potentially be used as alternative compliance options for Priority Development Projects. Such projects may include, for example, opportunities for stream or riparian area

rehabilitation, opportunities for retrofitting existing infrastructure to incorporate storm water retention or treatment, or opportunities for regional BMPs, among others. Prior to implementing these candidate projects the Copermittees must demonstrate that implementing such a candidate project would provide greater overall benefit to the watershed than requiring implementation of the onsite structural BMPs. Note, compilation or evaluation of potential projects was not performed as part of this regional effort. Identification and listing of candidate projects will be performed for each WMA through the WQIP process for WMAs that elect to submit the optional WMAA as part of the WQIP.

3. Additionally, using the WMA Characterization maps, identify areas within the watershed management area where it is appropriate to allow for exemptions from hydromodification management requirements that are in addition to those already allowed by the Regional MS4 Permit for Priority Development Projects. The Copermittees shall identify such cases on a watershed basis and include them in the WMAA with supporting rationale to support claims for exemptions.

1.3. Scope of Work for Regional WMAA

In July 2013, the Copermittees elected to fund a regional effort to develop elements of the regional WMAA for the 9 San Diego-area WMAs within the County of San Diego that are currently subject to the Regional MS4 Permit, which include:

- Santa Margarita River (for portion in San Diego County)
- San Luis Rey River
- Carlsbad
- San Dieguito River
- Los Peñasquitos
- Mission Bay & La Jolla Watershed
- San Diego River
- San Diego Bay
- Tijuana River (for portion in San Diego County)

The regional-level information developed through this effort is intended to provide consistency across WMAs and serve as the foundation for developing watershed-specific information for each WMA to be developed through the WQIP process. The regional effort scope of work included:

1. Development of GIS map layers that characterize the WMAs using data previously collected, readily available, and provided by the Copermittees, including:
    a. Description of dominant hydrologic processes, such as areas where infiltration or overland flow likely dominates;
    b. Description of existing streams in the watershed, including bed material and composition, and if they are perennial or ephemeral;

   c. Current and anticipated future land uses;
   d. Potential coarse sediment yield areas; and
   e. Locations of existing flood control structures and channel structures, such as stream armoring, constrictions, grade control structures, and hydromodification or flood management basins.

2. Development of a Microsoft® Excel (Excel) template for use by Copermittees to compile lists of candidate projects for an optional alternative compliance program.
3. Development of additional criteria and analyses to support reinstating the following proposed exemptions that were originally developed in the approved 2011 Final Hydromodification Management Plan but not included in the Regional MS4 Permit unless provided by the Copermittees in the WMAA. In addition, development of the associated Hydromodification Applicability/Exemption Mapping.
   a. Exempt River Reaches including:
      i. San Diego River;
      ii. Otay River;
      iii. San Dieguito River;
      iv. San Luis Rey River; and
      v. Sweetwater River
   b. Stabilized Conveyance Systems Draining to Exempt Water Bodies
   c. Highly Impervious/Highly Urbanized Watersheds and Urban Infill, and
   d. Tidally Influenced Lagoons (where data/study provided)

The scope of work for the regional effort excluded performing analysis within the following areas unless data was readily available, as Copermittees do not have jurisdiction over these areas:

1. State Lands;
2. U.S. Departments of Defense land;
3. U.S. National Forest land;
4. U.S. Department of Interior land and
5. Tribal land

Additional description of excluded areas, for the purposes of the Regional WMAA, is indicated in Section 2.3 Land Uses.

1.4. Project Process

The process for developing the Regional WMAA included close coordination with the Land Development Workgroup (LDW) at key points during the project. The LDW is composed of the 21 San Diego-area Copermittees and serves to develop and implement regional land development plans and programs necessary to support the requirements of the Regional MS4 Permit. The consultant team (Geosyntec Consultants and Rick Engineering Company) presented preliminary project assumptions and methodologies proposed to be used to develop the Regional WMAA to meet the requirements of the Regional MS4 Permit in December 2013. The consultant team incorporated workgroup feedback from this meeting and subsequently presented the preliminary Regional WMAA project results to the LDW in March 2014, again to receive direction and incorporate input on the preliminary results. Subsequently, the draft report was released to the public in July 2014, by a public workshop that included Consultation Panel members from each of the WMAs on July 29, 2014. This version of the report including all of the input described above is being issued for optional inclusion into the respective WQIP Provision B.3 submittals to the SDRWQCB in December 2014.

1.5. Report Organization

This report is organized as follows:

- Chapter 1 provides the project background and purpose;
- Chapter 2 describes the technical basis for characterizing the WMA;
- Chapter 3 describes the template that can be used by Copermittees to compile the list of candidate projects;
- Chapter 4 summarizes the analyses performed to support reinstating select exemptions from hydromodification control requirements for PDPs;
- Chapter 5 presents the WMAA conclusions;
- Chapter 6 presents the references used for the WMAA;
- Attachment A presents the exhibits and additional supporting information for watershed management area characterization;
- Attachment B presents the exhibits and additional supporting information for hydromodification management applicability/exemptions;
- Attachment C expands on the structure of the geodatabase that hosts the GIS data developed by the WMAA; and
- Attachment D provides a crosswalk between the Regional MS4 Permit requirements for WMAA and this report.

1.6. Terms of Reference

The work described in this report was conducted by Geosyntec Consultants (Geosyntec) and Rick Engineering Company (RICK) on behalf of the County of San Diego and the regional Copermittees.

2. Watershed Management Area Characterization

Watershed health and function are strongly influenced by hydrological and geomorphological processes occurring in the watershed. Both hydrological response and geomorphological response of the watershed are dependent on a variety of physical characteristics of the watershed. To this end, the Regional MS4 Permit specifies a set of data that is required to adequately characterize overall watershed processes as a foundation to enhancing integration and effectiveness of watershed management and water quality programs. The following GIS map layers were developed to characterize the hydrological and geomorphological processes within the San Diego River WMA:

- Dominant Hydrologic Processes: A description of dominant hydrologic processes, such as areas where infiltration or overland flow likely dominates;
- Stream Characterization: A description of existing streams in the watershed, including bed material and composition, and if they are perennial or ephemeral;
- Land Uses: Current and anticipated future land uses;
- Potential Critical Coarse Sediment Yield Areas; and
- Physical Structures: Locations of existing flood control structures and channel structures, such as stream armoring, constrictions, grade control structures, and hydromodification or flood management basins.

These GIS layers can be used to:

- Identify the nature and distribution of key macro-scale watershed processes;
- Identify potential opportunities and constraints for regional and sub-regional storm water management facilities that can play a critical role in meeting water quality, hydromodification, water supply, and/or habitat goals within the watershed;
- Assist with determining the most appropriate management actions for specific portions of the watershed; and
- Suggest where further study is appropriate.

2.1.Dominant Hydrologic Processes

The Regional MS4 Permit identifies in the provisions related to the WMAA that a description of dominant hydrologic processes within the watershed must be developed, with GIS layers (maps) as output. The Permit specifically calls for processes "*such as areas where infiltration or overland flow likely dominates*." These particular aspects of the hydrological mechanics of watersheds are particularly important when attempting to understand the macro-scale opportunities for locating projects that take advantage of either capturing overland flow for treatment or for infiltration.

Investigation of the dominant hydrologic processes in the San Diego-area watersheds indicates that evapotranspiration (ET) is the most dominant hydrologic process for the region based on review of a published study (Sanford and Selnick, 2013). ET is the sum of evaporation and plant transpiration in the hydrologic cycle that transports water from land surfaces to the atmosphere. This is conclusion is supported by comparing the 30-year average annual rainfall for the study area (San Diego County east of the peninsular divide) of between 15 and 18 inches per year (San Diego County, 2005) to the average annual ET rates. According to the California Irrigation Management Information System (CIMIS) Reference Evapotranspiration Map (CIMIS, 1999), the study area (within Zones 4, 6, and 9) experiences annual reference ET of 46.6, 49.7 and 59.9 inches, respectively. Therefore, theoretically, if all of the annual precipitation for the San Diego-area watersheds remained stationary where it fell and did not either infiltrate or runoff to local waterbodies where it would be conveyed downstream ultimately to the ocean, it all would be consumed by ET. As such, the effect of ET on the overall hydrologic processes within the San Diego watersheds is a function of the temporal scale over which it acts. Precipitation events often produce runoff in these watersheds, particularly in the urbanized portions, based on the topography and land cover that tend to accelerate the conveyance of runoff downstream rather than collecting, storing, or spreading out that then would maximize the effect of ET.

Because this study is focused on developing information and mapping for the portion of the hydrologic process that informs watershed management decisions, i.e., locating beneficial projects in areas of greatest opportunity, the next tier of dominant hydrologic processes are studied and mapped by this project. As such, the study area was characterized, based on the methodology described in the following section, according to the predicted fate of runoff within the watersheds being either overland flow or infiltration after considering the effects of ET (as well as an intermediate category of interflow). Areas that were mapped as overland flow do not necessarily preclude infiltration but rather indicate the dominant expected process that runoff would experience if not intercepted for the express purpose of infiltrating storm water runoff. The Model BMP Design Manual will provide more detailed guidance and procedures for determining the potential for infiltrating captured storm water at the project level irrespective of the mapping produced in the WMAA. To reiterate, the WMAA mapping is to provide macro-scale processes for high-level analysis and to inform decisions affecting regional scales. Furthermore, the Model BMP Design Manual will indicate the degree to which site-scale BMPs can expect to benefit from ET or how ET is considered in the sizing of BMPs. In brief, typical storm water BMPs only store water for a few days and therefore are not really capable of significant volume disposal through ET. However, pervious area dispersion (i.e., directing storm water runoff to flat areas for spreading and infiltration) has appreciable benefits with regard to ET and is a practice promoted in the BMP Design Manual.

The processes of interest are further defined as follows:

Overland flow: This process can be thought of as the inverse of infiltration; precipitation reaching the ground surface that does not immediately soak in must run over the land surface (thus, "overland" flow). It reflects the relative rates of rainfall intensity and the soil's infiltration capacity: wherever and whenever the rainfall intensity exceeds the soil's infiltration capacity, some overland flow will occur. Most uncompacted, vegetated soils have infiltration capacities of one to several inches per hour at the ground surface, which exceeds the rainfall intensity of even unusually intense storms. In contrast, pavement and hard surfaces reduce the effective infiltration capacity of the ground surface to zero, ensuring overland flow regardless of the meteorological attributes of a storm, together with a much faster rate of runoff relative to vegetated surfaces.

Infiltration and groundwater recharge: These closely linked hydrologic processes are most apparent near ephemeral and perennial conveyances in the San Diego region. Their widespread occurrence is expressed by the common absence of surface-water channels on even steep (undisturbed) hillslopes. Thus, on virtually any geologic material on all but the steepest slopes (or bare rock), infiltration of rainfall into the soil is inferred to be widespread, if not ubiquitous. With urbanization, changes to the process of infiltration are also quite simple to characterize: some (typically large) fraction of that once infiltrating water is now converted to overland flow.

Interflow: Interflow takes place following storm events as shallow subsurface flow (usually within 3 to 6 feet of the surface) occurring in a more permeable soil layer above a less permeable substrate. In the storm response of a stream, interflow provides a transition between the rapid response from surface runoff and much slower stream discharge from deeper groundwater. In some geologic settings, the distinction between "interflow" and "deep groundwater" is artificial and largely meaningless; in others, however, there is a strong physical discrimination between "shallow" and "deep" groundwater movement. Development reduces infiltration and thus interflow as discussed previously, as well as reducing the footprint of the area supporting interflow volume.

The datasets used, methodology for creating the dominant hydrologic processes maps, and the results are described in the sections below.

2.1.1. Datasets Used for identifying dominant hydrologic processes

The following datasets were used in the analysis:

Dataset	Source	Year	Description
Elevation	USGS	2013	1/3rd Arc Second (~10 meter cells) digital elevation model for San Diego County
Soils Data	SanGIS	2013	NRCS (SSURGO) Database for San Diego County downloaded from SanGIS
Land Cover	SanGIS	2013	Ecology-Vegetation layer for San Diego County downloaded from SanGIS

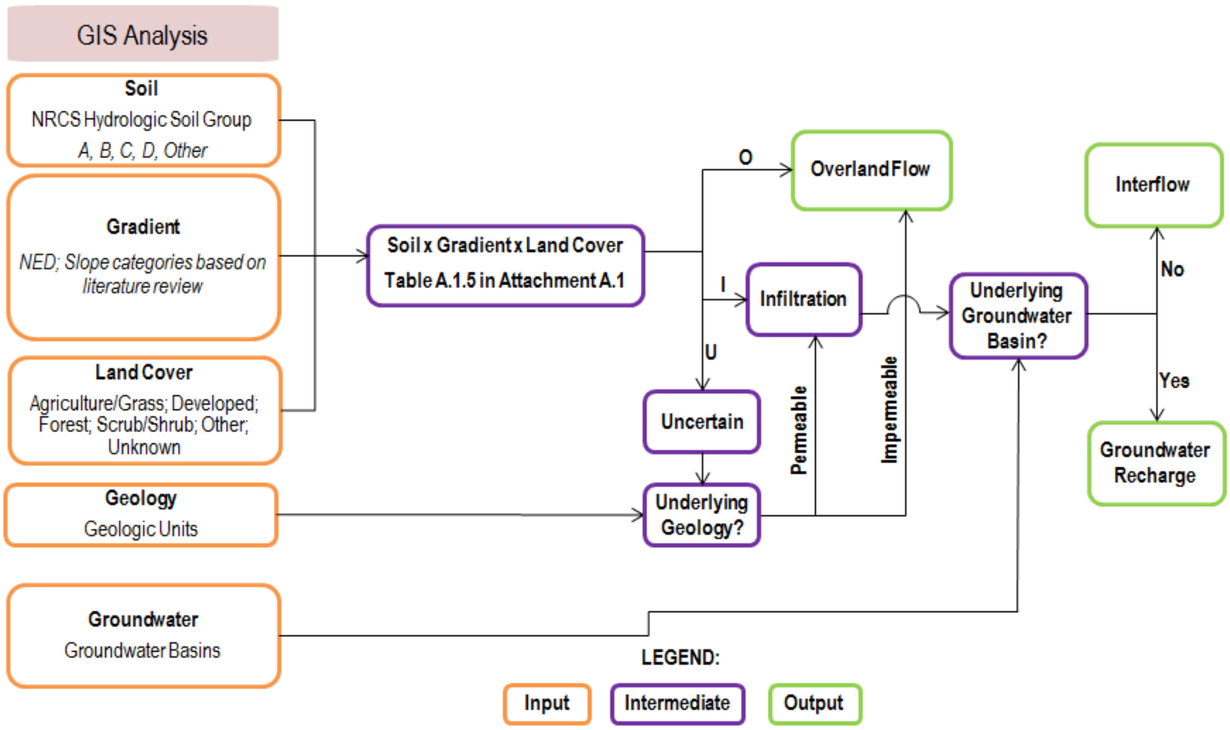
Dataset	Source	Year	Description
Geology	Kennedy, M.P., and Tan, S.S.	2002	Geologic Map of the Oceanside 30'x60' Quadrangle, California, California Geological Survey, Regional Geologic Map No. 2, 1:100,000 scale.
	Kennedy, M.P., and Tan, S.S.	2008	Geologic Map of the San Diego 30'x60' Quadrangle, California, California Geological Survey, Regional Geologic Map No. 3, 1:100,000 scale.
	Todd, V.R.	2004	Preliminary Geologic Map of the El Cajon 30'x60' Quadrangle, Southern California, United States Geological Survey, Southern California Aerial Mapping Project (SCAMP), Open File Report 2004-1361, 1:100,000 scale.
	Jennings et al.	2010	"Geologic Map of California," California Geological Survey, Map No. 2 – Geologic Map of California, 1:750,000 scale
Groundwater Basins	SanGIS	2013	Groundwater Basins in San Diego County downloaded from SanGIS

2.1.2. Methodology/Assumptions/Criteria for identifying dominant hydrologic processes

The methodology used to describe dominant hydrologic processes is based on recommendations included in the Southern California Coastal Water Research Project's (SCCWRP) Technical Report 605 titled "Hydromodification Screening Tools: GIS-Based Catchment Analyses of Potential Changes in Runoff and Sediment Discharge" (SCCWRP, 2010). The foundation for this analysis was to incorporate the Report's concept of grouping common hydrologic attributes into Hydrologic Response Units (HRUs). The report states the following:

> *"Grouping common hydrologic attributes across a watershed into a tractable number of Hydrologic Response Units (HRUs: a term first used by England and Holtan 1969) has become a well-established approach for condensing the near-infinite variability of a natural watershed into a tractable number of different elements. The normal procedure for developing HRUs is to identify presumptively similar rainfall–runoff characteristics across a watershed by combining spatially distributed climate, geology, soils, land use, and topographic data into areas that are approximately homogeneous in their hydrologic properties (Green and Cruise 1995, Becker and Braun 1999, Beven 2001, Haverkamp et al. 2005). As noted by Beighley et al (2005), this process of merging the landscape into discrete HRUs is a common and effective method for reducing model complexity and data requirements. Using watershed characteristics to predict runoff is the explicit task of hydrologic models, and there is a host of such models available for application to hydromodification evaluation. For purposes of "screening," however, the goal is simplicity and ease of application even if the precision of the resulting analysis is crude."*

The following process describes the methodology used to define Hydrologic Response Units (HRUs) and then relate the HRUs to the dominant hydrologic processes (i.e., overland flow, interflow, and groundwater recharge) in the San Diego River WMA.



The first step is to define the HRUs. Once these are defined, the remaining steps determine the dominant hydrologic process.

1. **Integrate data sets used to determine HRU**: Categories for soil type, gradient, and land cover were defined based on readily available GIS datasets for the region and classifications found in relevant literature, as indicated below. The different combinations of these three categories comprise the distinct HRUs.

   - **Soil Categories**: based on National Resource Conservation Service (NRCS) Hydrologic Soil Group (HSG) classifications, which are commonly used to describe runoff/infiltration potential of soils on a regional scale. These categories include: A, B, C, and D. HSG A soils have the lowest runoff potential, while HSG D soils have the highest runoff potential.

   - **Gradient Categories**: based on slope ranges found in a review of relevant literature identified in Chapter 6. The spatial processing of the slope categories utilized the United States Geologic Survey (USGS) National Elevation Dataset (NED). Slopes were grouped (bins) into the following ranges: 0% to 2%; 2% to 6%; 6% to 10%; and greater than 10%. The 2% and 6% slope thresholds were based on slope ranges included in Table A.1.1 (McCuen, 2005) presented in Attachment A.1. This table provides runoff coefficients as a function of slope, soil group, land cover, and return period and was used for subsequent steps in the mapping effort. The 10% slope threshold was used in SCCWRP's Technical

Report 605 (SCCWRP, 2010) and is a logical cutoff since slopes steeper than 10% are assumed to be dominated by overland flow.

- **Land Cover Categories**: were defined using the Ecology Vegetation GIS map layer developed by the City of San Diego, the County of San Diego and SANDAG and downloaded from SanGIS (2013). The vegetation categories in the GIS layer were grouped (Table A.1.2 in Attachment A.1) to match the following categories used in SCCWRP's Technical Report 605 (SCCWRP, 2010): Agriculture/Grass; Developed; Forest; Scrub/Shrub, Other (Water), and Unknown.

2. **Evaluate Land Cover**: Land cover categories for Agriculture/Grass, Forest, Scrub/Shrub and Other were related to land use categories defined in Table A.1.1 as shown in Table A.1.3 in Attachment A.1. Relating a land use category for the Developed land cover category was not necessary because all Developed cover was assumed to have overland flow as its dominant hydrologic process.

3. **Determine Hydrology Characteristics for Land Covers**: For each of the land cover/land use categories listed in Table A.1.3, the ratio of precipitation lost to evapotranspiration (i.e. an evapotranspiration coefficient) was estimated using Table A.1.1 using the process described below. Since precipitation is considered to be the sum of the resulting runoff, infiltration, and evapotranspiration, the coefficients for these three hydrologic pathways sum to one, as indicated below.

   Runoff Coefficient + Infiltration Coefficient + Evapotranspiration Coefficient = 1

   i) **Estimate Evapotranspiration**: To estimate the evapotranspiration (ET) coefficient for each land cover, first the runoff coefficient was identified in Table A.1.1 for the highest runoff potential (i.e., Group D soil and 6%+ slope) and most common storm conditions (i.e., storm recurrence intervals less than 25 years). The infiltration for these high runoff conditions was assumed to be negligible, resulting in an infiltration coefficient of zero. Since the sum of the three coefficients should sum to one, the ET coefficient was assumed to be the remaining difference (i.e., ET Coefficient = 1 – Runoff Coefficient). The ET coefficient calculated for the highest runoff potential was then applied to all soil types and slopes within that land use category. The calculated ET coefficient for each applicable HRU is provided in Table A.1.4 in Attachment A.1. The ET coefficient for HRUs that have a Developed land cover or a gradient greater than 10% were not calculated since these HRUs were assumed to have overland flow as the dominant hydrologic process.

   ii) **Estimate Infiltration**: The infiltration coefficient for each applicable HRU (i.e., combination of soil, gradient, and land cover) was estimated by subtracting both the runoff coefficient, provided in Table A.1.1, and the ET coefficient, calculated in step 3(i), from one (i.e., Infiltration Coefficient = 1 – Runoff Coefficient – ET Coefficient). The calculated infiltration coefficient for each applicable HRU is provided in Table A.1.4 in Attachment A.1.

   iii) **Estimate Runoff**: For each applicable HRU, the runoff coefficient was divided by the infiltration coefficient to obtain a ratio representing the potential for runoff or infiltration. The higher the ratio, the greater the potential for runoff to be a more dominant hydrologic process than infiltration. Similarly, the lower the ratio, the greater the potential for infiltration to be a more dominant hydrologic process than runoff. The calculated runoff to infiltration ratios are provided in Table A.1.4 in Attachment A.1.

4. **Associate Runoff and Infiltration to HRUs**: The following designations were assigned to each applicable HRU based on the runoff to infiltration ratio (i.e., runoff coefficient/infiltration coefficient). These designations were based on best engineering judgment with the underlying assumption that if a runoff or infiltration coefficient is more than 50% greater than its counterpart, then the prevailing process is considered dominant.

    - HRUs with runoff to infiltration ratios greater than 1.5 (3:2 ratio) were assumed to have relatively high runoff and overland flow was considered its dominant hydrologic process. These HRUs are designated by the letter "O" (Overland flow is dominant process) in Tables A.1.4 and A.1.5 in Attachment A.1.

    - HRUs with runoff to infiltration ratios less than 0.67 (2:3 ratio) were assumed to have relatively high infiltration and its dominant hydrologic process was either interflow or groundwater recharge, based on analysis described in subsequent steps. These HRUs are designated by the letter "I" (Interflow is dominant process) in Tables A.1.4 and A.1.5.

    - For HRUs with runoff to infiltration ratios between, and including, 1.5 and 0.67 it was uncertain whether it was dominated by overland flow or infiltration. These HRUs are designated by the letter "U" (Dominant process is uncertain) in Tables A.1.4 and A.1.5.

    - For HRUs that have a Developed land cover or a gradient greater than 10%, the runoff to infiltration ratios were not calculated because these HRUs were assumed to have overland flow as the dominant hydrologic process. These HRUs are designated by the letter "O" (Overland flow is dominant process) in Table A.1.5.

5. **Uncertain HRUs Assignment**: For HRUs with an uncertain designation ("U") in Table A.1.5 in Attachment A.1, the underlying regional geology (Kennedy and Tan, 2002 & 2008; Todd, 2004 and Jennings et al., 2010) was used to evaluate whether overland flow or infiltration were dominant. If the underlying geology was considered impermeable, then these uncertain areas were considered to have overland flow as its dominant hydrologic process. If the underlying geology was considered permeable, then these uncertain areas were considered to be dominated by infiltration. The determination of whether a geologic unit is impermeable or permeable was based on desktop evaluation and the best professional judgment of a Certified Engineering Geologist (CEG). This analysis was performed in GIS and is illustrated in the flowchart above.

6. **Associate Infiltration HRUs with Known Groundwater Basins**: For HRUs with relatively high infiltration and have a designation of “I” in Table A.1.5 in Attachment A.1, the presence or absence of a regional groundwater basin (SanGIS, 2013) underlying these areas determined whether the dominant hydrologic process was designated as interflow or groundwater recharge. The groundwater recharge hydrologic process was assigned as dominant for those applicable areas which had an underlying groundwater basin. The interflow hydrologic process was assigned as dominant for those applicable areas which did not have an underlying groundwater basin directly below it. This analysis was performed in GIS and is illustrated in the flowchart above.
7. **Resulting HRU Data:** The resulting GIS map of dominant hydrologic processes was reviewed by engineering professionals familiar with the hydrology in the County of San Diego to confirm that the mapping is consistent with their experience working in the region.

2.1.3. Results for identifying dominant hydrologic processes

The resulting GIS map showing the spatial distribution of dominant hydrologic processes (i.e., overland flow, interflow, and groundwater recharge) within the San Diego River WMA is provided in Attachment A.1. An ArcMap document which presents the results from each step of the methodology is included in Attachment C, as well as Google Earth KMZ file. Based on this analysis, overland flow is the predominant hydrologic process in this WMA, which is consistent with the experience of engineering professionals familiar with the hydrology of the County of San Diego.

Summary of Deliverables for Dominant Hydrologic Processes

Format	Item	Description	Location
Report	Figure	"Dominant Hydrologic Processes"	Attachment A.1
GIS	Map Group Title	Hydrologic Processes	Attachment C
	Map Layer Title	Soil Land Cover Slope Hydrologic Response Unit Initial Rating Permeability Groundwater Basin Dominant Hydrologic Processes	
	Geodatabase Feature Dataset	HydrologicProcesses	
	Geodatabase Feature Class	HRUAnalysis	
	Geodatabase Geometry Type	Polygon	
KMZ [1]	KMZ File Name	Dominant Hydrologic Processes	Attachment C

[1] To enhance the utilization of this data, the Dominant Hydrological Processes map is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zipped) file that can be viewed with the free download version of Google Earth (http://www.google.com/earth/).

2.1.4. Limitations for identifying dominant hydrologic processes

The resulting GIS map layer only lists the dominant hydrological process (i.e., an HRU assigned a dominant process of overland flow can also experience small amounts of infiltration) and provides a useful, rapid framework to perform screening-level analysis that is appropriate for watershed-scale planning studies. When more precise estimates are required for a particular site and subarea it is recommended that this analysis be augmented with site-specific analysis.

2.2.Stream Characterization

For the purpose of WMAA, the Regional MS4 Permit requires a description of existing streams in the watershed, including bed material and composition, and if they are perennial or ephemeral. Under the Regional WMAA, this analysis was prepared for 27 streams throughout the San Diego Region agreed upon by the consultant team and Copermittees. Within the San Diego River WMA, stream characterization and detailed mapping is provided for San Diego River, Sycamore Creek, Woodglen Vista Creek, San Vicente Creek, and Forester Creek as shown on the exhibit titled "Watershed Management Area Streams" located in Attachment A.2.

2.2.1. Datasets Used for stream characterization

The following data were referenced for the purpose of stream characterization:

- USGS National Hydrography Dataset, downloaded from USGS November 2013
- USGS 7.5-minute quadrangles, compiled image of quadrangles covering San Diego County, various dates
- Floodplains: "National Flood Hazard Layer," provided by Federal Emergency Management Agency October 2012
- Various datasets provided by Copermittees depicting existing storm water conveyance infrastructure within their jurisdictions.
- Aerial photography by Digital Globe dated 2012

2.2.2. Methodology/Assumptions/Criteria for stream characterization

The analysis was prepared by digitizing each of the 27 streams based on review of data listed above. Within the pre-existing datasets depicting streams, floodplains, or infrastructure, no single dataset included a complete, accurate alignment of each stream. Digitizing the streams based on review of all of the data listed above allowed creation of GIS linework with a continuous corrected alignment for each stream. The following data were recorded as GIS attributes for each stream as the stream was digitized:

- River name
- Reach type (engineered or natural, constrained or un-constrained)
- Bed material
- Bank material
- Hydrographic category (perennial or intermittent)

The attributes listed above were collected manually based on interpretation of the reference data. Assumptions used in making the interpretations are listed below. The ***Hydrographic Category*** section below will provide the rationale as to why perennial and intermittent were the hydrographic categories chosen for this WMAA and not perennial and ephemeral.

Note that stream classification was not prepared within areas of Federal/State/Indian lands unless data was readily available. Stream lines were prepared within these areas for continuity, but some data fields were not populated within these areas.

Reach Type

Streams were classified as either engineered or natural, and either constrained or un-constrained. See the exhibit titled, “Watershed Management Area Streams by Reach Type" in Attachment A.2. The purpose of this exercise was to identify whether the stream has been modified by human activity within the stream itself, which may include addition of crossing structures, stabilization of banks, dredging, or any other human activity. This aids the identification of physical structures including stream armoring, constrictions, grade control, and other modifications as required by the Regional MS4 Permit.

Classification of the streams as either “**engineered”** or **“natural”** was based on the following criteria:

Engineered

- A classification of "engineered" was assigned where the stream itself has been modified by human activity.
- All culvert/bridge/pipe crossings either provided in the Copermittes’ storm water conveyance system data or clearly visible on the aerial photo have been assigned as engineered within the limits of the crossing.
- If the Copermittees did not provide storm water conveyance system data for the dirt road crossings/dip sections the streams have been assigned as engineered within the limits of the crossing. These crossings may or may not have culverts.
- If the Copermittees’ storm water conveyance system data stated the facility is a detention or desilting basin, they were assigned as engineered.
- Golf courses have been assigned as engineered.
- If aerial photography showed large water bodies (lake, pond, irrigation pond, etc.) they were assigned as engineered.
- If the storm water conveyance system data provided by the Copermittees has identified the stream as “rockbs”, the assumption has been made that these streams have rocks on their bottom and the sides (“bs”), and have been assigned as engineered.
- Sand mining operations have been assigned as engineered. Sand mining is an operation that is in continuous flux and does not typically result in a discrete, engineered geometry in any given channel cross section until restoration is implemented at the conclusion of the sand mining operation. It is assigned as engineered to acknowledge human alteration of the stream.

Natural

- Streams that have no apparent alteration within the stream itself by human activity have been assigned as natural.

Classification of the streams as either **“constrained”** or **“un-constrained”** was based on the following criteria:

Constrained

- All culvers/bridge/pipe crossings either provided in the Copermittes' storm water conveyance system data or clearly visible on the aerial photo have been assigned as constrained.
- If the Copermittees did not provide storm water conveyance system data for the dirt road crossings/dip sections the streams have been assigned as constrained. These crossings may or may not have culverts.
- If the Copermittees' storm water conveyance system data stated the facility is a detention or desilting basin, they were assigned as constrained.
- Golf courses have been assigned as constrained if located within the Federal Emergency Management Agency (FEMA) floodway based on the "National Flood Hazard Layer" data.
- The USGS National Hydrographic Dataset in their hydrographic category had assigned some reaches as artificial paths. In these situations and if the aerial photography shows large water bodies (lake, pond, irrigation pond, etc.) these streams have been assigned as constrained.
- Sand mining operations located within the FEMA floodway based on the "National Flood Hazard Layer" have been assigned as constrained.

Un-constrained

- Golf courses have been assigned as un-constrained if not located within the FEMA floodway based on the "National Flood Hazard Layer" data.
- Sand mining operations not located within the FEMA floodway based on the "National Flood Hazard Layer" data have been assigned un-constrained.
- If the stream is located within the FEMA floodway based on the "National Flood Hazard Layer" and there is available land in the floodway fringe (the area between the floodway and the 100-yeaer floodplain) the area has been assigned un-constrained. Note that there may be only one side or both sides of the stream with available land in the floodway fringe therefore a note was added as to which side of the stream is constrained and un-constrained.
- If the stream is located within a FEMA 100-year floodplain based on the "National Flood Hazard Layer" data with no floodway and the FEMA floodplain width is not within an existing development or bordered by roads have been assigned as un-constrained.

Bed Material and Bank Material

The following bed and bank materials were identified:

- Concrete
- Riprap
- Pipe / culvert
- Earth

The assumptions made to identify the streams bed and bank materials were based on the following criteria:

- If the data provided by the Copermittees provided information about the stream bed and bank material, the provided data was used for the bed and bank material.
- Generally the data provided by the Copermittees did not identify the crossing type (pipe, box culvert, bridge with or without piers, etc.) or the material (RCP, RCB, earth, riprap, concrete, etc.). In that case, all culvert/bridge/pipe crossings were assigned as pipe/culvert for the bed and bank material.
- If the Copermittees did not provide data for the dirt road crossings/dip sections the bed and bank material have been assigned as pipe/culvert. These crossings may or may not have culverts.
- If the Copermittees' storm water conveyance system data stated the facility is a detention or desilting basin, the bed and bank material have been assigned as earth.
- If aerial photography showed large water bodies (lake, pond, irrigation pond, etc.) they were assigned as earth bed and bank material. The USGS National Hydrographic Dataset in their hydrographic category had assigned some of these types of reaches as artificial paths.
- Sand mining operations within the stream have been assigned as earth for bed and bank material.
- If the Copermittees did not provide data for the stream material the bed and bank material have been assigned based on the aerial photography.

See exhibits titled, "Watershed Management Area Streams by Bed Material" in Attachment A.2.

After stream bed and bank material was classified, earthen reaches were further classified by geologic group. This was accomplished by intersecting the streams with the geologic group layer that had been prepared for use in the dominant hydrologic process and potential coarse sediment yield analyses. The result is displayed in exhibits titled, "Watershed Management Area Streams by Geologic Group" in Attachment A.2.

Hydrographic Category

Streams were classified as "perennial" or "intermittent." See exhibits titled, "Watershed Management Area Streams by Hydrographic Category" in Attachment A.2. Classification was obtained from the USGS National Hydrography Dataset (NHD). The definitions of these categories in the USGS National Hydrography Dataset are:

- **Perennial**: Contains water throughout the year, except for infrequent periods of severe drought.
- **Intermittent**: Contains water for only part of the year, but more than just after rainstorms and at snowmelt.

While the specific Regional MS4 Permit language requested classification of perennial or ephemeral, rather than perennial or intermittent, the data that was referenced in order to classify streams did not include "ephemeral" streams. For reference, the USGS National Hydrography Dataset definition of "ephemeral" is: "contains water only during or after a local rainstorm or heavy snowmelt." None of the stream reaches in the study were classified as ephemeral in the NHD dataset, therefore none are classified as ephemeral in the WMAA product. The City of San Diego provided a map titled "City of San Diego Stream Survey" dated April 3, 2013 prepared by AMEC that shows streams that are "dry" and streams that are "flowing". This information in conjunction with the other parameters listed in this section was used to determine if a stream was perennial or intermittent.

USGS NHD includes hydrographic category classification for many of the streams. However data was not available for all reaches of all streams. In order to classify reaches of streams that did not already contain this data in NHD, these assumptions were made:

- The USGS NHD information for the stream hydrographic category has been used when available.
- When USGS NHD has "artificial paths" for portions of the stream, the hydrographic category of the upstream portion of the stream have been assigned to the stream unless other assumptions took precedence.
- If aerial photography shows large waterbody (lake, pond, irrigation pond, etc.) perennial has been assumed for the hydrographic category.
- For ponded areas shown on the aerial photography and if the USGS 7.5-minute quadrangles shows cross hatching for the area, intermittent has been assigned unless the upstream portion of the stream was assigned as perennial pursuant to the USGS National Hydrography Dataset then assigned perennial for the ponded area.
- USGS has a dashed line for intermittent streams. USGS has a solid line for perennial streams. In some situations this information was used to assist in the determination of assigning perennial or intermittent to a stream.

2.2.3. Results for stream characterization

The 27 streams and data are contained in a GIS file titled "SD_Regional_WMAA_Streams" located in Attachment C. The streams are shown in watershed maps included in Attachment A.2.

Summary of Deliverables for Stream Characterization

Format	Item	Description	Location
Report	Title of Figures	• "Watershed Management Area Streams" • "Watershed Management Area Streams by Hydrographic Category" • "Watershed Management Area Streams by Bed Material" • "Watershed Management Area Streams by Geologic Group" • "Watershed Management Area Streams by Reach	Attachment A.2

		Type"	
GIS	Map Group Title	Not Grouped	Attachment C
	Map Layer Title	SD_Regional_WMAA_Streams	
	Geodatabase Feature Dataset	Streams	
	Geodatabase Feature Class	SD_Regional_WMAA_Streams	
	Geodatabase Geometry Type	Line	
KMZ [1]	KMZ File Name	SD_Regional_WMAA_Streams	Attachment C
[1] To enhance the utilization of this data, the Stream Characterization map is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zipped) file that can be viewed with the free download version of Google Earth (http://www.google.com/earth/).			

In addition to the 27 streams that were subject of detailed analysis, NHD streams have been included on maps and within the geodatabase for reference. The NHD stream alignments have not been corrected and in some cases may be inconsistent with the existing infrastructure. The NHD streams are contained in a GIS file titled, "SD_NHD_Streams."

2.2.4. Limitations for stream characterization

- Only a desktop analysis was performed and no field verification was conducted.
- Infrastructure is only based on storm water conveyance system data provided by Copermittees or clearly visible on aerial photography. If the Copermittee used a numbering or lettering system for describing bed and bank material for example, since the metadata was not provided the bed and bank material could not be verified.
- In some instances concrete channels cannot be identified on aerial photography if it is filled with sediment and/ or vegetation.

2.3.Land Uses

For the purpose of the WMAA, the Regional MS4 Permit requires a description of current and anticipated future land uses. This is presented in the final GIS deliverable as "Land Use Planning" and includes the following representations of land uses in the watersheds: existing land uses, planned land uses, developable lands, redevelopment and infill areas, floodplains, Multiple Species Conservation Program (MSCP) designated areas, and areas not within the Copermittees' jurisdictions (tribal lands, state lands, and federal lands).

2.3.1. Datasets Used for land uses

The following existing regional datasets were referenced to meet this requirement:

- Municipal boundaries: "Municipal_Boundaries" dated August 2012, available from SanGIS/SANDAG
- Ownership: "Parcels" dated December 2013, available from SanGIS/SANDAG
- Existing land use: "SANGIS.LANDUSE_CURRENT" dated December 2012, available from SanGIS/SANDAG (existing land use)
- Planned land use: "PLANLU" (Planned Land Use for the Series 12 Regional Growth Forecast (2050)), dated December 2010, available from SanGIS/SANDAG
- Developable land: "DEVABLE" (Land available for potential development for the Series 12 Regional Growth Forecast), dated December 2010, available from SanGIS/SANDAG
- Redevelopment and infill areas: "REDEVINF" (Redevelopment and infill areas for the Series 12 Regional Growth Forecast), dated December 2010, available from SanGIS/SANDAG
- Floodplains: "National Flood Hazard Layer" provided by Federal Emergency Management Agency October 2012
- Multiple Species Conservation Program (MSCP), total of four datasets available from SanGIS/SANDAG: "MHPA_SD," dated 2012, (Multiple Habitat Planning Areas for City of San Diego); "MSCP_CN," dated 2009 (designations of the County of San Diego's Multiple Species Conservation Program South County Subregional Plan); "MSCP_EAST_DRAFT_CN," dated 2009 (draft East County MSCP Plan); and "Draft_North_County_MSCP_Version_8.0_Categories," dated 2008 (draft North County MSCP Plan)

2.3.2. Methodology/Assumptions/Criteria for land uses

The existing regional datasets for existing land use, planned land use, developable land, redevelopment and infill areas, floodplains, and MSCP designated areas were referenced with no modifications. Areas not within the Copermittees' jurisdictions (tribal lands, state lands, and federal lands) were compiled from SanGIS parcel data (December 2013) based on the "ownership" value. The owners listed below were excluded from the Copermittees jurisdictions and represent the "Federal/State/Indian" layer, which is displayed on various maps included in Attachment A.2.

- Bureau of Land Management
- California Department of Fish and Game
- Indian Reservations
- Military Reservations

- Other Federal
- State
- State of California Land Commission
- State Parks
- U.S. Fish and Wildlife Service
- U.S. Forest Service

When available, relevant data from these areas was included in analyses (e.g., developable land areas within Federal/State/Indian areas). Stream lines were prepared within these areas for continuity. However, stream classification (e.g., bed and bank material) was not prepared within these areas unless data was readily available (e.g., hydrographic category data available from NHD)

2.3.3. Results for land uses

The existing regional datasets are compiled into the Geodatabase in a group titled, "Land Use Planning." Current and anticipated future land uses are depicted in watershed maps included in Attachment C. Federal/State/Indian Lands are also referenced on all other map exhibits included in Attachment A.2.

Summary of Deliverables for Land Uses

<table>
<tr><th>Format</th><th>Item</th><th>Description</th><th>Location</th></tr>
<tr><td>Report</td><td>Title of Figures</td><td>• "Existing Land Use"
• "Planned Land Use"
• "Developable Land"
• "Redevelopment and Infill Areas"</td><td>Attachment A.3</td></tr>
<tr><td rowspan="4">GIS</td><td>Map Group Title</td><td>Land Use Planning</td><td rowspan="4">Attachment C</td></tr>
<tr><td>Map Layer Title</td><td>Municipal Boundaries
Federal/State/Indian Lands
SanGIS_ExistingLandUse
SanGIS_PlannedLandUse
SanGIS_DevelopableLand
SanGIS_RedevelopmentandInfill
FEMA Floodplain
MHPA_SD
MSCP_CN
MSCP_EAST_DRAFT_CN
Draft_North_County_MSCP_Version_8_Categories</td></tr>
<tr><td>Geodatabase Feature Dataset</td><td>LandUsePlanning</td></tr>
<tr><td>Geodatabase Feature Class</td><td>SanGIS_MunicipalBoundaries
Federal_State_Indian_Lands
SanGIS_ExistingLandUse
SanGIS_PlannedLandUse</td></tr>
</table>

		SanGIS_DevelopableLand SanGIS_RedevelopmentandInfill FEMA_NFHL SanGIS_MHPA_SD SanGIS_MSCP_CN SanGIS_MSCP_EAST_DRAFT_CN SanGIS_Draft_North_County_MSCP_Version_8_Categories	
	Geodatabase Geometry Type	Polygon	
KMZ [1]	KMZ File Name	Municipal Boundaries Federal/State/Indian Lands Floodplains Due to file size limitations, SanGIS land use datasets were not converted to KMZ.	Attachment C
[1] To enhance the utilization of this data, the Land Uses map is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zipped) file that can be viewed with the free download version of Google Earth (http://www.google.com/earth/).			

2.3.4. Limitations

Some jurisdictions may have compiled GIS land use layers that include more detailed or more current information than the regional datasets available from SanGIS. SanGIS layers were selected for the Regional WMAA to provide consistent land use characterization region-wide, and to provide for repeatability of GIS analyses when a land use layer is required for input data. The definition of non-Copermittee areas identified in this document as "Federal/State/Indian Lands" is for the Regional WMAA. Some WQIPs may define non-Copermittee areas differently.

2.4. Potential Critical Coarse Sediment Yield Areas

The Regional MS4 Permit identifies in the provisions related to the WMAA that potential coarse sediment yield areas within the watershed be identified, with GIS layers (maps) as output. With regard to the function and importance of coarse sediment, SCCWRP Technical Report 667 titled "Hydromodification Assessment and Management in California" states the following:

"Coarse sediment functions to naturally armor the stream bed and reduce the erosive forces associated with high flows. Absence of coarse sediment often results in erosion of in-channel substrate during high flows. In addition, coarse sediment contributes to formation of in-channel habitats necessary to support native flora and fauna."

This report identifies the potential critical coarse sediment yield areas for the San Diego River WMA in compliance with this permit provision. The applied datasets and methodologies for identifying the coarse sediment yield areas, along with their respective results, are described in the sections below.

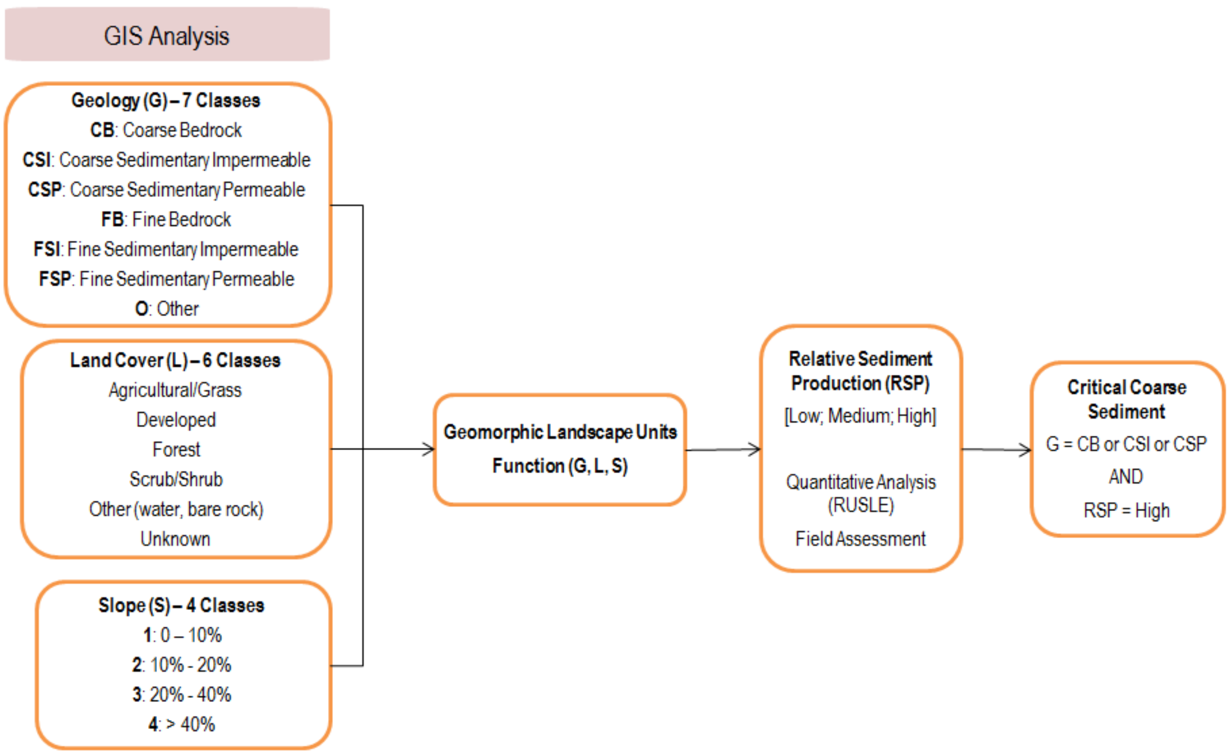
2.4.1. Datasets Used for identifying potential critical coarse sediment yield areas

The following datasets were used in the analysis

Dataset	Source	Year	Description
Elevation	USGS	2013	1/3rd Arc Second (~10 meter cells) digital elevation model for San Diego County
Land Cover	SanGIS	2013	Ecology-Vegetation layer for San Diego County downloaded from SanGIS
Geology	Kennedy, M.P., and Tan, S.S.	2002	Geologic Map of the Oceanside 30'x60' Quadrangle, California, California Geological Survey, Regional Geologic Map No. 2, 1:100,000 scale.
	Kennedy, M.P., and Tan, S.S.	2008	Geologic Map of the San Diego 30'x60' Quadrangle, California, California Geological Survey, Regional Geologic Map No. 3, 1:100,000 scale.
	Todd, V.R.	2004	Preliminary Geologic Map of the El Cajon 30'x60' Quadrangle, Southern California, United States Geological Survey, Southern California Areal Mapping Project (SCAMP), Open File Report 2004-1361, 1:100,000 scale.
	Jennings et al.	2010	"Geologic Map of California," California Geological Survey, Map No. 2 – Geologic Map of California, 1:750,000 scale

2.4.2. Methodology/Assumptions/Criteria for identifying potential critical coarse sediment yield areas

The methodology used to identify coarse sediment yield areas is based on Geomorphic Landscape Unit (GLU) methodology presented in the SCCWRP Technical Report 605 titled "Hydromodification Screening Tools: GIS-Based Catchment Analyses of Potential Changes in Runoff and Sediment Discharge" (SCCWRP, 2010). Geomorphic Landscape Units characterize the magnitude of sediment production from areas through three factors judged to exert the greatest influence on the variability on sediment-production rates: geology types, hillslope gradient, and land cover. The GLU approach provides a useful, rapid framework to identify sediment-delivery attributes of the watershed. The process to integrate these factors into GLUs is indicated in the flow chart below.



The following steps were used to define Geomorphic Landscape Units (GLUs), which were then related to the coarse sediment and critical coarse sediment yield areas in the San Diego River WMA.

1. **Integrate data sets used to determine GLU:** Categories for geology, gradient, and land cover were defined based on readily available GIS datasets for the region and classifications found in relevant literature listed in Chapter 6. The different combinations of these categories make up distinct GLUs.

    - **Geologic Categories**: based on methodology listed in Attachment A.4.1 of Attachment A.4. Resulting geologic categories from this analysis are: Coarse Bedrock (CB), Coarse Sedimentary Impermeable (CSI), Coarse Sedimentary Permeable (CSP), Fine Bedrock (FB), Fine Sedimentary Impermeable (FSI), Fine Sedimentary

Permeable (FSP), and Other (O). An exhibit showing the regional geology groupings is presented in Attachment A.4.

- **Land cover categories**: defined using the Ecology Vegetation GIS map layer developed by the City of San Diego, the County of San Diego and SANDAG which were downloaded from SanGIS (2013). The vegetation categories in the GIS layer were grouped (Table A.1.2 in Attachment A.1) to match the following categories used in SCCWRP's Technical Report 605 (SCCWRP, 2010): Agriculture/Grass; Developed; Forest; Scrub/Shrub, Other (Water) and Unknown.

- **Gradient Categories**: based on slope ranges found in a review of relevant literature (GLU methodology applied in California) listed in Chapter 6. The spatial processing of the slope categories utilized the USGS National Elevation Dataset (NED). Slope ranges used include: 0% to 10%, 10% to 20%, 20% to 40%, and greater than 40%.

2. **GLU Union Results**: GIS mapping exercise for the study area resulted in 166 GLUs within the 9 WMAs in San Diego County. Table A.4.2 in Attachment A.4 provides the list of the 166 GLUs.

For implementing hydromodification management performance standards in the Regional MS4 Permit, the Copermittees need to identify Critical Coarse Sediment Yield areas in the study region. To provide information on the identification of Critical Coarse Sediment yield, the study assumed that critical coarse sediment would be generated from GLUs that are composed of geologic units likely to generate coarse sediment (based on the methodology listed in Step 3) and have the potential for high relative sediment production (as estimated using the methodology listed in Step 4).

3. **Define Pertinent Geologic groups**: the geologic groups (Attachment A.4.1) considered in this study to have the potential to generate coarse sediment are Coarse Bedrock (CB), Coarse Sedimentary Impermeable (CSI), and Coarse Sedimentary Permeable (CSP). An exhibit showing the regional geologic grouping is presented in Attachment A.4.

4. **Relate GLU to Sediment Production**: For assigning GLUs with a relative sediment production, the following methodology was utilized:

    - Conducted quantitative analysis to assign relative sediment production. Analysis was performed based on the assumption that sediment production from an area is proportional to the soil loss from the area, as evaluated using standard soil loss equation. Detailed analysis steps are documented in Attachment A.4.2;

    - To validate the quantitative assignment above, a qualitative field assessment was conducted for 40 sites. Site selection and findings from the field assessment is documented in Attachment A.4.3.

    - The result of the field assessment indicated a 65% match between field conditions and the quantitative assignments. The mismatches are attributed to differences in percent land cover as assumed for the quantitative analysis and those observed in the field. As such, the quantitative assignments were considered to be valid for the purposes of assigning relative sediment production.

2.4.3. Results for identifying potential coarse sediment yield areas

The resulting GIS maps showing the spatial distribution of geologic grouping and critical coarse sediment yield areas within the San Diego River WMA are provided in Attachment A.4. An ArcMap document which presents the results from each step of the methodology is included in Attachment C. Based on this analysis it was estimated that 22.8% of the study area is a potential critical coarse sediment yield area.

As a result of the regional-scale datasets, and commensurate data resolution, used to map the potential critical coarse sediment yield areas, some areas may have been mapped that in reality do not produce critical coarse sediment as they are existing developed areas. As such, an opportunity for jurisdictions to incorporate more refined data into the preliminary WMAA GIS dataset based on local knowledge and review of current aerial images was provided. The County of San Diego provided augmented data in the San Diego River WMA within the unincorporated jurisdictional area.

Summary of Deliverables for Potential Coarse Sediment Yield Areas

Format	Item	Description	Location
Report	Figures	“Geologic Grouping” "Potential Critical Coarse Sediment Yield Areas"	Attachment A.4
GIS	Map Group Layer Name	Potential Coarse Sediment Yield	Attachment C
	Map Layer Title	Geologic Grouping Land Cover Slope Category Geomorphic Landscape Unit Potential Coarse Sediment Yield Area Relative Sediment Production Potential Critical Coarse Sediment Yield Area	
	Geodatabase Feature Dataset	PotentialCoarseSedimentYield	
	Geodatabase Feature Class	GLUAnalysis PotentialCoarseSedimentYieldAreas PotentialCriticalCoarseSedimentYieldAreas	
	Geodatabase Geometry Type	Polygon	
KMZ [1]	KMZ File Name	Potential Critical Coarse Sediment Yield Areas	Attachment C

[1] To enhance the utilization of this data, the Geomorphic Landscape Unit Analysis is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zipped) file that can be viewed with the free download version of Google Earth (http://www.google.com/earth/).

2.4.4. Limitations for identifying potential critical coarse sediment yield areas

The resulting GIS layers were developed using regional datasets and provide a useful, rapid framework to perform screening-level analysis that is appropriate for watershed-scale planning studies. The methodology used to identify potential coarse sediment yield areas does not account for instream sediment supply and sediment production from mass failures like landslides which are difficult to estimate on a regional scale without performing extensive field investigation. This data set also does not account for potential existing impediments that may hinder delivery of coarse sediment to receiving waters or downstream locations within the watershed as this was beyond the scope of a regional study. Where more precise estimates are required for a particular site or subarea it is recommended that this analysis be augmented with site-specific analysis. It is also recognized that this regional data set is a function of the inherent data resolution and therefore may not conform to all site conditions, or does not reflect changes to particular areas that have occurred since the underlying data was developed. As such, the WMAA data for the potential critical coarse sediment yield areas should be verified in the field according to the procedures outlined in the Model BMP Design Manual and/or jurisdiction specific BMP Design Manual.

2.5.Physical Structures

The Regional MS4 Permit requires the Copermittees to identify information regarding locations of existing flood control structures and channel structures, such as stream armoring, constrictions, grade control structures, and hydromodification or flood management basins with GIS layers (maps) as output, for each WMA being analyzed for the purpose of developing watershed-specific requirements for structural BMP implementation. This study identified the physical structures using a desktop-level analysis for the stream(s) identified in Section 2.2 in compliance with this permit provision.

2.5.1. Approach for identifying physical structures

The intent of this portion of the WMAA project was to provide an initial assessment of the structures of interest for the stream(s) identified in Section 2.2. This desktop-level analysis was conducted primarily as a visual survey of aerial imagery and FEMA flood insurance study (FIS) profiles where available. The collected information was entered into a GIS layer for inclusion into the overall WMAA geodatabase containing the characterization layers required by the Regional MS4 Permit. To support overall WMA characterization, the information derived in this task provides insight into water and sediment movement through the watershed (SCCWRP, 2012), the opportunities and limitations for infrastructure retrofits and also informs efforts to identify appropriate locations for habitat or riparian area rehabilitation in relation to proximate infrastructure. Specific information regarding how the survey was performed and the attributes of the generated data is presented in Attachment A.5. Note that concrete channels, pipes/culverts, riprap or other artificial stream armoring, and basins have also been identified in the linework generated for the streams (see Section 2.2).

2.5.2. Results for identifying physical structures

The resulting GIS mapping provided in Attachment A.5 shows the spatial locations of the physical structures within the mapped stream(s).

Summary of Deliverables for Physical Structures

Format	Item	Description	Location
Report	Figure	Watershed Management Area Streams by Reach Type with Channel Structures	Attachment A.5
GIS	Map Group Layer Name	Channel Structures	Attachment C.1
	Map Layer Title	Channel Structures	
	Geodatabase Feature Dataset	ChannelStructures	
	Geodatabase Feature Class	ChannelStructures	
	Geodatabase Geometry Type	Point	
KMZ [1]	Kmz File Name	ChannelStructures	Attachment C.2

[1] To enhance the utilization of this data, the Physical Structures map is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zipped) file that can be viewed with the free download version of Google Earth (http://www.google.com/earth/).

3. Template for Candidate Project List

The Regional MS4 Permit requires each WMA to use the results from the WMA characterization to compile a list of candidate projects that could potentially be used as alternative compliance options for Priority Development Projects should an agency or jurisdiction opt to develop an alternative compliance program. Copermittees must first conclude that implementing such a candidate project would provide greater overall benefit to the watershed than requiring implementation of structural BMPs onsite prior to implementing these candidate projects as alternative compliance projects.

The Copermittees elected to identify potential candidate projects as a separate effort from this regional project, and therefore the process for identifying candidate projects is not documented in this report. Instead, this project only developed a template, in a spreadsheet format, for use by the Copermittees to compile lists of potential candidate projects. The template is intended to enhance regional consistency of the information that is gathered for candidate projects. The template spreadsheet file was distributed to the Copermittees on January 28, 2014. A table of the template components is indicated below:

Column	Primary Heading	Secondary Heading	Guidance for Completing the Project List
A	Project Identifier	-	Unique identifier for the project.
B	Watershed Management Area	-	Dropdown menu to select the watershed management area the project is located in
C	Hydrologic Area (HA)	-	Dropdown menu to select the hydrologic area the project is located in Select a WMA in column B for HA (Column C) dropdown menu to activate.
D	Hydrologic Subarea (HSA)	-	Dropdown menu to select the hydrologic subarea the project is located in. Select a HA in column C for HSA (Column D) dropdown menu to activate.
E	Jurisdiction	-	Dropdown menu to select the jurisdiction the project is located in. Select a HSA in column D for Jurisdiction (Column E) dropdown menu to activate.
F	Project Name	-	Indicate the name of the project.
G	Ownership	Type	Dropdown menu to select if the project is a public project, private project, or public-private partnership.
H	Ownership	Ownership Information	List the details for the owner.
I	Project Location	Address	List the address of the project site.
J	Project Location	APN	List the APN of the parcel.
K	Project Location	Latitude	List the latitude of the project site.
L	Project Location	Longitude	List the longitude of the project site.

Column	Primary Heading	Secondary Heading	Guidance for Completing the Project List
M	Project Origination/ Originator	Name	List the name of the report/organization/individual that provided the idea for the project. Potential origination sources: WQIP, WMAA, JURMPs, WURMPs, CLRPs, IRWM, MSCP, MHPA, Other.
N	Project Origination/ Originator	Contact Information	Link or report title if the proposed project is from a report [or] contact information if from an organization/individual.
O	Project Category	-	Drop Down menu to select the project category; In addition to the 6 project categories explicitly listed in the Regional MS4 Permit, the drop down menu also has a category "Other project types allowed by the MS4 Permit". Example for "Other" project types are agency CIP programs such as Green Streets, LID conversions (medians, parks), agency filter installation, etc.
P	Specific Project Type	-	List the subcategory of the project; for example, list Regional BMP type (i.e. infiltration basin, wetland, etc.).
Q	Potential Pollutant	-	Identify the potential pollutant(s) that can be treated by the proposed project.
R	Project Size & Parameters	Contributing Drainage Area (acres)	List the contributing drainage area to the project.
S	Project Size & Parameters	Parcel Size (acres)	List the size of the parcel the project is located on.
T	Project Size & Parameters	Project Footprint (acres)	List the size of the project footprint.
U	Project Size & Parameters	Parameters (with units as necessary)	Parameters needed to quantify benefits from the project; i.e. for an infiltration basin, list the water quality volume, long-term infiltration rate, depth of the basin, etc.
V	Regulatory Requirement	-	Indicate if the project is proposed to meet particular regulatory requirement such as TMDL, etc.
W	Project Timeline	-	Indicate if a project must be implemented by certain date to meet a grant deadline or other time commitment.
X	Other Notes	-	List any other relevant notes; for example, when retrofitting existing infrastructure project category is selected, input parameters needed to quantify benefits from existing infrastructure into this column as these will be needed to estimate additional benefits that can be used for alternative compliance. If N/A is selected in any dropdown menus, add additional explanation in here

4. Hydromodification Management Applicability/Exemptions

Hydromodification, which is caused by both altered storm water flow and altered sediment flow regimes, is largely responsible for degradation of creeks, streams, and associated habitats in the San Diego Region. The purpose of the hydromodification management requirements in the Regional MS4 Permit is to maintain or restore more natural hydrologic flow regimes to prevent accelerated, unnatural erosion in downstream receiving waters.

In some cases, priority development projects may be exempt from hydromodification management requirements if the project site discharges runoff to receiving waters that are not susceptible to erosion (e.g., a lake, bay, or the Pacific Ocean) either directly or via hardened systems including concrete-lined channels or existing underground storm drain systems.

The March 2011 Final Hydromodification Management Plan (HMP) identified certain exemptions from hydromodification management requirements by presenting "HMP applicability criteria." The Regional MS4 Permit maintains some of these HMP applicability criteria. However, some of the applicability criteria are not included under the Regional MS4 Permit unless the area or receiving water is mapped in the WMAA. The intent of this Section is to provide mapping of areas exempt from hydromodification management requirements, and provide supporting technical analyses for exemptions that are recommended by the WMAA.

4.1. Additional Analysis for Hydromodification Management Exemptions

This section documents additional analysis performed to further evaluate the following exemptions that were already approved by the San Diego Regional Board with the 2011 Final HMP. This study only provides additional analysis, data, and rationale for supporting or eliminating the following existing exemptions and does not propose or study any new exemptions.

- Exempt River Reaches
- Stabilized Conveyance Systems Draining to Exempt Water Bodies
- Highly Impervious Watersheds and Urban Infill and
- Tidally Influenced Lagoons

4.1.1. Exempt River Reaches

4.1.1.1. History

The March 2011 Final HMP, approved by the SDRWQCB under the 2007 MS4 Permit, provided a potential exemption from hydromodification management requirements for projects discharging runoff directly to certain major river reaches, including a reach of the San Diego River, provided that the outlet elevation of the project's outfall(s) to an identified exempt river reach are between the river bottom elevation and the 100-year floodplain elevation, and properly sized energy dissipation is provided at the outfall(s).

Exempt river system/reach from the 2011 Final HMP:

River	Downstream Limit	Upstream Limit
San Diego River	Outfall to Pacific Ocean	Confluence with San Vicente Creek

Exemptions related to runoff discharging directly to the above river reach was based on the flow duration analysis performed for the San Diego River in the Final HMP and the Technical Advisory Committee (formed to provide input on the development of the Final HMP) members' opinion (based on field observations and years of historical perspective) that the above river reach have very low gradients, were depositional (aggrading), have very wide floodplain areas when in the natural condition and that the effects of cumulative watershed impacts to this reach is minimal provided that properly sized energy dissipation is provided at outfalls to the river.

4.1.1.2. Status under 2013 Regional MS4 Permit

Under the Regional MS4 Permit, exempt river reaches would not qualify for exemption from hydromodification management controls unless the optional WMAA is developed with additional rationale/analyses to support reinstating exemptions to these river reaches. Additional analysis performed as part of the WMAA to evaluate hydromodification management control exemptions to the previously exempt reaches is presented below.

4.1.1.3. Research, Approach and Results

Hydromodification impacts can be caused due to increase in flows, changes in sediment transport capacity and changes in sediment supply to the streams (SCCWRP, 2012). In order to evaluate the cumulative impacts due to development and determine if hydromodification management exemption can be reinstated for the river reach that was exempt in the previous permit term erosion potential (Ep) analysis was used to evaluate the increase in flows and changes in sediment transport capacity. In addition, sediment supply potential (Sp) analysis was used to evaluate the changes in sediment supply in this study. In regards to Ep analysis SCCWRP Technical Report 667 "Hydromodification Assessment and Management in California" states:

> *"The underlying premise of the erosion potential approach advances the concept of flow duration control by addressing in-stream processes related to sediment transport. An erosion potential calculation combines flow parameters with stream geometry to assess long term (decadal) changes in the sediment transport capacity. The cumulative distribution of shear stress, specific stream power and sediment transport capacity across the entire range of relevant flows can be calculated and expressed using an erosion*

potential metric, Ep (e.g., Bledsoe, 2002).”

The approach used in this study is explained in detail in Attachment B.1.1.1. The following WMA characterization maps developed in Section 2 were used to select inputs for the exempt river reach analysis:

- Planning land use layers from Section 2.3 were used to estimate the existing impervious area and identify the developable parcels in each watershed. A GIS exercise was performed to identify the developable parcels in each watershed that will be exempt from hydromodification management requirements if the exemption is granted.
- Stream type classification analysis from Section 2.2 was used to select a conservative cross section (segments that are assigned naturally constrained) to be used in analysis for each watershed
- GLU analysis and its associated quantitative analysis described in Section 2.4 were used to determine Sp metric for each watershed. In this study coarse sediment supply changes were limited to changes in hill slope erosion between existing condition and future condition (for parcels that are proposed to be exempt from hydromodification management) of the watershed. It was assumed that the changes in instream sediment supply between existing and future condition for these large depositional river systems are very minimal.

Selection of inputs for the analysis is explained in detail in Attachment B.1.1.2 and results from the analysis are presented in Attachment B.1.1.3 in tabular format. The Ep analysis performed in this study does not account for the following Regional MS4 permit requirements as a conservative assumption. If accounted for, it will result in a smaller Ep than what is currently reported in Attachment B.1.1.3:

- New development priority development projects including projects that are proposed to be exempt from hydromodification management requirements through this WMAA study must implement retention BMPs to the extent feasible if alternative compliance option is not selected or not available.
- Redevelopment priority development projects must mitigate to the pre-developed condition

4.1.1.4. Recommendation

Based on the results from this study reported in Attachment B.1.1.3, the flow duration analysis performed in the Final HMP, and the Technical Advisory Committee (TAC) recommendations provided during the Final HMP development, it is recommended that hydromodification management exemption be reinstated for projects discharging runoff directly to the following exempt river reach:

River	Downstream Limit	Upstream Limit
San Diego River	Outfall to Pacific Ocean	Confluence with San Vicente Creek

Each municipality must define/approve “direct discharge” based on the project site conditions.

To qualify for the potential exemption, the outlet elevation must be between the river bottom elevation and the 100-year floodplain elevation and properly designed energy dissipation must be provided. Mapping of these exempt river reaches is presented in Attachment B.2.

4.1.1.5. Limitations

The analysis and associated recommendations as presented above were based on instream erosion as the primary consideration to support reinstatement of exemptions from hydromodification management controls for discharges directly to these river reaches. While it is recognized that other factors contribute to adverse impacts (e.g., salinity imbalance, pollutants) to instream habitat and resulting biotic integrity, hydromodification management control has traditionally been considered an "umbrella process" that encompasses most of the highest risk stressors (percent sands and fines present, channel alteration, and riparian disturbance) to physical habitat. Beyond demonstrating that instream erosion is not anticipated as a result of reinstating hydromodification management control exemptions for discharges to these river reaches, a focused method for correlating physical and biotic integrity to modified hydrological conditions has not been performed in this analysis, as an assessment method has not yet been developed.

The current assessment methods may yield inconclusive results when attempting to identify causal relationships between degraded instream habitat solely due to increased flows and erosive force from hydromodification. A causal assessment recently conducted in the lower reaches of the San Diego River, conducted as a partnership between the Southern California Coastal Water Research Project (SCCWRP), the City of San Diego, the County of San Diego, and the San Diego RWQCB, focused on stressors potentially responsible for known biological impairment of the river. Once the data of the causal assessment become available, it may be useful in classifying the potential stressors such as altered physical habitat as likely, unlikely, or an uncertain cause to biological impairment.

With respect to adverse impacts to habitat as a result of pollutants entrained in storm water discharges, these areas will still be subject over time to the pollutant control requirements of the Regional MS4 Permit as areas develop or redevelop. The current requirements obligate development to maximize retention of the design storm volume which will mitigate a portion of the volume that would otherwise be controlled with hydromodification management BMPs. In some cases, this offsetting of volume reduction through pollutant control BMPs may exceed the HMP volumes. In addition, the development that occurs within the exempted watershed areas is still required to provide any applicable flood control measures. Risk of flooding as a result of exemption from hydromodification controls is unlikely as the control thresholds are significantly lower (order of magnitude) than flood control requirements implemented to protect life and property.

4.1.2. Stabilized Conveyance Systems Draining to Exempt Water Bodies

4.1.2.1. History

The March 2011 Final HMP, approved by the SDRWQCB under the 2007 MS4 Permit, provided a potential exemption from hydromodification management requirements for projects discharging runoff directly to hardened or rehabilitated systems that extend to exempt receiving waters. As described in the HMP, hardened or rehabilitated systems could include existing storm drain systems, existing concrete channels, or stable engineered unlined channels. To qualify for this exemption, the existing hardened or rehabilitated conveyance system must continue uninterrupted to the exempt system. In other words, the hardened or rehabilitated conveyance system cannot discharge to an unlined, non-engineered channel segment prior to discharge to the exempt system. Additionally, the project proponent must demonstrate that the hardened or rehabilitated conveyance system has capacity to convey the 10-year ultimate condition flow through the conveyance system. The 10-year flow should be calculated based upon single-event hydrologic criteria as detailed in the San Diego County Hydrology Manual.

This exemption was consistent with 2007 MS4 Permit language allowing exemption for discharges into "channels that are concrete-lined or significantly hardened (e.g., with rip-rap, sackrete, etc.) downstream to their outfall in bays or the ocean." The HMP language also allowed for channels stabilized by soft methods such as turf reinforcement mat or vegetation to be considered for exemption. Under these criteria, an engineered channel that is stabilized with riprap, turf reinforcement mat, vegetation, or other materials other than concrete could be determined to be exempt from hydromodification management requirements, pending demonstrating that it has capacity to convey the 10-year ultimate condition flow.

4.1.2.2. Status under 2013 Regional MS4 Permit

A significant change under the Regional MS4 Permit is the requirement that exempt systems draining to exempt water bodies either be "existing underground storm drain systems," or "conveyance channels whose bed and banks are concrete lined" all the way to exempt water bodies. The Regional MS4 Permit language does not include engineered channels that are stabilized with materials other than concrete, such as riprap, turf reinforcement mat, or vegetation. However, areas identified by Copermittees as appropriate for an exemption may be identified in the optional WMAA incorporated into the WQIP.

4.1.2.3. Research and Results

To provide a process for engineered channels that are stabilized with materials other than concrete, such as riprap, turf reinforcement mat, or vegetation to be identified in the WMAAs, an example study was prepared for an existing engineered channel stabilized with vegetation. The study demonstrates that a channel stabilized with materials other than concrete can be stable or have minimal potential for erosion. In order to allow for other channels that are stabilized with materials other than concrete to be identified in each WMAA, criteria for defining what is "stable" or "minimal potential for erosion" was determined.

Forester Creek in the City of Santee was selected for the sample channel analysis. Forester Creek is stabilized with vegetation from its confluence with the San Diego River downstream to Prospect Avenue upstream. For the purpose of this discussion, the confluence is the location where the floodplain of Forester Creek meets the San Diego River floodplain, just west of Gorge

Avenue and Willowgrove Avenue, at the eastern side of the Carlton Oaks Golf Course. Stabilization occurred in two separate projects. The reach from the San Diego River confluence downstream to Mission Gorge Road upstream was constructed in 1990. The reach from Mission Gorge Road downstream to Prospect Avenue upstream is known as the Forester Creek Improvement Project and was constructed in 2006-2007. Forester Creek includes energy dissipators stabilized with riprap, concrete, and articulated concrete block at Mission Gorge Road undercrossing and Prospect Avenue undercrossing. Other than at bridge crossings, the engineered un-lined reach of Forester Creek is stabilized with native vegetation. There is dense growth of trees in the channel.

Vegetation in Forester Creek Downstream of Mission Gorge Road

Vegetation in Forester Creek Upstream of Mission Gorge Road between Mission Gorge Road and State Route 52

Vegetation in Forester Creek between State Route 52 and Olive Lane

Upstream of Prospect Avenue, Forester Creek is a concrete-lined channel serving an urban area that is almost fully built out and served by existing underground storm drain systems and concrete-lined channels. Because of the vegetated reaches of Forester Creek extending to the San Diego River, the concrete-lined portion of Forester Creek and tributary underground storm drain systems and concrete-lined channels are not exempt from hydromodification management requirements unless the vegetated reaches of Forester Creek are identified in the optional WMAA incorporated into the WQIP.

An erosion potential analysis was prepared for the vegetated reaches of Forester Creek. An erosion potential analysis compares cumulative excess shear stress over all flows capable of transporting the channel-bed material from post-development to pre-development condition. The analysis used the same methods for determining erosion potential as presented in Section 4.1.1 and Attachment B.1.1 for the major river reaches.

For the purpose of determining flow rates and durations (hydrologic analysis), a regional scaling procedure developed by Hawley & Bledsoe in 2011 was used, the same method as presented in Section 4.1.1 and Attachment B.1.1 for the major river reaches. The method uses Duration Density Functions (DDFs) presented in the 2011 paper, "How do flow peaks and durations change in suburbanizing semi-arid watersheds? A southern California case study, “to estimate cumulative durations for geomorphically-effective flows in a logarithmically-binned histogram format. Using these flows, long-term sediment transport can be subsequently estimated. The analysis requires the following data, summarized below.

Summary of Input Data for Hydrologic Calculations for Forester Creek Erosion Potential Analysis

Data	Units	Forester Creek Watershed Existing Condition	Forester Creek Watershed Future Condition
Tributary Area, A	square miles (mi^2)	23.36	23.36
Mean Annual Precipitation, MAP	inches	14	14
Length of Daily Flow Record	Years	30	30
Minimum Flow Rate	cubic feet per second	0.01	0.01
Number of Flow Bins	--	25	25
Impervious Cover	mi^2/ mi^2	0.4634	0.4792

Impervious cover for the Forester Creek watershed was determined by assigning land-use specific imperviousness values to the land use categories presented in the SanGIS land use data sets (existing land use in 2012 and planned land use, described in Chapter 2.3). The composite imperviousness of the watershed was then calculated based on the existing condition and future condition land use distribution within the watershed. The Forester Creek watershed is nearly fully built out therefore there is little change in imperviousness from existing to future condition. Impervious area calculations for the Forester Creek watershed are provided in Attachment B.1.2.

For the purpose of determining shear stress in the channel (hydraulic analysis), normal depth calculations for the binned flow rates determined from the DDF analysis were prepared for two channel cross sections. One cross section was taken in the reach constructed in 1990, and one cross section in the Forester Creek Improvement Project reach. For each reach, the cross section expected to experience the greatest shear stress was selected, based on channel width and slope. The analysis requires the following data, summarized below.

Summary of Input Data for Hydraulic Calculations for Forester Creek Erosion Potential Analysis

Data	Units	Forester Creek Watershed Cross Section 1300	Forester Creek Watershed Cross Section 2475
Channel Bottom Width, b	feet	84	155
Channel Side Slopes, z1 and z2	Horizontal:Vertical	z1 = 1.5:1 z2 = 2:1	z1 = z2 = 2:1
Channel Slope	foot/foot	0.006	0.003
Channel Roughness (Manning's n)	--	0.100	0.100
Critical Shear Stress	pounds per square foot (lb/ft^2)	2.1	2.1

Critical shear stress for the reaches was estimated to be greater than or equal to 2.1 pounds per square foot (lb/ft2), based on review of permissible shear stress values presented in "Stability Thresholds for Stream Restoration Materials" (Fischenich 2001) and "Streambank Soil Bioengineering Considerations for Semi-Arid Climates" (Hoag and Fripp 2005). Based on Fischenich 2001, permissible shear stress for "live willow stakes" is approximately 2.10 to 3.10 lb/ft2.

The analysis results, presented in Attachment B.1.2, show that for both the existing and future condition, the shear stress for all geomorphically-effective flows based on the DDF analysis is less than the estimated critical shear stress of 2.1 lb/ft2. This means that no excess shear stress or "work" occurs in the channel in either the existing or future condition. Therefore, there is no increase in the duration of "work" (cumulative work), in the future condition, and erosion potential is 1.0.

Note that while the flow rates are the same in both the existing and future condition analyses, the duration of each flow rate is increased in the future condition. The flow rates in the flow bins are based on the watershed area, mean annual precipitation, and length of the synthetic record. These do not change from existing to future condition. The duration for each flow bin is related to the watershed area, mean annual precipitation, length of the synthetic record, and the impervious area. The duration increases in the future condition based on the increased impervious area. The increase in duration would result in increased cumulative work in the future condition if any of the flow rates resulted in shear stress greater than the estimated critical shear stress (excess shear stress, or "work"), because cumulative work is the product of work times duration.

The scenario that occurred in the Forester Creek analysis, in which no work occurred in the expected range of geomorphically-effective flow rates, is a potential scenario for engineered channels because engineered conveyance systems are typically engineered for flood flows much greater and less frequent than the geomorphically-effective flows. For example, Forester Creek is engineered to convey a 100-year single-storm event flow rate of approximately 12,450 to 13,840 cubic feet per second (cfs) within the channel. The 10-year single-storm event flow rate for Forester Creek is approximately 6,000 to 6,800 cfs. The maximum geomorphically-effective flow rate for Forester Creek based on the DDF analysis is 836 cfs.

4.1.2.4. Recommendation

Based on the study that was prepared under the Regional WMAA and described above, the vegetated reaches of Forester Creek from its confluence with the San Diego River downstream to Prospect Avenue upstream are recommended to be exempt from hydromodification management requirements. The analysis has shown that future increases in impervious area within the watershed are not expected to increase the erosion potential in Forester Creek. The concrete-lined portion of Forester Creek and existing storm drain systems draining directly to the concrete-lined portion of Forester Creek should also be exempt. Storm drain systems draining directly to the vegetated reaches of Forester Creek would also be exempt if there is no evidence of localized erosion issues at the storm drain outfall.

Because engineered conveyance systems are typically engineered to convey flood flows much greater than the geomorphically-effective flows typically determined using continuous simulation modeling or DDF analysis, some engineered conveyance systems may be capable of conveying all geomorphically-effective flows at very low depths with shear stress less than critical shear stress, as was the case for Forester Creek. Based on this, other engineered conveyance systems that are stabilized with materials other than concrete, such as riprap, turf reinforcement mat, or vegetation, including rehabilitated stream systems, may be studied. Those systems that meet criteria presented in the Regional WMAA for stabilized conveyance systems draining to exempt water bodies may be recommended as exempt systems in the optional WMAA incorporated into the WQIP. However, any future proposed HMP exemptions would need to be approved through the WQIP Annual Update process (Regional MS4 Permit Section F.1.2.c.).

4.1.3. Highly Impervious/Highly Urbanized Watersheds and Urban Infill

Based on evaluation of the highly impervious/highly urbanized watershed and urban infill exemptions presented in the March 2011 Final HMP, and comparison with more recent research prepared for the Ventura County Hydromodification Control Plan (Ventura County HCP) (Final Draft dated September 2013), resurrection of these exemptions from the March 2011 Final HMP was not recommended by the Regional WMAA. The research prepared in support of the Ventura County HCP determined lower thresholds of additional impervious area (ranging from 0.44% to 1.65%) than the limit presented in the San Diego County Final HMP dated March 2011 (3%). No areas within the San Diego River WMA are currently recommended for highly impervious/highly urbanized watershed or urban infill exemption.

4.1.4. Tidally Influenced Lagoons

There are no tidally influenced lagoons recommended for exemption from hydromodification management requirements in the San Diego River WMA. Refer to the Regional WMAA for further information regarding this exemption.

5. Conclusions

5.1. Watershed Management Area Characterization

The WMA Characterization data was developed using available regional data to further understand the macro-scale watershed characteristics and processes in the San Diego River WMA. The Regional MS4 Permit allows for flexibility in complying with land development requirements when using the information developed in the WMAA to improve water quality planning and implementation associated with land development. This dataset will assist with identifying the opportunities and constraints for projects and management decisions based on a watershed-scale (rather than piecemeal project identification without context within the watershed) and provides Copermittees the ability to exercise the option to create an alternative compliance program that offers the opportunity to develop watershed-specific alternatives to universal onsite structural BMP implementation. The characterization data includes:

Characterization Data	Utilization Potential
Dominant Hydrologic Process: • Overland flow • Infiltration • Interflow	• Identify areas for enhanced infiltration or collection of storm water for treatment • Implement management measures that correspond to pre-development conditions – promotes long-term channel stability and health • Increases understanding of the natural functioning of the watershed and what has been (or is at risk of being) altered by urbanization.
Stream Characterization: • Reach type • Bed material • Bank material • Hydrographic category • Channel infrastructure	• Preliminary dataset that can be used to conduct stream power evaluations • Identify channel systems for preservation or restoration • Identification of appropriate space for channel processes to occur (e.g., flood plain connectivity) • Insight to sensitivity of receiving stream reach • Indicates the features within channels that affect water and sediment movement through the watershed

Characterization Data	Utilization Potential
Land Use: • Existing • Future	• Foresight (identifies relative risks, opportunities, or constraints) in comparing future to existing land uses, i.e., areas that may be more/less vulnerable to adverse impacts to changes in storm water runoff associated with development • Encourage infill development
Potential Critical Coarse Sediment Yield Areas	• Preservation of areas or function that contributes critical sediment within the watershed to stream armoring/stability • Assist with identifying potentially susceptible stream reaches that require uninterrupted coarse sediment supplies to remain stable • Dual goal of open space conservation

Regarding the identification of the potential critical coarse sediment yield areas in the WMAA using readily available regional datasets, it is anticipated that when more precise estimates for potential critical coarse sediment yield areas are required for a particular site or subarea that this regional study will be augmented with site-specific analysis. Development projects must avoid critical sediment yield areas or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no net impact to the receiving water to meet the requirements of the Regional MS4 permit. As such, projects should consult the Model BMP Design Manual and/or jurisdiction specific BMP Design manual for options to meet the Regional MS4 permit requirements. It is anticipated that the data will not be static but will be enhanced over time through future studies or field assessments that will refine what is currently a macro-level data set.

5.2. Template for Candidate Project List

It is anticipated the Copermittees that elect to develop alternative compliance programs will conduct a separate exercise to nominate potential candidate projects for inclusion into the WQIPs using the template developed for this project.

5.3. Hydromodification Management Exemptions

Attachment B.2 presents hydromodification management applicability/exemption mapping for the San Diego River WMA. The mapping includes receiving waters that are exempt based on the Regional MS4 Permit or recommended exempt based on studies.

Receiving waters that are **exempt** based on the Regional MS4 Permit include:

- The Pacific Ocean
- Lakes and Reservoirs
- Existing underground storm drains or concrete-lined channels draining directly to the ocean

Receiving waters or conveyance systems that are **recommended exempt** in the San Diego River WMA based on studies that were prepared as part of the Regional WMAA include:

- San Diego River from Pacific Ocean to confluence with San Vicente Creek
- Forester Creek stabilized reach from the confluence with the San Diego River to Prospect Avenue
- Existing underground storm drains or concrete-lined channels discharging directly to the above receiving waters. These systems were identified based on MS4 data provided by the Copermittees via the data call. These systems may not represent all discharges to the above receiving waters. Additional systems may be considered exempt if there is no evidence of erosion at the outfall of the conveyance system, and any other criteria determined by the local jurisdiction.

6. References

Becker, A. and Braun, P. 1999. Disaggregation, aggregation and spatial scaling in hydrological modeling. Journal of Hydrology 217:239-252.

Beighley, R.E., Dunne, T., and Melack, J.M. 2005. Understanding and modeling basin hydrology: Interpreting the hydrogeological signature. Hydrological Processes 19:1333-1353.

Beven, K.J. 2001. Rainfall-Runoff Modelling, The Primer. John Wiley. Chichester, UK.

Brown and Caldwell. 2011. Final Hydromodification Management Plan Prepared for County of San Diego, California.

Chang Consultants. 2013. Hydromodification Exemption Analyses for Select Carlsbad Watersheds. Study prepared for City of Carlsbad, California.

County of San Diego, 2010. Impervious Surface Coefficients for General Land Use Categories for Application within San Diego County. County of San Diego, Department of Planning and Land Use

England, C.B. and H.N. Holtan. 1969. Geomorphic grouping of soils in watershed engineering. Journal of Hydrology 7:217-225.

Fischenich, C. 2001. Stability Thresholds for Stream Restoration Materials. USAE Research and Development Center ERDC TN-EMRRP-SR-29, 10 pp.

Geosyntec Consultants. 2013. Ventura County Hydromodification Control Plan (HCP) Prepared for Ventura Countywide Stormwater Quality Management Program.

Greene, R.G. and J.F. Cruise. 1995. Urban watershed modeling using geographic information system. Journal of Water Resources Planning and Management - ASCE 121:318-325.McCuen, R.H. 2005. Hydrologic Analysis and Design. 3rd Edition. Pearson Prentice Hall. Upper Saddle River, New Jersey. pp 378.

Haverkamp, S., N. Fohrer and H.-G. Frede. 2005. Assessment of the effect of land use patterns on hydrologic landscape functions: A comprehensive GIS-based tool to minimize model uncertainty resulting from spatial aggregation. Hydrological Processes 19:715-727.

Hawley, R.J., and Bledsoe, B.P. 2011. "How do flow peaks and durations change in suburbanizing semi-arid watersheds? A southern California Study," Journal of Hydrology, Elsevier, Vol 405, pp 69-82.

Hawley, R.J., and Bledsoe, B.P. 2013. "Channel enlargement in semiarid suburbanizing watersheds: A southern California case study," Journal of Hydrology, Elsevier, Vol 496, pp 17-30.

Hoag, J.C., and J. Fripp. 2005. Streambank Soil Bioengineering Considerations for Semi-Arid Climates. Riparian/Wetland Project Information Series No. 18, May 2005, 15 pp.

Jennings, C.W., Gutierrez, C., Bryant, W., Saucedo, G., and Wills, C., 2010. "Geologic Map of California," California Geological Survey, Map No. 2 – Geologic Map of California, 1:750,000 scale.

http://www.conservation.ca.gov/cgs/cgs_history/PublishingImages/GMC_750k_MapRelease_page.jpg

Kennedy, M.P., and Peterson, G.L., 1975. "Geology of the San Diego Metropolitan Area, California, Del Mar, La Jolla, Point Loma, La Mesa, Poway, and SW1/4 Escondido 7.5 minute quadrangles," California Division of Mines and Geology, Bulletin 200, 1:24,000 scale.

Kennedy, M.P., and Tan, S.S., 1977. "Geology of National City, Imperial Beach, and Otay Mesa Quadrangles, Southern San Diego Metropolitan Area, California," California Division of Mines and Geology, Map Sheet 29, 1:24,000 scale.

Kennedy, M.P., and Tan, S.S., 2002. "Geologic Map of the Oceanside 30'x60' Quadrangle, California," California Geological Survey, Regional Geologic Map No. 2, 1:100,000 scale. http://www.quake.ca.gov/gmaps/RGM/oceanside/oceanside.html

Kennedy, M.P., and Tan, S.S., 2008. "Geologic Map of the San Diego 30'x60' Quadrangle, California," California Geological Survey, Regional Geologic Map No. 3, 1:100,000 scale. http://www.quake.ca.gov/gmaps/RGM/sandiego/sandiego.html

National Resources Conservation Service (NRCS). U.S. Department of Agriculture. n.d. SSURGO computerized soils and interpretive maps (automating soil survey maps). Soil Data Mart. Online Database. http://soildatam art.nrcs.usda.gov/County.aspx?State=CA.

RBF Consulting, 2013. Santa Margarita Regional Hydromodification Management Plan. Prepared for Riverside County Copermittees

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool and D.C. Yoder, 1997. Predicting Soil Erosion by Water. A guide to conservation planning with Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture, Agriculture Handbook No. 703.

Rodgers, T.H., 1965. "Geologic Atlas of California - Santa Ana Sheet," California Geological Survey, Map No. 019, 1:250,000 scale. http://www.quake.ca.gov/gmaps/GAM/santaana/santaana.html

San Diego Regional Water Quality Control Board. 2013. 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. NPDES No. CAS0109266.

Sanford, W.E. and D.L. Selnick, 2013. Estimation of evapotranspiration across the conterminous United States using a regression with climate and land-cover data. Journal of the American Water Resources Association, Vol.49, No.1.

SanGIS, 2013. http://www.sangis.org/download/index.html

Santa Paula Creek Watershed Planning Project: Geomorphology and Channel Stability Assessment. Final Report, 2007. Prepared by Stillwater Sciences for Santa Paula Creek Fish Ladder Joint Powers Authority and California Department of Fish and Game.

SCCWRP, 2010. Hydromodification Screening Tools: GIS-based Catchment analyses of Potential Changes in Runoff and Sediment Discharge. Technical Report 605.

SCCWRP, 2012. Hydromodification Assessment and Management in California. Eric D. Stein;

Felicia Federico; Derek B. Booth; Brian P. Bledsoe; Chris Bowles; Zan Rubin; G. Mathias Kondolf and Ashmita Sengupta. Technical Report 667.

Soar, P.J., and Thorne, C.R., 2001. Channel Restoration Design for Meandering Rivers. US Army Corps of Engineers, Final Report, ERDC/CHL CR-01-1. September 2001.

State Water Resources Control Board (2009). Order 2009-0009-DWQ, NPDES General Permit No. CAS000002: National Pollutant Discharges Elimination System (NPDES) California General Permit for Storm Water Discharge Associated with Construction and Land Disturbing.

Stillwater Sciences and TetraTech. 2011. Watershed Characterization Part 2: Watershed Management Zones and Receiving-Water Conditions. Report prepared for California State Central Coast Regional Water Quality Control Board, 52 pp.

Strand, R.G. 1962. “Geologic Atlas of California - San Diego-El Centro Sheet,” California Geological Survey, Map No. 015, 1:125,000 scale. http://www.quake.ca.gov/gmaps/GAM/sandiegoelcentro/sandiegoelcentro.html

Todd, V.R., 2004. “Preliminary Geologic Map of the El Cajon 30’x60’ Quadrangle, Southern California,” United States Geological Survey, Southern California Areal Mapping Project (SCAMP), Open File Report 2004-1361, 1:100,000 scale. http://pubs.usgs.gov/of/2004/1361/

USGS, 2013. National Elevation Dataset.

San Diego River
Watershed Management Area Analysis
ATTACHMENTS

Lake Henshaw

October 3, 2014

Prepared for:
San Diego County Copermittees

Prepared by:

Geosyntec consultants
engineers | scientists | innovators

RICK ENGINEERING COMPANY

ATTACHMENT A

WATERSHED MANAGEMENT AREA CHARACTERIZATION

ATTACHMENT A.1

DOMINANT HYDROLOGICAL PROCESS

A.1 Dominant Hydrological Process

Table A.1.1: Runoff Coefficients versus Land Use, Hydrologic Soil Group (A, B, C, D), and Slope Range

	A			B			C			D		
Land Use	0–2%	2–6%	6%+	0–2%	2–6%	6%+	0–2%	2–6%	6%+	0–2%	2–6%	6%+
Cultivated land	0.08[a]	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
	0.14[b]	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Pasture	0.12	0.20	0.30	0.18	0.28	0.37	0.24	0.34	0.44	0.30	0.40	0.50
	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Meadow	0.10	0.16	0.25	0.14	0.22	0.30	0.20	0.28	0.36	0.24	0.30	0.40
	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Forest	0.05	0.08	0.11	0.08	0.11	0.14	0.10	0.13	0.16	0.12	0.16	0.20
	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Residential lot size 1/8 acre	0.25	0.28	0.31	0.27	0.30	0.35	0.30	0.33	0.38	0.33	0.36	0.42
	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Residential lot size 1/4 acre	0.22	0.26	0.29	0.24	0.29	0.33	0.27	0.31	0.36	0.30	0.34	0.40
	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
Residential lot size 1/3 acre	0.19	0.23	0.26	0.22	0.26	0.30	0.25	0.29	0.34	0.28	0.32	0.39
	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
Residential lot size 1/2 acre	0.16	0.20	0.24	0.19	0.23	0.28	0.22	0.27	0.32	0.26	0.30	0.37
	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.48
Residential lot size 1 acre	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.29	0.35
	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Industrial	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.58
Commercial	0.71	0.71	0.72	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets	0.70	0.71	0.72	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78
	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Open space	0.05	0.10	0.14	0.08	0.13	0.19	0.12	0.17	0.24	0.15	0.21	0.28
	0.11	0.16	0.20	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Parking	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97

[a] Runoff coefficients for storm recurrence intervals less than 25 years.

[b]Runoff coefficients for storm recurrence intervals of 25 years or longer.

Source: Table 7-9 in *Hydrologic Analysis and Design* (McCuen, 2005)

Table A.1.2: Land Cover Grouping

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
1	42000 Valley and Foothill Grassland	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	Agricultural/Grass
2	42100 Native Grassland		Agricultural/Grass
3	42110 Valley Needlegrass Grassland		Agricultural/Grass
4	42120 Valley Sacaton Grassland		Agricultural/Grass

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
5	42200 Non-Native Grassland	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	Agricultural/Grass
6	42300 Wildflower Field		Agriculture/Grass
7	42400 Foothill/Mountain Perennial Grassland		Agriculture/Grass
8	42470 Transmontane Dropseed Grassland		Agriculture/Grass
9	45000 Meadow and Seep		Agriculture/Grass
10	45100 Montane Meadow		Agriculture/Grass
11	45110 Wet Montane Meadow		Agriculture/Grass
12	45120 Dry Montane Meadows		Agriculture/Grass
13	45300 Alkali Meadows and Seeps		Agriculture/Grass
14	45320 Alkali Seep		Agriculture/Grass
15	45400 Freshwater Seep		Agriculture/Grass
16	46000 Alkali Playa Community		Agriculture/Grass
17	46100 Badlands/Mudhill Forbs		Agriculture/Grass
18	Non-Native Grassland		Agriculture/Grass
19	18000 General Agriculture	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Agriculture/Grass
20	18100 Orchards and Vineyards		Agriculture/Grass
21	18200 Intensive Agriculture		Agriculture/Grass
22	18200 Intensive Agriculture - Dairies, Nurseries, Chicken Ranches		Agriculture/Grass
23	18300 Extensive Agriculture - Field/Pasture, Row Crops		Agriculture/Grass
24	18310 Field/Pasture		Agriculture/Grass
25	18310 Pasture		Agriculture/Grass
26	18320 Row Crops		Agriculture/Grass
27	12000 Urban/Developed		Developed
28	12000 Urban/Develpoed		Developed
29	81100 Mixed Evergreen Forest	Forest	Forest
30	81300 Oak Forest		Forest
31	81310 Coast Live Oak Forest		Forest
32	81320 Canyon Live Oak Forest		Forest
33	81340 Black Oak Forest		Forest
34	83140 Torrey Pine Forest		Forest
35	83230 Southern Interior Cypress Forest		Forest
36	84000 Lower Montane Coniferous Forest		Forest
37	84100 Coast Range, Klamath and Peninsular Coniferous Forest		Forest

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
38	84140 Coulter Pine Forest	Forest	Forest
39	84150 Bigcone Spruce (Bigcone Douglas Fir)-Canyon Oak Forest		Forest
40	84230 Sierran Mixed Coniferous Forest		Forest
41	84500 Mixed Oak/Coniferous/Bigcone/Coulter		Forest
42	85100 Jeffrey Pine Forest		Forest
43	11100 Eucalyptus Woodland	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Forest
44	60000 RIPARIAN AND BOTTOMLAND HABITAT	Riparian and Bottomland Habitat	Forest
45	61000 Riparian Forests		Forest
46	61300 Southern Riparian Forest		Forest
47	61310 Southern Coast Live Oak Riparian Forest		Forest
48	61320 Southern Arroyo Willow Riparian Forest		Forest
49	61330 Southern Cottonwood-willow Riparian Forest		Forest
50	61510 White Alder Riparian Forest		Forest
51	61810 Sonoran Cottonwood-willow Riparian Forest		Forest
52	61820 Mesquite Bosque		Forest
53	62000 Riparian Woodlands		Forest
54	62200 Desert Dry Wash Woodland		Forest
55	62300 Desert Fan Palm Oasis Woodland		Forest
56	62400 Southern Sycamore-alder Riparian Woodland		Forest
57	70000 WOODLAND	Woodland	Forest
58	71000 Cismontane Woodland		Forest
59	71100 Oak Woodland		Forest
60	71120 Black Oak Woodland		Forest
61	71160 Coast Live Oak Woodland		Forest
62	71161 Open Coast Live Oak Woodland		Forest
63	71162 Dense Coast Live Oak Woodland		Forest
64	71162 Dense Coast Love Oak Woodland		Forest

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
65	71180 Engelmann Oak Woodland	Woodland	Forest
66	71181 Open Engelmann Oak Woodland		Forest
67	71182 Dense Engelmann Oak Woodland		Forest
68	72300 Peninsular Pinon and Juniper Woodlands		Forest
69	72310 Peninsular Pinon Woodland		Forest
70	72320 Peninsular Juniper Woodland and Scrub		Forest
71	75100 Elephant Tree Woodland		Forest
72	77000 Mixed Oak Woodland		Forest
73	78000 Undifferentiated Open Woodland		Forest
74	79000 Undifferentiated Dense Woodland		Forest
75	Engelmann Oak Woodland		Forest
76	52120 Southern Coastal Salt Marsh	Bog and Marsh	Other
77	52300 Alkali Marsh		Other
78	52310 Cismontane Alkali Marsh		Other
79	52400 Freshwater Marsh		Other
80	52410 Coastal and Valley Freshwater Marsh		Other
81	52420 Transmontane Freshwater Marsh		Other
82	52440 Emergent Wetland		Other
83	44000 Vernal Pool	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	Other
84	44320 San Diego Mesa Vernal Pool		Other
85	44322 San Diego Mesa Claypan Vernal Pool (southern mesas)		Other
86	13100 Open Water	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Other
87	13110 Marine		Other
88	13111 Subtidal		Other
89	13112 Intertidal		Other
90	13121 Deep Bay		Other
91	13122 Intermediate Bay		Other
92	13123 Shallow Bay		Other
93	13130 Estuarine		Other
94	13131 Subtidal		Other
95	13133 Brackishwater		Other

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
96	13140 Freshwater	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Other
97	13200 Non-Vegetated Channel, Floodway, Lakeshore Fringe		Other
98	13300 Saltpan/Mudflats		Other
99	13400 Beach		Other
100	21230 Southern Foredunes	Dune Community	Scrub/Shrub
101	22100 Active Desert Dunes		Scrub/Shrub
102	22300 Stabilized and Partially-Stabilized Desert Sand Field		Scrub/Shrub
103	24000 Stabilized Alkaline Dunes		Scrub/Shrub
104	29000 ACACIA SCRUB		Scrub/Shrub
105	63000 Riparian Scrubs	Riparian and Bottomland Habitat	Scrub/Shrub
106	63300 Southern Riparian Scrub		Scrub/Shrub
107	63310 Mule Fat Scrub		Scrub/Shrub
108	63310 Mulefat Scrub		Scrub/Shrub
109	63320 Southern Willow Scrub		Scrub/Shrub
110	63321 Arundo donnax Dominant/Southern Willow Scrub		Scrub/Shrub
111	63330 Southern Riparian Scrub		Scrub/Shrub
112	63400 Great Valley Scrub		Scrub/Shrub
113	63410 Great Valley Willow Scrub		Scrub/Shrub
114	63800 Colorado Riparian Scrub		Scrub/Shrub
115	63810 Tamarisk Scrub		Scrub/Shrub
116	63820 Arrowweed Scrub		Scrub/Shrub
117	31200 Southern Coastal Bluff Scrub	Scrub and Chaparral	Scrub/Shrub
118	32000 Coastal Scrub		Scrub/Shrub
119	32400 Maritime Succulent Scrub		Scrub/Shrub
120	32500 Diegan Coastal Sage Scrub		Scrub/Shrub
121	32510 Coastal form		Scrub/Shrub
122	32520 Inland form (> 1,000 ft. elevation)		Scrub/Shrub
123	32700 Riversidian Sage Scrub		Scrub/Shrub
124	32710 Riversidian Upland Sage Scrub		Scrub/Shrub
125	32720 Alluvial Fan Scrub		Scrub/Shrub
126	33000 Sonoran Desert Scrub		Scrub/Shrub
127	33100 Sonoran Creosote Bush Scrub		Scrub/Shrub
128	33200 Sonoran Desert Mixed Scrub		Scrub/Shrub
129	33210 Sonoran Mixed Woody Scrub		Scrub/Shrub

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
130	33220 Sonoran Mixed Woody and Succulent Scrub	Scrub and Chaparral	Scrub/Shrub
131	33230 Sonoran Wash Scrub		Scrub/Shrub
132	33300 Colorado Desert Wash Scrub		Scrub/Shrub
133	33600 Encelia Scrub		Scrub/Shrub
134	34000 Mojavean Desert Scrub		Scrub/Shrub
135	34300 Blackbush Scrub		Scrub/Shrub
136	35000 Great Basin Scrub		Scrub/Shrub
137	35200 Sagebrush Scrub		Scrub/Shrub
138	35210 Big Sagebrush Scrub		Scrub/Shrub
139	35210 Sagebrush Scrub		Scrub/Shrub
140	36110 Desert Saltbush Scrub		Scrub/Shrub
141	36120 Desert Sink Scrub		Scrub/Shrub
142	37000 Chaparral		Scrub/Shrub
143	37120 Southern Mixed Chaparral		Scrub/Shrub
144	37120 Southern Mixed Chapparal		Scrub/Shrub
145	37121 Granitic Southern Mixed Chaparral		Scrub/Shrub
146	37121 Southern Mixed Chaparral		Scrub/Shrub
147	37122 Mafic Southern Mixed Chaparral		Scrub/Shrub
148	37130 Northern Mixed Chaparral		Scrub/Shrub
149	37131 Granitic Northern Mixed Chaparral		Scrub/Shrub
150	37132 Mafic Northern Mixed Chaparral		Scrub/Shrub
151	37200 Chamise Chaparral		Scrub/Shrub
152	37210 Granitic Chamise Chaparral		Scrub/Shrub
153	37220 Mafic Chamise Chaparral		Scrub/Shrub
154	37300 Red Shank Chaparral		Scrub/Shrub
155	37400 Semi-Desert Chaparral		Scrub/Shrub
156	37500 Montane Chaparral		Scrub/Shrub
157	37510 Mixed Montane Chaparral		Scrub/Shrub
158	37520 Montane Manzanita Chaparral		Scrub/Shrub
159	37530 Montane Ceanothus Chaparral		Scrub/Shrub
160	37540 Montane Scrub Oak Chaparral		Scrub/Shrub
161	37800 Upper Sonoran Ceanothus Chaparral		Scrub/Shrub
162	37830 Ceanothus crassifolius Chaparral		Scrub/Shrub
163	37900 Scrub Oak Chaparral		Scrub/Shrub
164	37A00 Interior Live Oak Chaparral		Scrub/Shrub

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
165	37C30 Southern Maritime Chaparral	Scrub and Chaparral	Scrub/Shrub
166	37G00 Coastal Sage-Chaparral Scrub		Scrub/Shrub
167	37K00 Flat-topped Buckwheat		Scrub/Shrub
168	39000 Upper Sonoran Subshrub Scrub		Scrub/Shrub
169	Diegan Coastal Sage Scrub		Scrub/Shrub
170	Granitic Northern Mixed Chaparral		Scrub/Shrub
171	Southern Mixed Chaparral		Scrub/Shrub
172	11000 Non-Native Vegetation	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Unknown
173	11000 Non-Native VegetionVegetation		Unknown
174	11200 Disturbed Wetland		Unknown
175	11300 Disturbed Habitat		Unknown
176	13000 Unvegetated Habitat		Unknown
177	Disturbed Habitat		Unknown

Table A.1.3: Related Land Cover and Land Use Categories

Land Cover per San Diego County	Land Use per Table A.1.1
Agriculture/Grass	Meadow
Forest	Forest
Scrub/Shrub	Average (Meadow, Forest)
Unknown/Other	Meadow

Table A.1.4: Applicable Hydrologic Response Unit Calculations

Land Cover	Soil	Gradient	Runoff Coeff.	ET Coeff.	Infiltration Coeff.	Runoff/ Infiltration Ratio	Hydrologic Process Designation
Agriculture/Grass	A	0-2%	0.10	0.60	0.30	0.33	I
Agriculture/Grass	A	2-6%	0.16	0.60	0.24	0.67	U
Agriculture/Grass	A	6-10%	0.25	0.60	0.15	1.67	O
Agriculture/Grass	B	0-2%	0.14	0.60	0.26	0.54	I
Agriculture/Grass	B	2-6%	0.22	0.60	0.18	1.22	U
Agriculture/Grass	B	6-10%	0.30	0.60	0.10	3.00	O
Agriculture/Grass	C	0-2%	0.20	0.60	0.20	1.00	U
Agriculture/Grass	C	2-6%	0.28	0.60	0.12	2.33	O
Agriculture/Grass	C	6-10%	0.36	0.60	0.04	9.00	O
Agriculture/Grass	D	0-2%	0.24	0.60	0.16	1.50	U
Agriculture/Grass	D	2-6%	0.30	0.60	0.10	3.00	O
Agriculture/Grass	D	6-10%	0.40	0.60	0.00	infinite	O

Land Cover	Soil	Gradient	Runoff Coeff.	ET Coeff.	Infiltration Coeff.	Runoff/ Infiltration Ratio	Hydrologic Process Designation
Forest	A	0-2%	0.05	0.80	0.15	0.33	I
Forest	A	2-6%	0.08	0.80	0.12	0.67	U
Forest	A	6-10%	0.11	0.80	0.09	1.22	U
Forest	B	0-2%	0.08	0.80	0.12	0.67	U
Forest	B	2-6%	0.11	0.80	0.09	1.22	U
Forest	B	6-10%	0.14	0.80	0.06	2.33	O
Forest	C	0-2%	0.10	0.80	0.10	1.00	U
Forest	C	2-6%	0.13	0.80	0.07	1.86	O
Forest	C	6-10%	0.16	0.80	0.04	4.00	O
Forest	D	0-2%	0.12	0.80	0.08	1.50	U
Forest	D	2-6%	0.16	0.80	0.04	4.00	O
Forest	D	6-10%	0.20	0.80	0.00	infinite	O
Scrub/Shrub	A	0-2%	0.08	0.70	0.23	0.33	I
Scrub/Shrub	A	2-6%	0.12	0.70	0.18	0.67	U
Scrub/Shrub	A	6-10%	0.18	0.70	0.12	1.50	U
Scrub/Shrub	B	0-2%	0.11	0.70	0.19	0.58	I
Scrub/Shrub	B	2-6%	0.17	0.70	0.14	1.22	U
Scrub/Shrub	B	6-10%	0.22	0.70	0.08	2.75	O
Scrub/Shrub	C	0-2%	0.15	0.70	0.15	1.00	U
Scrub/Shrub	C	2-6%	0.21	0.70	0.10	2.16	O
Scrub/Shrub	C	6-10%	0.26	0.70	0.04	6.50	O
Scrub/Shrub	D	0-2%	0.19	0.70	0.12	1.50	U
Scrub/Shrub	D	2-6%	0.23	0.70	0.07	3.29	O
Scrub/Shrub	D	6-10%	0.30	0.70	0.00	infinite	O

Hydrologic Process Designation: I = Interflow; O = Overland Flow; U = Uncertain

Table A.1.5: Hydrologic Response Unit Designations

Land Cover	Slope	Soil Type				
		A	B	C	D	Other (fill/water)
Agriculture/ Grass/Unknown/ Other	0-2%	I	I	U	U	U
	2-6%	U	U	O	O	U
	6-10%	O	O	O	O	O
	>10%	O	O	O	O	O
Developed	0-2%	O	O	O	O	O
	2-6%	O	O	O	O	O
	6-10%	O	O	O	O	O
	>10%	O	O	O	O	O
Forest	0-2%	I	U	U	U	U
	2-6%	U	U	O	O	U
	6-10%	U	O	O	O	U
	>10%	O	O	O	O	O
Scrub/Shrub	0-2%	I	I	U	U	U
	2-6%	U	U	O	O	U
	6-10%	U	O	O	O	U
	>10%	O	O	O	O	O

Hydrologic Process Designation: I = Interflow; O = Overland Flow; U = Uncertain

Exhibit Showing Dominant Hydrologic Processes

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

ATTACHMENT A.2

STREAM CHARACTERIZATION

Watershed Management Area Streams

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

Watershed Management Area Streams by Hydrographic Category

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

Watershed Management Area Streams by Bed Material

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

Watershed Management Area Streams by Geologic Group

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

Watershed Management Area Streams by Reach Type

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

ATTACHMENT A.3

LAND USES

Existing Land Use

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

Planned Land Use

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Developable Land

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

Redevelopment and Infill Areas

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

ATTACHMENT A.4

POTENTIAL CRITICAL COARSE SEDIMENT YIELD AREAS

A.4.1 Geology Grouping

Geologic grouping was based on the mapped geologic unit as determined by published geologic mapping information. The following describes the methodology utilized to determine bedrock or sedimentary characteristics, anticipated grain size, and suitability for infiltration. A complete list of the various geologic maps used in this evaluation is listed in Chapter 6.

Due to the various mapped scales of the published data and differing mapped unit names, the geologic units were initially compiled into similar categories where possible. For example, the Lindavista Formation is mapped as unit Ql on geologic maps at a scale of 1:24,000 but correlates to the same unit Qvop8 on geologic maps at a scale of 1:100,000. Following the compilation of geologic unit names, the units were differentiated between crystalline bedrock and sedimentary formations based on geologic characterization and material behavior. The Point Loma Formation for example, is a Cretaceous-age sandstone, but it was classified as a “coarse bedrock” unit due to its indurated and resistant nature.

For each site location, the predominant geologic units were then described as “coarse” or “fine” based on typical weathering characteristics of the bedrock units, or primary grain size of the sedimentary units. For example, granodiorite or tonalite crystalline rock typically weathers to a coarse material such as a silty sand and therefore was classified as “coarse,” compared to a gabbro which generally weathers to a sandy clay and was characterized as “fine.” Sedimentary formations can be more variable, such as the Mission Valley Formation. In this case, the Mission Valley Formation was characterized as “coarse” since the unit is predominantly comprised of sandstone even if it does contain localities of siltstone and claystone within the unit.

To further characterize the sedimentary formations, these units were evaluated for suitability of infiltration. Since no field investigations were performed for this evaluation to determine permeability, the differentiation between impermeable and permeable were based on the age of the geologic unit with the assumption that relatively younger sedimentary units of Pleistocene-age or younger (<1.6 mya) would be more susceptible to surface water infiltration. Geology grouping of different map units is presented in Table A.4.1

Table A.4.1 Geologic grouping for different map units

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
gr-m	Jennings; CA	Coarse	Bedrock	Impermeable	CB
grMz	Jennings; CA	Coarse	Bedrock	Impermeable	CB
Jcr	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Jhc	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Jsp	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ka	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kbm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kbp	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kcc	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kcg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kcm	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kcp	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kd	San Diego & Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kdl	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgbf	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgd	San Diego & Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgdf	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgh	San Diego 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm1	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm2	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm3	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm4	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgp	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgr	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgu	San Diego 30' x 60'	Coarse	Bedrock	Impermeable	CB
Khg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ki	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kis	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kjd	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
KJem	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
KJld	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kjv	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
Klb	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Klh	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Klp	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Km	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kmg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kmgp	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kmm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kpa	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kpv	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kqbd	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Krm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Krr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kt	San Diego & Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ktr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kvc	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kwm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kwp	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kwsr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
m	Jennings; CA	Coarse	Bedrock	Impermeable	CB
Mzd	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Mzg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Mzq	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Mzs	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
sch	Jennings; CA	Coarse	Bedrock	Impermeable	CB
Kp	San Diego & Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ql	El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
QTf	El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Ec	Jennings; CA	Coarse	Sedimentary	Impermeable	CSI
K	Jennings; CA	Coarse	Sedimentary	Impermeable	CSI
Kccg	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Kcs	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Kl	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Ku	Jennings; CA	Coarse	Sedimentary	Impermeable	CSI

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
Qvof	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop8a	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop9a	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tmsc	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tmss	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tp	San Diego & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tpm	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsc	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tscu	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsd	San Diego & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsdcg	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsdss	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsm	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tso	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tst	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tt	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tta	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tmv	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsi	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoa	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoa11	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoa12	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoa13	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoc	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop1	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop10	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop10a	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop11	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
Qvop11a	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop12	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop13	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop2	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop3	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop4	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop5	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop6	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop7	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop8	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop9	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsa	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qof	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qof1	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qof2	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Q	Jennings; CA	Coarse	Sedimentary	Permeable	CSP
Qa	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qd	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qf	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qmb	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qw	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qyf	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qt	El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa1-2	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa2-6	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa5	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa6	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa7	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
Qoc	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop1	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qc	El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qu	El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop2-4	San Diego 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop3	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop4	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop6	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop7	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qya	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qyc	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Mzu	San Diego & Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
gb	Jennings; CA	Fine	Bedrock	Impermeable	FB
JTRm	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kat	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Kc	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kgb	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
KJvs	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kmv	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Ksp	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kvsp	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Kwmt	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Qv	Jennings; CA	Fine	Bedrock	Impermeable	FB
Tba	San Diego 30' x 60'	Fine	Bedrock	Impermeable	FB
Tda	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Tv	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Tvsr	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Kgdfg	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Ta	San Diego 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tcs	Oceanside 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Td	San Diego & Oceanside	Fine	Sedimentary	Impermeable	FSI

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
	30' x 60'				
Td+Tf	San Diego 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Qls	San Diego, Oceanside & El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tm	Oceanside 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tf	San Diego, Oceanside & El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tfr	El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
To	San Diego & El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Qpe	San Diego & Oceanside 30' x 60'	Fine	Sedimentary	Permeable	FSP
Mexico	San Diego 30' x 60'	NA	NA	Permeable	Other
Kuo	San Diego 30' x 60'	NA (Offshore)	NA	Permeable	Other
Teo	San Diego & Oceanside 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
Tmo	Oceanside 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
Qmo	San Diego 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
QTso	San Diego 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
af	San Diego & Oceanside 30' x 60'	Variable, dependent on source material	Sedimentary		Other

A.4.2 Quantitative Analysis

Soil loss estimates for each Geomorphic Landscape Unit were estimated using the Revised Universal Soil Loss Equation (RUSLE; Renard et al. 1997) listed below:

$$A = R \times K \times LS \times C \times P$$

Where

A = estimated average soil loss in tons/acre/year

R = rainfall-runoff erosivity factor

K = soil erodibility factor

LS = slope length and steepness factor

C = cover-management factor

P = support practice factor; assumed 1 for this analysis

Regional datasets used to estimate the inputs required to estimate the soil loss from each GLU are listed in table below:

Dataset	Source	Download year	Description
RUSLE – R Factor	SWRCB	2014	Regional R factor map was downloaded from ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/RUSLE_R_Factor/
RUSLE – K Factor	SWRCB	2014	Regional K factor map was downloaded from ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/RUSLE_K_Factor/
RUSLE – LS Factor	SWRCB	2014	Regional LS factor map was downloaded from ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/RUSLE_LS_Factor/
RUSLE – C Factor	USEPA	2014	Regional C factor map was downloaded from http://www.epa.gov/esd/land-sci/emap_west_browser/pages/wemap_mm_sl_rusle_c_qt.htm#mapnav

GIS analysis was used to calculate the area weighted estimate of R, K, LS and C factors using the regional datasets listed in the table above. For the developed land cover the C factor was then adjusted to 0 from the regional estimate to account for management actions implemented on developed sites (e.g. impervious surfaces). Soil loss estimates ranged from 0 to 15.2 tons/acre/year.

For evaluating the degree of relative risk to a stream solely arising from changes in sediment and/or water delivery SCCWRP Technical Report 605, 2010 states:

> *"The challenge in implementing this step is that presently we have insufficient basis to defensibly identify either low-risk or high-risk conditions using these metrics. For example, channels that are close to a threshold for geomorphic change may display significant morphological changes under nothing more than natural year-to-year variability in flow or sediment load.*

- *Acknowledging this caveat, we nonetheless anticipate that changes of less than 10% in either driver are unlikely to instigate, on their own, significant channel changes. This value is a conservative estimate of the year-to-year variability in either discharge or sediment flux that can be accommodated by a channel system in a state of dynamic equilibrium. It does not "guarantee," however, that channel change may not occur—either in response to yet modest alterations in water or sediment delivery, or because of other urbanization impacts (e.g., point discharge of runoff or the trapping of the upstream sediment flux; see Booth 1990) that are not represented with this analysis.*
- *In contrast, recognizing a condition of undisputed "high risk" must await broader collection of regionally relevant data. We note that >60% reductions in predicted sediment production have resulted in both minimal (McGonigle) and dramatic (Agua Hedionda) channel changes, indicating that "more data" may never provide absolute guidance. At present, we suggest using predicted watershed changes of 50% or more in either runoff (as indexed by change in impervious area) or sediment production as provisional criteria for requiring a more detailed evaluation of both the drivers and the resisting factors for channel change, regardless of other screening-level assessments. Clearly, however, only more experience with the application of such "thresholds," and the actual channel conditions that accompany them, will provide a defensible basis for setting numeric standards."*

The following criterion was developed using the suggestions listed above and then used to assign relative sediment production rating to each GLU:

- Low: Soil Loss < 5.6 tons/acre/year [GLUs that have a soil loss of 0 to 5.6 tons/acre/year produces around 10% of the total coarse sediment soil loss from the study area]
- Medium: 5.6 tons/acre/year < Soil Loss < 8.4 tons/acre/year
- High: > 8.4 tons/acre/year [GLUs that have a soil loss greater than 8.4 tons/acre/year produces around 42% of the total coarse sediment soil loss from the study area]

Results from the quantitative analysis are summarized in Table A.4.2.

Table A.4.2 Relative Sediment Production for different Geomorphic Landscape Units

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CB-Agricultural/Grass-1	52883	0.20	4.67	0.14	50	6.5	Medium	No
CB-Agricultural/Grass-2	40633	0.21	5.19	0.14	56	8.3	Medium	No
CB-Agricultural/Grass-3	32617	0.22	6.04	0.14	57	10.6	High	Yes
CB-Agricultural/Grass-4	11066	0.23	7.38	0.14	57	13.5	High	Yes
CB-Developed-1	39746	0.22	3.77	0	49	0	Low	No
CB-Developed-2	32614	0.22	4.28	0	50	0	Low	No
CB-Developed-3	15841	0.22	4.86	0	49	0	Low	No
CB-Developed-4	1805	0.22	5.63	0	48	0	Low	No
CB-Forest-1	32231	0.20	6.38	0.14	39	6.8	Medium	No
CB-Forest-2	38507	0.20	7.20	0.13	45	8.8	High	Yes
CB-Forest-3	55303	0.20	8.14	0.13	48	10.6	High	Yes
CB-Forest-4	38217	0.20	9.95	0.14	50	13.6	High	Yes
CB-Other-1	1036	0.20	5.52	0.13	45	6.5	Medium	No
CB-Other-2	317	0.20	6.46	0.13	45	7.9	Medium	No
CB-Other-3	296	0.20	6.96	0.14	43	8.3	Medium	No
CB-Other-4	111	0.21	6.84	0.14	41	8.2	Medium	No
CB-Scrub/Shrub-1	88135	0.20	5.66	0.14	33	5.3	Low	No
CB-Scrub/Shrub-2	143694	0.20	6.51	0.14	37	6.8	Medium	No
CB-Scrub/Shrub-3	246703	0.21	7.33	0.14	41	8.4	Medium	No
CB-Scrub/Shrub-4	191150	0.21	8.28	0.14	42	9.8	High	No
CB-Unknown-1	1727	0.21	5.32	0.13	44	6.3	Medium	No
CB-Unknown-2	1935	0.21	5.95	0.13	44	7.1	Medium	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CB-Unknown-3	1539	0.22	6.21	0.13	44	7.7	Medium	No
CB-Unknown-4	278	0.22	6.61	0.13	44	8.4	High	Yes
CSI-Agricultural/Grass-1	14609	0.34	2.72	0.14	39	4.8	Low	No
CSI-Agricultural/Grass-2	9059	0.37	3.61	0.14	47	8.7	High	Yes
CSI-Agricultural/Grass-3	10096	0.38	3.99	0.14	47	9.8	High	Yes
CSI-Agricultural/Grass-4	2498	0.37	4.33	0.14	47	10.5	High	Yes
CSI-Developed-1	82371	0.28	2.51	0	39	0	Low	No
CSI-Developed-2	22570	0.30	2.66	0	41	0	Low	No
CSI-Developed-3	13675	0.30	2.89	0	40	0	Low	No
CSI-Developed-4	3064	0.27	3.20	0	39	0	Low	No
CSI-Forest-1	449	0.27	4.26	0.13	43	6.6	Medium	No
CSI-Forest-2	611	0.25	5.11	0.13	44	7.5	Medium	No
CSI-Forest-3	716	0.29	4.43	0.13	44	7.4	Medium	No
CSI-Forest-4	348	0.30	4.49	0.13	43	7.6	Medium	No
CSI-Other-1	319	0.31	2.50	0.13	32	3.2	Low	No
CSI-Other-2	83	0.27	3.01	0.13	39	4.3	Low	No
CSI-Other-3	45	0.28	3.03	0.13	39	4.5	Low	No
CSI-Other-4	13	0.24	4.01	0.14	39	5.2	Low	No
CSI-Scrub/Shrub-1	9051	0.26	3.53	0.13	39	4.7	Low	No
CSI-Scrub/Shrub-2	10802	0.27	4.36	0.13	41	6.3	Medium	No
CSI-Scrub/Shrub-3	28220	0.26	4.82	0.13	41	6.7	Medium	No
CSI-Scrub/Shrub-4	20510	0.26	5.52	0.13	41	7.8	Medium	No
CSI-Unknown-1	5292	0.28	2.38	0.13	36	3.1	Low	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CSI-Unknown-2	2074	0.29	2.98	0.13	40	4.5	Low	No
CSI-Unknown-3	2171	0.27	3.04	0.13	39	4.2	Low	No
CSI-Unknown-4	676	0.26	3.04	0.13	38	3.8	Low	No
CSP-Agricultural/Grass-1	59327	0.22	3.01	0.14	44	4.0	Low	No
CSP-Agricultural/Grass-2	8426	0.23	3.81	0.14	42	5.2	Low	No
CSP-Agricultural/Grass-3	2377	0.24	4.05	0.14	41	5.6	Low	No
CSP-Agricultural/Grass-4	291	0.22	6.28	0.14	52	10.1	High	Yes
CSP-Developed-1	85283	0.27	2.10	0	42	0	Low	No
CSP-Developed-2	7513	0.26	2.77	0	42	0	Low	No
CSP-Developed-3	2317	0.27	2.70	0	40	0	Low	No
CSP-Developed-4	272	0.27	2.76	0	38	0	Low	No
CSP-Forest-1	14738	0.22	4.52	0.14	44	6.0	Medium	No
CSP-Forest-2	3737	0.22	5.99	0.14	45	8.2	Medium	No
CSP-Forest-3	1858	0.21	6.42	0.14	45	8.5	High	Yes
CSP-Forest-4	484	0.21	7.62	0.14	48	10.2	High	Yes
CSP-Other-1	7404	0.23	2.61	0.14	39	3.2	Low	No
CSP-Other-2	343	0.24	3.68	0.13	40	4.8	Low	No
CSP-Other-3	126	0.24	3.76	0.13	40	4.9	Low	No
CSP-Other-4	17	0.24	4.19	0.13	39	5.3	Low	No
CSP-Scrub/Shrub-1	22583	0.23	3.75	0.14	41	4.8	Low	No
CSP-Scrub/Shrub-2	8938	0.24	5.63	0.14	40	7.1	Medium	No
CSP-Scrub/Shrub-3	7186	0.23	6.15	0.13	39	7.5	Medium	No
CSP-Scrub/Shrub-4	2609	0.22	7.16	0.14	43	9.3	High	Yes

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CSP-Unknown-1	6186	0.25	2.63	0.13	40	3.4	Low	No
CSP-Unknown-2	744	0.27	3.49	0.13	39	4.8	Low	No
CSP-Unknown-3	350	0.28	3.32	0.13	38	4.5	Low	No
CSP-Unknown-4	78	0.28	3.26	0.13	40	4.5	Low	No
FB-Agricultural/Grass-1	6103	0.25	5.49	0.14	49	9.2	High	No
FB-Agricultural/Grass-2	7205	0.25	5.87	0.14	51	10.1	High	No
FB-Agricultural/Grass-3	6730	0.24	6.43	0.14	53	11.3	High	No
FB-Agricultural/Grass-4	2586	0.22	8.62	0.14	57	15.2	High	No
FB-Developed-1	10116	0.28	3.94	0	46	0	Low	No
FB-Developed-2	9075	0.28	4.41	0	45	0	Low	No
FB-Developed-3	5499	0.27	4.72	0	44	0	Low	No
FB-Developed-4	785	0.27	5.08	0	43	0	Low	No
FB-Forest-1	3780	0.21	7.24	0.13	39	8.0	Medium	No
FB-Forest-2	7059	0.21	7.53	0.13	43	8.8	High	No
FB-Forest-3	13753	0.22	8.02	0.13	43	9.7	High	No
FB-Forest-4	8899	0.26	9.63	0.13	35	11.5	High	No
FB-Other-1	172	0.26	5.72	0.13	44	8.6	High	No
FB-Other-2	75	0.26	5.97	0.13	38	7.7	Medium	No
FB-Other-3	76	0.28	6.27	0.13	34	7.6	Medium	No
FB-Other-4	36	0.31	6.70	0.13	33	8.6	High	No
FB-Scrub/Shrub-1	10297	0.24	6.94	0.14	36	8.3	Medium	No
FB-Scrub/Shrub-2	25150	0.25	7.24	0.14	38	9.0	High	No
FB-Scrub/Shrub-3	70895	0.25	7.89	0.13	38	10.0	High	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
FB-Scrub/Shrub-4	70679	0.26	9.05	0.14	39	12.1	High	No
FB-Unknown-1	654	0.30	5.33	0.13	37	7.6	Medium	No
FB-Unknown-2	829	0.29	5.26	0.13	40	7.9	Medium	No
FB-Unknown-3	1062	0.29	5.54	0.13	39	8.2	Medium	No
FB-Unknown-4	299	0.28	6.02	0.13	38	8.4	High	No
FSI-Agricultural/Grass-1	8462	0.32	3.91	0.13	24	3.9	Low	No
FSI-Agricultural/Grass-2	4979	0.33	4.29	0.13	31	5.7	Medium	No
FSI-Agricultural/Grass-3	4808	0.34	4.26	0.13	34	6.3	Medium	No
FSI-Agricultural/Grass-4	1055	0.35	4.11	0.13	36	6.7	Medium	No
FSI-Developed-1	9953	0.29	3.09	0	34	0	Low	No
FSI-Developed-2	4972	0.31	3.22	0	37	0	Low	No
FSI-Developed-3	3350	0.29	3.30	0	36	0	Low	No
FSI-Developed-4	763	0.28	3.31	0	37	0	Low	No
FSI-Forest-1	186	0.33	4.62	0.13	37	7.2	Medium	No
FSI-Forest-2	217	0.35	4.47	0.13	39	7.9	Medium	No
FSI-Forest-3	262	0.37	4.71	0.13	40	9.2	High	No
FSI-Forest-4	111	0.36	4.73	0.13	40	9.2	High	No
FSI-Other-1	266	0.31	3.11	0.13	24	2.9	Low	No
FSI-Other-2	81	0.30	3.29	0.13	25	3.1	Low	No
FSI-Other-3	56	0.31	3.04	0.13	27	3.2	Low	No
FSI-Other-4	15	0.29	3.57	0.13	33	4.4	Low	No
FSI-Scrub/Shrub-1	2241	0.27	4.46	0.13	29	4.5	Low	No
FSI-Scrub/Shrub-2	3911	0.28	4.96	0.13	31	5.7	Medium	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
FSI-Scrub/Shrub-3	7590	0.29	5.05	0.13	34	6.3	Medium	No
FSI-Scrub/Shrub-4	3502	0.30	5.14	0.13	37	7.5	Medium	No
FSI-Unknown-1	1117	0.29	2.83	0.13	27	3.0	Low	No
FSI-Unknown-2	780	0.30	3.44	0.13	32	4.3	Low	No
FSI-Unknown-3	855	0.29	3.41	0.13	31	4.0	Low	No
FSI-Unknown-4	285	0.28	3.21	0.13	32	3.7	Low	No
FSP-Agricultural/Grass-1	13	0.22	2.22	0.13	40	2.5	Low	No
FSP-Agricultural/Grass-2	3	0.22	2.59	0.13	40	3.0	Low	No
FSP-Agricultural/Grass-3	2	0.22	2.69	0.13	40	3.2	Low	No
FSP-Agricultural/Grass-4	0	0.20	2.94	0.12	40	2.9	Low	No
FSP-Developed-1	180	0.26	2.85	0	40	0	Low	No
FSP-Developed-2	13	0.25	2.69	0	40	0	Low	No
FSP-Developed-3	8	0.21	2.25	0	40	0	Low	No
FSP-Developed-4	0	0.21	2.29	0	40	0	Low	No
FSP-Forest-1	8	0.22	2.29	0.14	40	2.9	Low	No
FSP-Forest-2	5	0.20	2.22	0.14	40	2.5	Low	No
FSP-Forest-3	0	0.20	2.22	0.14	40	2.5	Low	No
FSP-Other-1	1307	0.20	2.38	0.14	40	2.7	Low	No
FSP-Other-2	34	0.21	2.36	0.14	40	2.7	Low	No
FSP-Other-3	8	0.22	2.56	0.13	40	3.0	Low	No
FSP-Other-4	0	0.43	4.35	0.12	40	9.3	High	No
FSP-Scrub/Shrub-1	147	0.23	2.68	0.14	40	3.3	Low	No
FSP-Scrub/Shrub-2	18	0.23	2.55	0.14	40	3.3	Low	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
FSP-Scrub/Shrub-3	4	0.20	2.23	0.14	40	2.6	Low	No
FSP-Scrub/Shrub-4	0	0.20	1.70	0.12	40	1.7	Low	No
FSP-Unknown-1	40	0.20	1.87	0.13	40	1.9	Low	No
FSP-Unknown-2	5	0.20	1.99	0.12	40	2.0	Low	No
FSP-Unknown-3	1	0.20	2.39	0.12	40	2.4	Low	No
O-Agricultural/Grass-1	2433	0.20	2.93	0.14	34	2.8	Low	No
O-Agricultural/Grass-2	112	0.21	3.44	0.14	32	3.2	Low	No
O-Agricultural/Grass-3	30	0.23	3.89	0.13	32	3.8	Low	No
O-Agricultural/Grass-4	1	0.26	6.47	0.13	37	7.9	Medium	No
O-Developed-1	8327	0.27	1.37	0	39	0	Low	No
O-Developed-2	474	0.25	2.12	0	40	0	Low	No
O-Developed-3	157	0.26	3.07	0	41	0	Low	No
O-Developed-4	26	0.24	3.89	0	41	0	Low	No
O-Forest-1	235	0.22	6.15	0.13	43	7.6	Medium	No
O-Forest-2	67	0.21	5.07	0.13	45	6.6	Medium	No
O-Forest-3	45	0.21	5.43	0.13	47	7.3	Medium	No
O-Forest-4	20	0.20	5.95	0.13	59	9.0	High	No
O-Other-1	9362	0.25	3.86	0.13	36	4.3	Low	No
O-Other-2	344	0.24	3.32	0.13	35	3.5	Low	No
O-Other-3	120	0.23	4.86	0.13	35	5.0	Low	No
O-Other-4	37	0.22	5.64	0.13	39	6.6	Medium	No
O-Scrub/Shrub-1	688	0.22	4.83	0.13	40	5.7	Medium	No
O-Scrub/Shrub-2	224	0.22	5.80	0.13	36	6.3	Medium	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
O-Scrub/Shrub-3	209	0.22	6.47	0.13	41	7.5	Medium	No
O-Scrub/Shrub-4	96	0.22	6.62	0.13	44	8.2	Medium	No
O-Unknown-1	1236	0.28	1.60	0.12	26	1.5	Low	No
O-Unknown-2	62	0.27	1.48	0.13	36	1.8	Low	No
O-Unknown-3	15	0.29	3.52	0.13	38	4.9	Low	No
O-Unknown-4	7	0.34	3.87	0.12	40	6.6	Medium	No

GLU Nomenclature: Geology – Land Cover – Slope Category

Geology Categories:

CB Coarse Bedrock

CSI Coarse Sedimentary Impermeable

CSP Coarse Sedimentary Permeable

FB Fine Bedrock

FSI Fine Sedimentary Impermeable

FSP Fine Sedimentary Permeable

O Other

Slope Categories:

1 0%-10%

2 10% - 20%

3 20% - 40%

4 > 40%

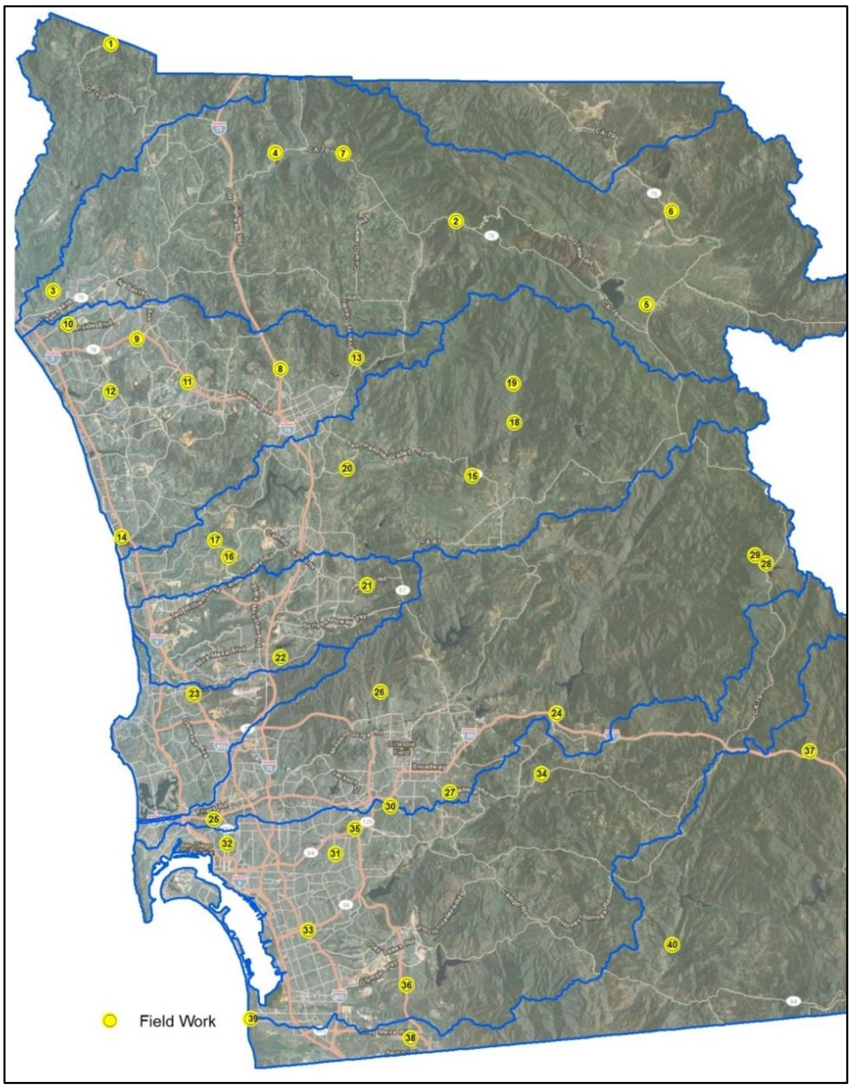
A4.3 Field Assessment

Site Selection:

Forty locations were selected from the study region for field assessment. Sites were selected such that they are accessible by existing road network based on review of satellite imagery and are uniformly distributed considering the following criteria:

- Geologic grouping
- Land cover
- Slope category
- WMA
- Jurisdiction

Yellow circles in the figure below shows the 40 locations for which field assessment was performed.



Pre-Field Activities

Prior to conducting field activities, the consultant team reviewed available published geologic information at each site location and prepared satellite imagery of each site using Google Earth™. Pre-field activities consisted of evaluating site access at each location using aerial imagery and logistics were coordinated based on regional site location to maximize field efficiency.

Site Reconnaissance

Site reconnaissance was performed at forty locations between 22 January and 7 February 2014 by a team of geologists. The reconnaissance consisted of:

- Visual soil classification,
- Assessing existing vegetative cover (0-100%),
- Qualitative assignment of existing sediment production (low, medium, and high) [based on existing vegetative cover],
- Qualitative assignment of potential sediment production (low, medium, and high)[assuming there is 0% vegetative cover], and
- Identifying existing erosional features.

Descriptions and visual classifications of the surficial materials were based on the Unified Soil Classification System (USCS). Underlying geologic units were confirmed where exposed formations were observed within the individual site limits.

SITE AND GEOLOGIC CONDTIONS

Our knowledge of the site conditions has been developed from a review of available geologic literature, previous geologic and geotechnical investigations by the consultant team in the study region, professional experience, site reconnaissance, and field investigations performed for this study.

Surface Conditions

Site locations were sited in open space with the exception of sites ID-27, -30, and -31 which were situated within developed areas with paved streets and sidewalks. The surface conditions at the site locations were characterized by sloping terrain varying from relatively flat (< 5%) to very steep slopes (> 40%). At the time of our reconnaissance the natural hillsides along the areas of interest were covered by varying degrees of moderate to dense growth scrub brush, low grasses, and scattered trees.

Existing erosional and geomorphic features at each site location were identified where possible. The observed erosional features included notable drainages, rilling, scour, and sediment accumulation. Observed geomorphic features included areas of minor slope instability and surficial slumping. Several sources of ground disturbance were identified during the site reconnaissance included active grading operations and bioturbation.

An evaluation of the existing and potential sediment production for each site was determined based on surface conditions. Sediment production was assigned as “high, medium, or low” based on the existing conditions and consultant team’s professional experience.

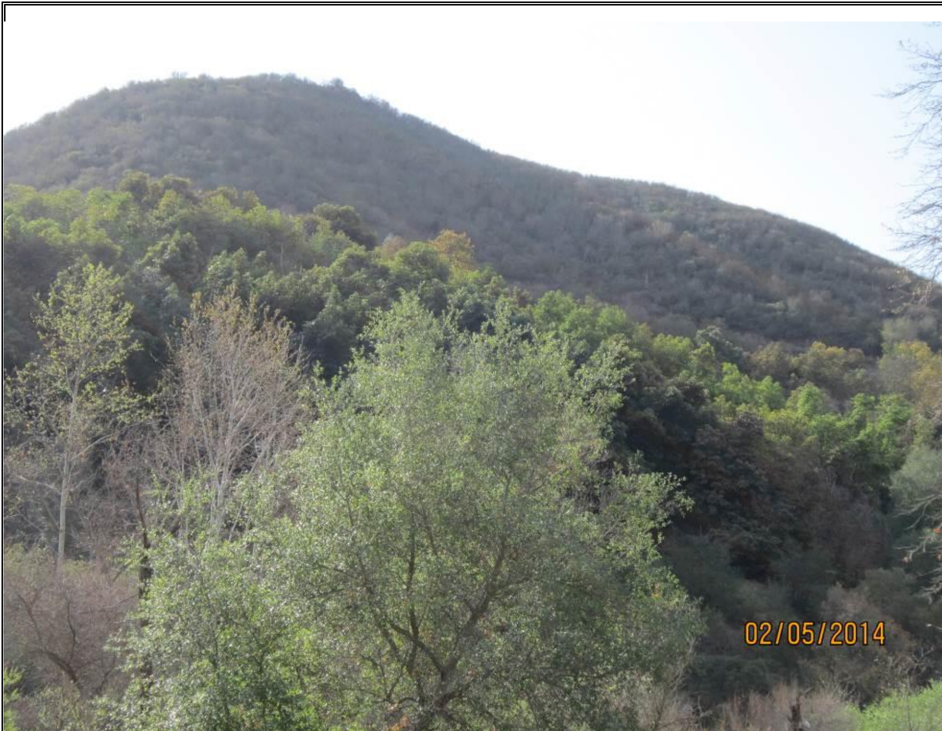
Surficial Deposits

Surficial deposits, including topsoil, alluvium, colluvium, slopewash, and residual soils are present in portions of the study area within the natural drainages and mantling the slope areas. The composition and grain size of these materials are variable depending on the age, parent sources, and mode of deposition.

Geologic Conditions

Our knowledge of the subsurface conditions at the site locations is based on a review of available published geologic information, professional experience, site reconnaissance, previous explorations and geotechnical investigations performed by the consultant team in the study region.

Field Assessment Photo Log



Field Visit ID-1

GLU: CB-Scrub/Shrub-4

View: Looking southwest

Existing sediment production: Med

Potential sediment production: High

Existing veg. cover: 90%

Field Visit ID-2

GLU: CB-Forest-4

View: Looking north

Existing sediment production: Med

Potential sediment production: High

Existing veg. cover: 95%

Field Visit ID-3

GLU: CSI-Agricultural/ Grass-3

View: Looking southwest

Existing sediment production: Low to Med

Potential sediment production:

Med to High

Existing veg. cover:

95-100%

Field Visit ID-4

GLU: CSI-Scrub/Shrub-2

View: Looking north

Existing sediment production: Med

Potential sediment production: High

Existing veg. cover: 70%

<table>
<tr><td>
</td><td>

Field Visit ID-5

GLU: CSP-Agricultural/ Grass-1

View: Looking southwest

Existing sediment production: Low to Med

Potential sediment production: Med

Existing veg. cover: 90%

</td></tr>
</table>

<table>
<tr><td>
</td><td>

Field Visit ID-6

GLU: CSP-Agricultural/ Grass-3

View: Looking east

Existing sediment production: Low to Med

Potential sediment production:

Low to Med

Existing veg. cover: Southeast slope ~50%

Northeast slope ~70%

</td></tr>
</table>

Field Visit ID-7

GLU: CSP-Forest-3

View: Looking east

Existing sediment production: Med to High

Potential sediment production: High

Existing veg. cover: 75-80%

Field Visit ID-8

GLU: CB-Scrub/Shrub-3

View: Looking southeast

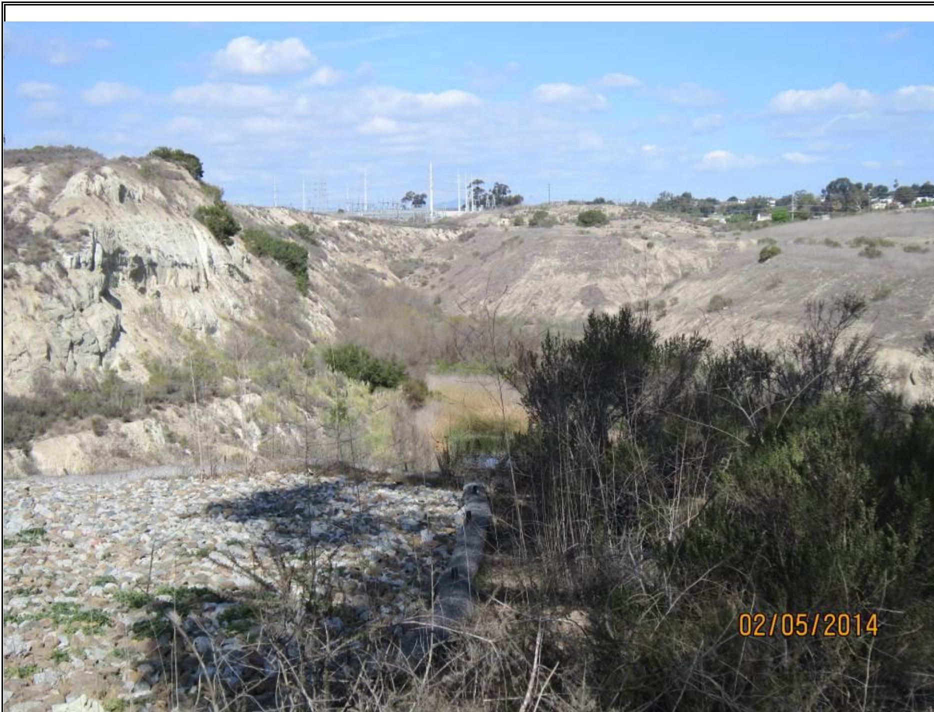
Existing sediment production: Low to Med

Potential sediment production:

Med to High

Existing veg. cover: 90-95%

	**Field Visit ID-9** **GLU: CB-Agricultural/ Grass-2** View: Looking northwest Existing sediment production: Low to Med Potential sediment production: Med Existing veg. cover: 70%

	**Field Visit ID-10** **GLU: CSI-Unknown-2** View: Looking north Existing sediment production: Med to High Potential sediment production: High Existing veg. cover: 75%

Field Visit ID-11

GLU: CSI-Agricultural/ Grass-2

View: Looking east

Existing sediment production: Low

Potential sediment production: Med

Existing veg. cover: 85%

Field Visit ID-12

GLU: CSP-Unknown-2

View: Looking southwest

Existing sediment production: Low

Potential sediment production:

Low to Med

Existing veg. cover: 50%

Field Visit ID-13

GLU: CSP-Scrub/Shrub-2

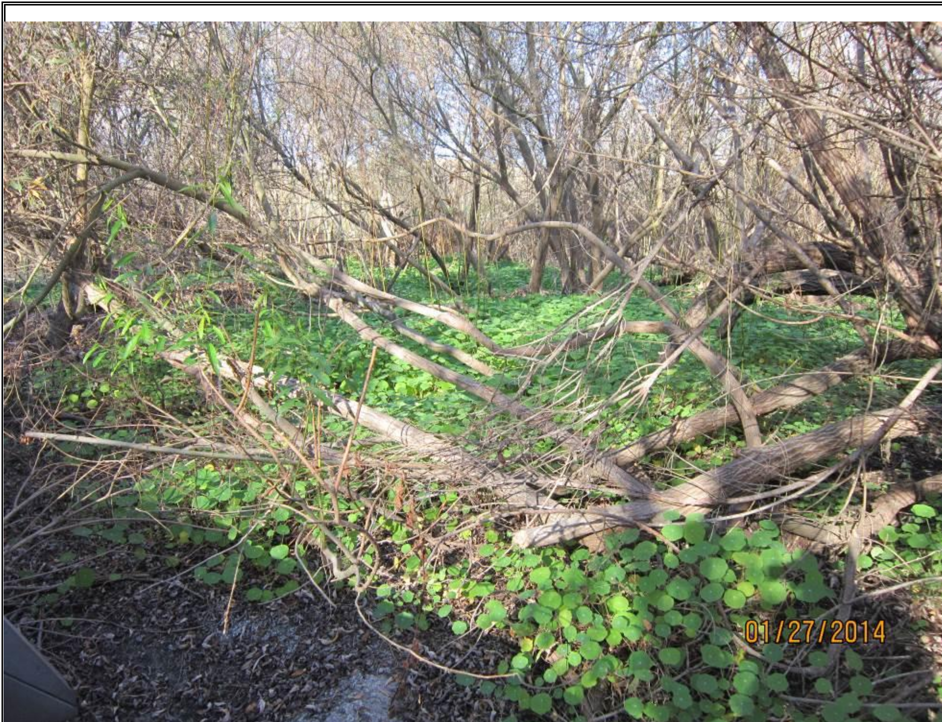
View: Looking southeast

Existing sediment production: Med

Potential sediment production:

Med to High

Existing veg. cover: 80-85%



Field Visit ID-14

GLU: FSP-Scrub/Shrub-1

View: Looking northeast

Existing sediment production: Low

Potential sediment production:

Low to Med

Existing veg. cover:

95-100%

Field Visit ID-15

GLU: CB-Agricultural/ Grass-4

View: Looking west

Existing sediment production: Med

Potential sediment production: High

Existing veg. cover: 95%

.

Field Visit ID-16

GLU: CB-Agricultural/ Grass-3

View: Looking south

Existing sediment production: High*

Potential sediment production: High

Existing veg. cover: 90-95%

* Area was burned in 2014 fires after the field assessment so existing sediment production was adjusted to High (based on potential sediment production) from Medium

Field Visit ID-17

GLU: CSI-Scrub/Shrub-4

View: Looking west

Existing sediment production: Med

Potential sediment production: High

Existing veg. cover: 95%

Field Visit ID-18

GLU: CSP-Forest-1

View: Looking southwest

Existing sediment production: Low to Med

Potential sediment production: Med

Existing veg. cover: 80%

Field Visit ID-19

GLU: CSP-Scrub/Shrub-3

View: Looking southwest

Existing sediment production: Low to Med

Potential sediment production:

Med to High

Existing veg. cover: 60%

Field Visit ID-20

GLU: CSP-Unknown-1

View: Looking southeast

Existing sediment production: Low

Potential sediment production: Med

Existing veg. cover: 95%

Field Visit ID-21

GLU: CB-Unknown-3

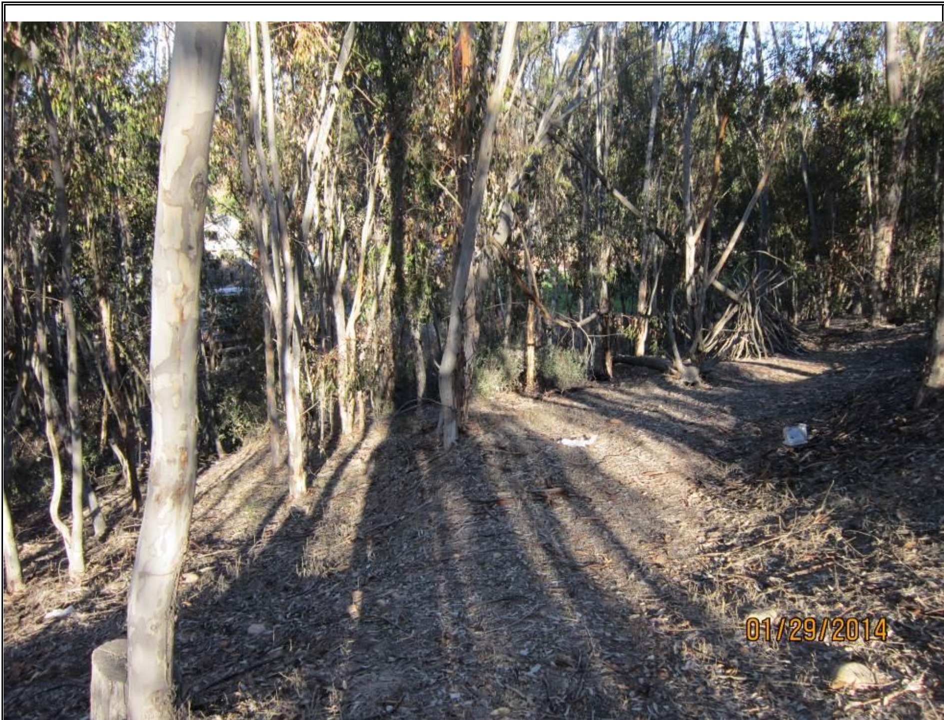
View: Looking northwest

Existing sediment production: Low to Med

Potential sediment production:

Med to High

Existing veg. cover: 50-60%



Field Visit ID-22

GLU: CSI-Forest-3

View: Looking east

Existing sediment production: Low

Potential sediment production: Med

Existing veg. cover: 60%

Field Visit ID-23

GLU: CSI-Scrub/Shrub-1

View: Looking north

Existing sediment production: Low

Potential sediment production: Low

Existing veg. cover: 80%

Field Visit ID-24

GLU: CB-Unknown-4

View: Looking northeast

Existing sediment production: Low to Med

Potential sediment production: High

Existing veg. cover: 80%

	**Field Visit ID-25** **GLU: CSI-Agricultural/ Grass-4** View: Looking east Existing sediment production: Low Potential sediment production: Med-High Existing veg. cover: 95%

	**Field Visit ID-26** **GLU: CSI-Scrub/Shrub-3** View: Looking east Existing sediment production: Low Potential sediment production: Med Existing veg. cover: 100% .

Field Visit ID-27

GLU: CSP-Developed-2

View: Looking north

Existing sediment production: Low

Potential sediment production: Low

Existing veg. cover: 30-35%

.

Field Visit ID-28

GLU: CSP-Agricultural/ Grass-2

View: Looking north

Existing sediment production: Low

Potential sediment production: Med

Existing veg. cover: 90-95%

.

Field Visit ID-29

GLU: FB-Forest-3

View: Looking northwest

Existing sediment production: Med

Potential sediment production: High

Existing veg. cover: 80-85%

Field Visit ID-30

GLU: CB-Developed-4

View: Looking northeast

Existing sediment production: Low

Potential sediment production: Med

Existing veg. cover: 70%

.

Field Visit ID-31

GLU: CSI-Developed-3

View: Looking north

Existing sediment production: Low

Potential sediment production: Low

Existing veg. cover: 30-35%

Field Visit ID-32

GLU: CSI-Unknown-3

View: Looking west

Existing sediment production: Low to Med

Potential sediment production: Med

Existing veg. cover: 70-75%

	**Field Visit ID-33** **GLU: CSP-Scrub/Shrub-1** View: Looking northeast Existing sediment production: Low to Med Potential sediment production: Med to High Existing veg. cover: 70%

	**Field Visit ID-34** **GLU: CSP-Developed-2** View: Looking south Existing sediment production: Low Potential sediment production: Low Existing veg. cover: 95%

	**Field Visit ID-35** **GLU: FB-Scrub/Shrub-3** View: Looking northeast Existing sediment production: Low Potential sediment production: Med Existing veg. cover: 90-95%

	**Field Visit ID-36** **GLU: FSI-Agricultural/ Grass-2** View: Looking northeast Existing sediment production: Low Potential sediment production: Med Existing veg. cover: 95%

	**Field Visit ID-37** **GLU: CB-Forest-3** View: Looking southeast Existing sediment production: Med-High Potential sediment production: High Existing veg. cover: 75-80%

	**Field Visit ID-38** **GLU: CSI-Agricultural/ Grass-1** View: Looking northeast Existing sediment production: Low Potential sediment production: Med Existing veg. cover: 85%

Field Visit ID-39

GLU: CSP-Developed-1

View: Looking west

Existing sediment production: Low

Potential sediment production: Low

Existing veg. cover: 30-35%

Field Visit ID-40

GLU: CSP-Scrub/Shrub-4

View: Looking south

Existing sediment production: Med

Potential sediment production: High

Existing veg. cover: 90-95%

Geologic Group

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

Potential Critical Coarse Sediment Yield Areas

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

ATTACHMENT A.5

PHYSICAL STRUCTURES

A.5 Physical Structures

The desktop-level analysis to identify existing physical structures within the nine watershed management areas within the San Diego region utilized the following GIS data sources:

- ESRI ArcMap, Google Earth, and Google Maps products
- Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) Flood Profiles and FEMA Flood Insurance Rate Map (FIRM)
- National Flood Hazard Layer (NFHL)
- Municipal master drainage plans (as provided)
- San Diego Geographic Information Source (SanGIS) Municipal Boundaries and Hydrologic Basins
- United States Geological Survey (USGS) National Hydrography Dataset (NHD) California data
- Stream data generated as indicated in Section 2.2

The following documents the process used to identify the physical structures along the reaches and the resulting GIS data:

- The process began by importing the data sources indicated above into a single ArcMap document that served as a master map file from which all further analysis proceeded.
- The data were screened and selected for inclusion as appropriate to the project scope.
- Point features were placed along river reach line segments to coincide with visually identified structures, utilizing different feature symbols according to the type of infrastructure.
- In the case of levees, the point was placed at the downstream-most end of the FEMA NFHL Shapefile. All point features generated in this task appear in the GIS shapefile.
- Municipal boundaries intersecting river reaches were identified to identify the applicable municipal drainage plan data.
- Point feature attributes and associated information for Physical Structures GIS shapefile is indicated in Table A.5.1 below.

Table A.5.1: Structure Identification Point Feature Attribute Development and Information

Attribute	Description
Struct_ID	The Structure ID field provides a six-digit identification number based upon the structure's specific location within a watershed. The first three digits in the code reflect the structure's Hydrologic Unit (HU) Basin number (ranging between 902-911 for Region 9, as defined in the Water Quality Control Plan for the San Diego Basin). The subsequent three digits reflect the structure's location along the reach, ascending along the channel from the headwaters to tailwaters (ranging between 001-999, beginning at the confluence and increasing in the upstream direction).

Attribute	Description
WMA	The Watershed Management Area field provides the name of the watershed in which the structure exists. The WMA corresponds with the HU identified in the first three digits in the Struct_ID (e.g., 911, Tijuana Watershed).
Channel_ID	The Channel ID field provides the name of the channel in which the structure exists.
Struct_Typ	The Structure Type field classifies known structures as one of the following types:, Bridge, Culvert, Dam, Energy Dissipater, Flood Management Basin, Flood Wall, Grade Control, Levee, Pipeline, Weir.
Struct_Dtl	The Structure Detail field provides known quantitative information for multi-section culverts.
Struct_Mtl	The Structure Material field provides known qualitative information for structure material composition.
Struct_Shp	The Structure Shape field provides known geometric information for culvert shapes, and is classified as one of the following types: Arch, Box, Pipe.
Jurisd_ID	The Jurisdiction ID field, when applicable, provides the known separate structure identification number developed and utilized by the jurisdiction or entity responsible for creating and distributing the coinciding structure Shapefile data used for this analysis. This number was copied from the coinciding external Shapefile data attribute field best representing a unique jurisdiction or entity-based identification number (external Shapefile data received from regional WMAA data call; for jurisdictional information, see "Other" attribute field). Coinciding external Shapefile data was used to determine various structure attributes.
Plan_ID	The Plan ID field, when applicable, provides the known structure plan number corresponding with the Jurisdiction ID. This number was copied from the coinciding external Shapefile data attribute field best representing a unique plan number received from the regional WMAA data call (external Shapefile data received from regional WMAA data call; for jurisdictional information, see "Other" field). Coinciding external Shapefile data was used to determine various structure attributes.
Diameter	The Diameter field, when applicable, provides the known diameter (in US feet) for culverts.
Length	The Length field, when applicable, provides the known length (in US feet) for select structure types. When lengths were determined using FEMA FIS Flood Profiles, the scaled horizontal distances along the indicated roadway or channel slope were used.
Width	The Width field, when applicable, provides the known width (in US feet) for select structure types.
Height	The Height field, when applicable, provides the known height (in US feet) for select structure types. When heights were determined using FEMA FIS Flood Profiles, the scaled vertical distances from channel bed to indicated roadway bottom were used.
US_Invert	The Upstream Invert field, when applicable, provides the known upstream invert elevation (in US feet) for select structure types.
DS_Invert	The Downstream Invert field, when applicable, provides the known downstream invert elevation (in US feet) for select structure types.

Attribute	Description
RD_EL_NAVD	The Roadway Elevation (NAVD) field, when applicable, provides the known roadway elevation (in US feet, NAVD) for select structure types. When roadway elevations were determined using FEMA FIS Flood Profiles, the horizontal projection onto the vertical grid scales were used.
Loc_Descr	The Location Description field, when applicable, provides information for structures crossing a known roadway. In nearly all cases, Google Earth imagery was used to determine the roadway name.
Other	The Other field is used to convey any information not present within the preceding fields. Typically, "other" information includes jurisdictional, plan, and supplemental dimensions for a given structure.

Example Structure Identification

The following example demonstrates the structure identification process for a discrete structure (ID 907029) along the San Diego River. The San Diego River is located in the San Diego River watershed (WMA 907). Scanning the river from lower to higher reached, a new point feature was placed at the road crossing over the San Diego River as indicated in Figure A.5.1. Select attributes of this particular structure were available from the FEMA NFHL as displayed in the highlighted boxes in Figure A.5.1. Additional attributes such as the culvert height, length, roadway elevation, and name were also determined from the FIS Flood Profile as indicated in Figure A.5.2. Satellite imagery (e.g., Google) was used to verify the existence of structure. In this case, the most current Google Map data indicated that the culvert still exists and that the roadway name has been changed to Qualcomm Way. When structures could not be verified with satellite imagery, the structure identification was based solely upon the information provided or readily available and was not physically verified in the field. Figure A.5.3 displays an example of imagery used to identify structures.

Figure A.5.1: Typical ArcMap Window

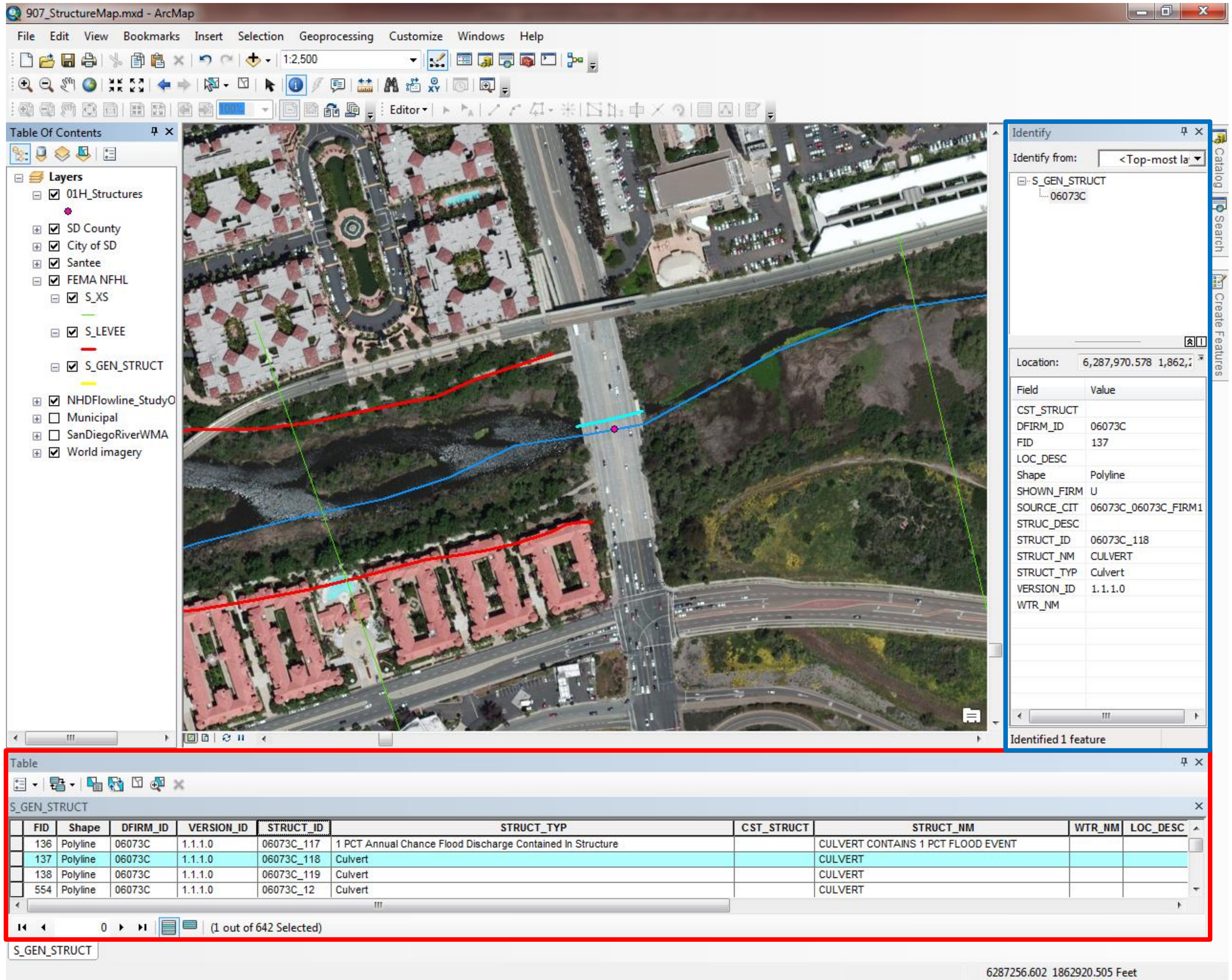
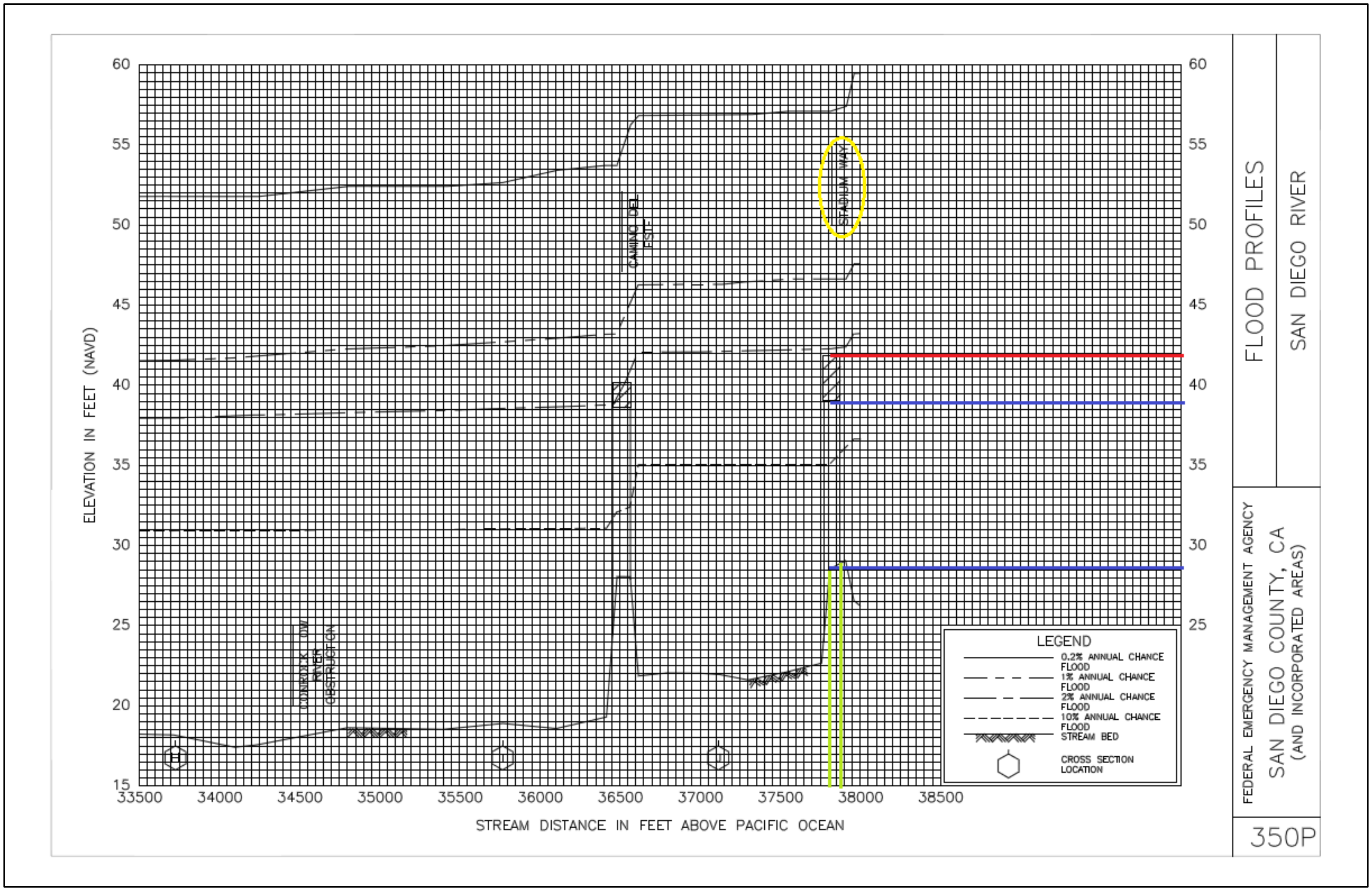


Figure A.5.2: Typical FEMA FIS Flood Profile



Legend: roadway elevation (red), roadway name (yellow), culvert height (blue), culvert width (green)

Figure A.5.3: Google Map Imagery for Structure Identification

The following bridge structure dimensional attributes were included in the point feature attributes:

- length 110 feet
- height 10 feet
- roadway elevation 41.9 feet

The attribute table associated with the identified structure included in the GIS shapefile is indicated in Table A.5.2.

Table A.5.2: Structure 907029 Attribute Table

Attribute	Description
Struct_ID	907029
WMA	San Diego
Channel_ID	San Diego River
Struct_Typ	Culvert
Struct_Dtl	
Struct_Mtl	
Struct_Shp	
Jurisd_ID	06073C_118
Plan_ID	06073C_06073C_FIRM1
Diameter	0
Length	110
Width	0
Height	10
US_Invert	0
DS_Invert	0
RD_EL_NAVD	41.9
Loc_Descr	Qualcomm Way
Other	Info from FEMA NFHL shapefile data/FIS FP V.9-350P

Watershed Management Area Streams with Channel Structures

San Diego River Watershed - HU 907.00, 436 mi2

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

ATTACHMENT B

HYDROMODIFICATION MANAGEMENT APPLICABILITY/EXEMPTIONS

ATTACHMENT B.1

EXEMPT RIVER REACH

B.1.1 Exempt River Reaches

B.1.1.1 Approach for Exempt River Reach Analysis

The approach selected in this cumulative hydromodification impacts study accounts for: (1) hydrology, (2) channel geometry, (3) bed and bank material, and (4) sediment supply. The selected approach compares long-term changes in sediment transport capacity, or in-stream work, and sediment supply for the existing and future development conditions. The ratio of future/existing condition transport capacity, or work, is termed Erosion Potential (Ep). The ratio of future/existing condition bed sediment supply is termed Sediment Supply Potential (Sp). To calculate Ep, the hydrology, channel geometry, and bed/bank materials are characterized for the existing and future conditions. To calculate Sp, the sediment supply factor is characterized for the existing and future conditions.

The findings in this study propose exemption for a given river reach if the analysis satisfies the following criteria:

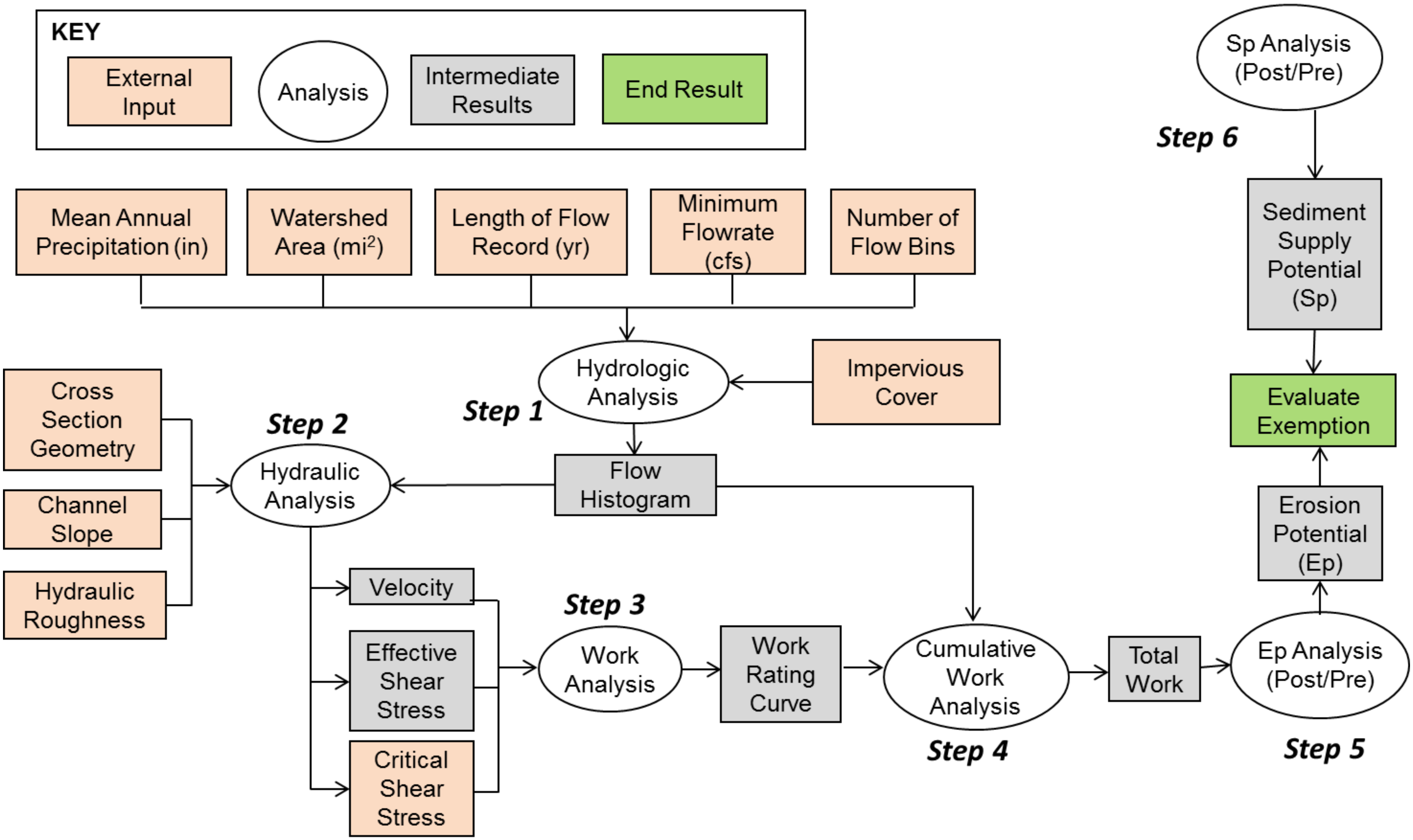
- Ep < 1.05 when d50 < 16 mm or Ep < 1.20 when d50 > 16 mm, and;
- Sp > 0.90

The following bullet points provide basis for the criteria listed above:

- For Ep
    - According to the Journal of Hydrology article titled Channel Enlargement in Semiarid Suburbanizing Watersheds: A Southern California Case Study (Hawley and Bledsoe, 2013): "*The threshold corresponding to the presence/absence of headcutting varied based on substrate type, and was roughly quantified as a sediment-transport ratio greater than ~1.20 in systems with a median grain size > 16mm, and [Ep] ~ 1.05 when d_{50} < 16 mm*"
- For Sp
    - Soar and Thorne (2001) indicate that a greater than 10% reduction in sediment supply can have potentially significant effects on stream stability.
    - SCCWRP Technical Report 605, 2010 states that changes of less than 10% in either driver (Water delivery and sediment are the drivers in this report) are unlikely to instigate, on their own, significant channel changes.

The flow chart summarizing the analysis procedure is presented below.

Flowchart for Exempt River Reach Analysis



B.1.1.2 Selection of Inputs for Exempt River Reach Analysis

The following steps were implemented for each river reach:

- Step 1 – Hydrologic Analysis:
    - Due to limited flow data, a flow duration equation developed for Southern California (Hawley and Bledsoe, 2011) was used to estimate existing and future flow histograms for each watershed.
    - The change in impervious cover between existing and future development conditions was estimated using the developable land use layer from Section 2.3.
    - A desktop-level GIS exercise was performed to manually assign land use classifications if the parcel in the developable land use layer directly discharges into the analyzed reach. Results are summarized in Section B.1.13.
    - Assumptions for percent imperviousness for each land use type were based on the information provided in the San Diego County Imperviousness Study (County of San Diego, 2010).
    - The table below presents the input parameters used to construct flow histograms, as well as the estimated channel slope at the critical cross section.

Exempt River Reach	Area (sq. miles)	Mean Annual Precipitation (in)	Length of Daily Flow Record (Years)	Channel Slope (ft/ft)
San Diego River	173	14.5	30	0.0012

- Step 2 – Hydraulic Analysis: The reach type classification from Section 2.2 was used to identify the critical cross section along the reach for Ep analysis. A critical flow rate of $0.5Q_2$ was assigned to estimate the critical shear stress for the analyzed cross section. Flow rates below $0.5Q_2$ were assumed to perform no work on the reach.
- Step 3 – Work Analysis: The simplified effective work equation shown below is used to calculate the work done for each flow bin.

$$W = (\tau - \tau_c)^{1.5} V$$

  Where

  W = Work (dimensionless)
  τ = effective Shear Stress [lb/ft^2]
  τ_c = Critical Shear Stress [lb/ft^2]
  V = Flow Velocity [ft/s]
- Step 4 – Cumulative Work Analysis: Cumulative work is a measure of the long-term total work or sediment transport capacity performed at a given stream location. Cumulative work incorporates both discharge magnitude and flow duration distributions for the full range of simulated flow rates. Cumulative work is calculated by multiplying work and duration for each bin. Total work is calculated through summation of work from all flow bins.
- Step 5 – Ep Analysis: Ep is calculated by dividing the total work of the future condition by that of the existing condition. The existing river reaches analyzed appear relatively stable and have not experienced excessive geomorphic instability due to the alteration of

the drainage areas. Given the stable condition of the existing channels, the existing condition was used as the baseline condition instead of natural. Results from the Ep analysis are presented in Section B.1.1.3.

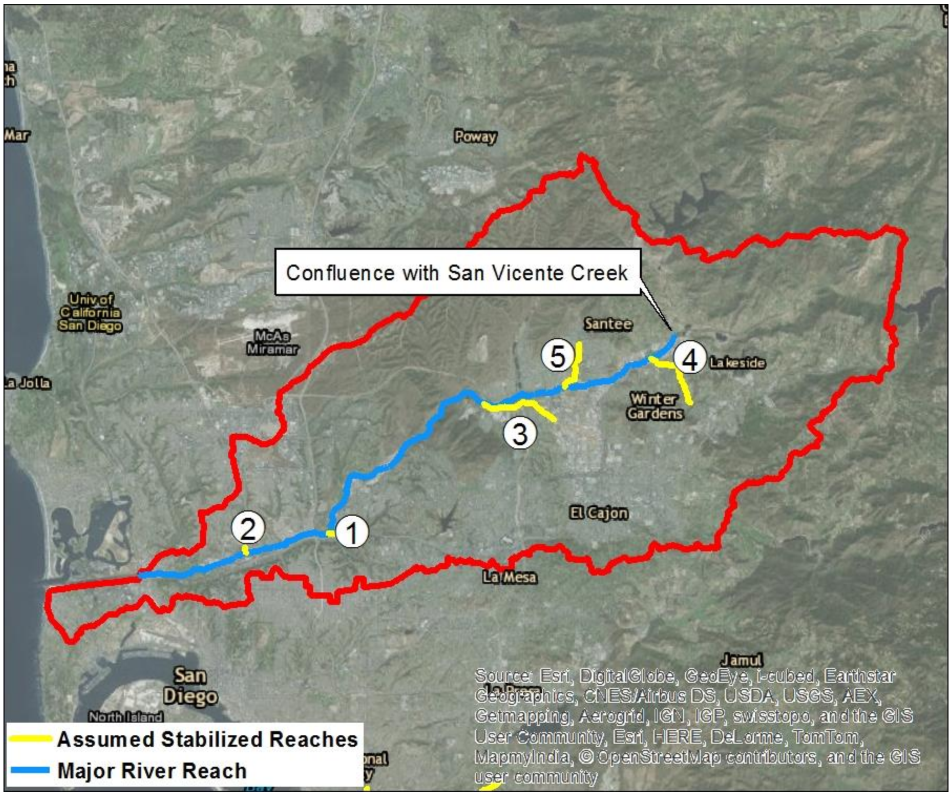
- Step 6 – Sp Analysis: Coarse Sediment Supply Potential for each watershed was estimated using the quantitative results from Section 2.4. First, the watershed coarse sediment soil loss was estimated for all GLUs producing coarse sediment. Then, the future-condition coarse sediment soil loss was estimated by subtracting the approximate exempt parcel soil loss from the existing soil loss. Sp is ultimately calculated by dividing the future coarse sediment soil loss by the existing coarse sediment soil loss. Results from Sp analysis are presented in Section B.1.1.3.

Steps 1 to 5 were performed in Excel and Steps 1 and 6 were executed in GIS. Ep estimates for the exempt river reaches are included in this attachment.

Exempt river reach extents are shown in the figure below. Figure also indicate the tributaries assumed to be stable for performing the erosion potential analysis as a conservative approach to approximate potential HMP exempt flows that may enter the river reach being analyzed.

For a PDP draining to one of the assumed stable tributaries shown in the following exempt reach figure, the PDP applicant shall verify and document that the assumed stable tributary is a stabilized conveyance system by using the methodology presented in section 4.1.2 prior to claiming exemption from hydromodification management requirements.

For a PDP draining to a tributary not shown in the figure below to be considered for exemption, a stability analysis using the section 4.1.2 methodology is to be conducted for the given tributary. If the stability analysis determines the tributary is stable, then the exempt river reach analysis indicated in section 4.1.1 shall be performed by adding the additional stabilized tributary to the current list of tributaries shown in the figure below to confirm that the reach satisfies the Ep and Sp criteria.



Extents of San Diego River and extents of assumed Stabilized Reaches: 1) Alvarado Creek; 2) Civita Channel; 3) Forester Creek; 4) Los Coches Creek and 5) Woodglen Vista Creek

The table below presents the summary of the developable land in each of the five watersheds with the exempt river reach and the estimated developable area that will be exempted from hydromodification management area requirements if the exempt river reach exemption is reinstated. This area will still be subject to the pollutant control requirements from the regional MS4 permit.

Exempt River Reach	Developable Land		
	Total (acres)	Area exempt (acres)	Exempt (%)
San Diego River	13,667	1,196	9%

B.1.1.3 Results from Exempt River Reach Analysis

Results from Erosion potential analysis are presented below:

Exempt River Reach	Area (acres)	Impervious Area (acres) [%]			Ep (Post/Pre) [Criteria<1.05]
		Pre	Post	Increase	
San Diego River	111,006	32,106[28.9]	32,777[29.5]	671 [0.6]	1.03

Results from coarse sediment supply potential analysis are presented below:

Exempt River Reach	Soil Loss (tons/yr.)			Sp (Post/Pre) [Criteria>0.90]
	Pre	Exempt Parcels	Post [Pre – Exempt Parcels]	
San Diego River	354,619	2,575	352,044	0.99

Based on the results from the analysis it is recommended that exemption be reinstated for San Diego River.

Erosion Potential Analysis for San Diego River

Erosion Potential (Ep)	1.03

Channel Slope	0.0012	ft/ft
Estimated Q_2	436	cfs
$0.5Q_2$	218	cfs
Critical Shear	0.109	lb/sq. ft
γ	62.4	lb/ft^3

			Existing Condition	**Future Condition**
Tributary Area	*A*	sq mi	173	173
Mean Annual Precip	*MAP*	in/yr	14.5	14.5
Length of Daily Flow Record	*Yr*	yr	30	30
Imperviousness	*Impav*	mi^2/mi^2	0.2892	0.2953
Maximum Flow of Record	*Qmax*	cfs	6336.8	6336.8
Minimum Flow of Record	*Qmin*	cfs	0.01	0.01
10-year peak flow	*Q10*	cfs	12411.4	12411.4
Coefficient of DDF	*day1*	days & cfs	48535.40	52754.33
Exponent of DDF	*day2*	days & cfs	-0.88	-0.88
Number of Bins	N_B	--	25	25
Bin Size	$H_{B\text{-}log}$	--	0.557	0.557

Bin Number	Lower Bound of Bin Number	Upper Bound of Bin Number	Flow	Hydraulic Radius	Flow Velocity	Shear Stress	Work	Duration	Cumulative Work	Duration	Cumulative Work
B	$B_{lwr\text{-}log\ (cfs)}$	$B_{upr\text{-}log\ (cfs)}$	*Q (cfs)*	*R (ft)*	*v (ft/s)*	τ (psf)	*W*		*W*duration*		*W*duration*
1	0.006	0.010	0.01	0.00	0.02	0.000	0.000	3404271	0.00	3830691	0.00
2	0.010	0.017	0.01	0.00	0.02	0.000	0.000	2089074	0.00	2341409	0.00
3	0.017	0.030	0.02	0.00	0.03	0.000	0.000	1281986	0.00	1431125	0.00
4	0.030	0.053	0.04	0.01	0.04	0.001	0.000	786707	0.00	874737	0.00
5	0.053	0.093	0.07	0.01	0.05	0.001	0.000	482773	0.00	534660	0.00
6	0.093	0.162	0.13	0.01	0.07	0.001	0.000	296259	0.00	326797	0.00
7	0.162	0.282	0.22	0.02	0.08	0.001	0.000	181803	0.00	199746	0.00
8	0.282	0.492	0.39	0.02	0.10	0.001	0.000	111566	0.00	122090	0.00
9	0.492	0.859	0.68	0.03	0.13	0.002	0.000	68464	0.00	74624	0.00
10	0.859	1.499	1.18	0.04	0.16	0.003	0.000	42014	0.00	45612	0.00
11	1.499	2.615	2.06	0.06	0.20	0.004	0.000	25782	0.00	27879	0.00
12	2.615	4.562	3.59	0.09	0.25	0.007	0.000	15822	0.00	17040	0.00
13	4.562	7.960	6.26	0.12	0.31	0.009	0.000	9709	0.00	10415	0.00
14	7.960	13.889	10.92	0.17	0.39	0.013	0.000	5958	0.00	6366	0.00
15	13.889	24.234	19.06	0.23	0.49	0.017	0.000	3656	0.00	3891	0.00
16	24.234	42.283	33.26	0.33	0.61	0.025	0.000	2244	0.00	2378	0.00
17	42.283	73.776	58.03	0.45	0.76	0.034	0.000	1377	0.00	1454	0.00
18	73.776	128.724	101.25	0.63	0.94	0.047	0.000	845	0.00	889	0.00
19	128.724	224.597	176.66	0.87	1.17	0.065	0.000	519	0.00	543	0.00
20	224.597	391.875	308.24	1.20	1.45	0.090	0.000	318	0.00	332	0.00
21	391.875	683.742	537.81	1.65	1.80	0.124	0.003	195	0.60	203	0.62
22	683.742	1192.991	938.37	2.25	2.21	0.168	0.032	120	3.81	124	3.94
23	1192.991	2081.525	1637.26	3.00	2.68	0.225	0.105	74	7.72	76	7.96
24	2081.525	3631.836	2856.68	3.80	3.13	0.285	0.230	45	10.36	46	10.64
25	3631.836	6336.812	4984.32	4.06	3.28	0.304	0.282	28	7.80	28	7.98

ATTACHMENT B.2

HYDROMODIFICATION MANAGEMENT EXEMPTION MAPPING

Receiving Waters and Conveyance Systems Exempt from Hydromodification Management Requirements

Exhibit Date: Sept. 8, 2014

ATTACHMENT C
ELECTRONIC FILES

Electronic Folder titled “San Diego River_WMAA_Attachment C Electronic_Data.zip” Contents:

1. ArcMap 10.0 and 10.1 map files created for purpose of viewing Regional WMAA data
   - WMAA_07_SanDiegoRiver_Data_2014_0908_v10 .mxd
   - WMAA_07_SanDiegoRiver_Data_2014_0908_v101.mxd
2. ESRI Geodatabase titled "WMAA_07_SanDiegoRiver_Data_2014_0908_v10.gdb" containing the following data:
   - WatershedBoundaries
     - Watershed_Boundaries
   - HydrologicProcesses
     - HRUAnalysis
   - Streams – description of existing streams in the watershed
     - SD_Regional_WMAA_Streams (streams selected for detailed analysis)
     - SD_NHD_Streams (portion of NHD dataset included for reference)
   - LandUsePlanning
     - SanGIS_ExistingLandUse
     - SanGIS_PlannedLandUse
     - SanGIS_DevelopableLands
     - SanGIS_RedevelopmentandInfill
     - SanGIS_MunicipalBoundaries
     - Federal_State_Indian_Lands
     - SanGIS_MHPA_SD
     - SanGIS_MSCP_CN
     - SanGIS_MSCP_EAST_DRAFT_CN
     - SanGIS_Draft_North_County_MSCP_Version_8_Categories
   - PotentialCoarseSedimentYield
     - GLUAnalysis
     - PotentialCoarseSedimentYieldAreas
     - MacroLevelPotentialCriticalAreas
     - PotentialCriticalCoarseSedimentYieldAreas
   - ChannelStructures
     - ChannelStructures
   - HydromodExemptions
     - Exempt_Systems
     - Exempt_Bodies
   - Floodplains: included for reference
     - FEMA_NFHL
   - Baselayers: included for reference
     - SanGIS_Lakes
     - link to ESRI World Imagery (internet connection is required to access ESRI World Imagery basemap)

Electronic Folder titled "San Diego River_WMAA_Attachment C Electronic_Data.zip" Contents, continued:

3. Google Earth – KMZ file titled: "WMAA_07_SanDiegoRiver_Data_2014_0908_GoogleEarth"**,** containing the following data:
   - WatershedBoundaries
   - Streams
     - SD Regional WMAA Streams (streams selected for detailed analysis)
     - SD NHD Streams (portion of NHD dataset included for reference)
   - LandUsePlanning
     - Municipal Boundaries
     - Federal/State/Indian Lands
   - ChannelStructures
   - HydromodExemptions
     - Exempt_Systems
     - Exempt_Bodies
   - Floodplains: included for reference
     - FEMA Floodplain
   - Dominant Hydrologic Processes
   - Potential Critical Coarse Sediment Yield Areas

Notes:
- Open a map file (with extension .mxd) using ArcMap to view the data.
- All data contained in the geodatabase is loaded into the map.

ATTACHMENT D
REGIONAL MS4 PERMIT CROSSWALK

Table below provides a linkage between the Regional MS4 Permit requirements for WMAA and this report.

Regional MS4 Permit Provision	Regional WMAA Report
B.3.b.(4)(a)	Chapter 2; Section 5.1; Attachment A and Attachment C
B.3.b.(4)(a)(i)	Section 2.1; Attachment A.1 and Attachment C
B.3.b.(4)(a)(ii)	Section 2.2; Attachment A.2 and Attachment C
B.3.b.(4)(a)(iii)	Section 2.3; Attachment A.3 and Attachment C
B.3.b.(4)(a)(iv)	Section 2.4; Attachment A.4 and Attachment C
B.3.b.(4)(a)(v)	Section 2.5; Attachment A.5 and Attachment C
B.3.b.(4)(b)	Chapter 3 and Section 5.2
B.3.b.(4)(c)	Chapter 4; Section 5.3; Attachment B and Attachment C

APPENDIX 3I ALTERNATIVE BMP IMPLEMENTATION SCENARIO METHODOLOGY

An alternative modeling analysis was performed for the San Diego River watershed (City of San Diego jurisdiction only) as part of the Water Quality Improvement Plan. The pollutant loads from Non-Phase I MS4s (Non-MS4s) can be differentiated from Phase I MS4s (MS4s) loads to more accurately and fairly assess load reduction responsibilities. The purpose of this analysis is to foster future discussions about accurate and fair apportionment of pollutant reduction responsibilities in the subwatershed to ensure that Non-MS4 discharges are regulated before they enter a MS4 to improve water quality throughout the watershed. The current analysis does not differentiate between MS4 loads and Non-MS4 loads. This baseline analysis represents the primary scenario included in this Water Quality Improvement Plan, which provided the foundation for the alternative modeling analysis that was used to estimate MS4 and Non-MS4 loads.

This appendix describes the methodology that was used to perform the alternative analysis, which focused on removing Non-MS4 areas to allow for BMP optimization within MS4 areas to achieve the required MS4 load reductions to meet the Water Quality Improvement Plan numeric goals while maintaining cost efficiencies. There are four classifications that constitute Non-MS4 areas, as summarized below:

- Areas covered by NPDES General Permit No. CA CAS000004—Waste Discharge Requirements for Storm Water Discharges from Small MS4s (General Phase II Permit)
- Industrial Areas, some of which may be covered by NPDES General Permit No. CAS000001 – Waste Discharge Requirements for Dischargers of Storm Water Associated with Industrial Activities Excluding Construction Activities (Industrial General Permit)
- Agricultural areas, some of which may addressed by the Conditional Waiver of Discharges from Agricultural and Nursery Operations (Ag Waiver)
- Areas identified as Federal and State lands (and Indian lands, if present)

Alternative scenario results are presented in Section 4.4. The MS4s will continue to refine and update the alternative scenario analysis, and engage stakeholders in a dialogue about how all the responsible parties within the watershed can work together to achieve the numeric goals in the Water Quality Improvement Plan. For example, the current list of Industrial General Permit (IGP) non-filers could be added to the analysis to more accurately estimate load reduction responsibilities for industrial dischargers within the watershed.

Alternative Scenario: Remove Non-MS4 Areas

The baseline watershed model was used to estimate the load reduction requirement for MS4 areas. The contributing load from MS4 areas was derived from the model output.

The required load reduction was then calculated based on multiplying the MS4 load by the percent reduction numeric goal. It is important to note that the overall watershed load reduction goal would be met through reductions by both the MS4s and Non-MS4s, thereby maintaining equity among all dischargers. Estimated load reductions were based on the relative loading from each responsible discharger in the watershed.

After defining the load reduction requirement for MS4 areas, BMP optimization using the EPA-released SUSTAIN (version 1.2) model was performed. BMP optimization refers to the modeling analysis that was conducted to identify the “optimal” structural BMP opportunities (considering BMP size, type, and location in the watershed) that would achieve the load reduction with the lowest cost. The following Figure 1rovides a conceptual diagram that summarizes the alternative modeling approach. Non-MS4 areas were removed from the modeling analysis.

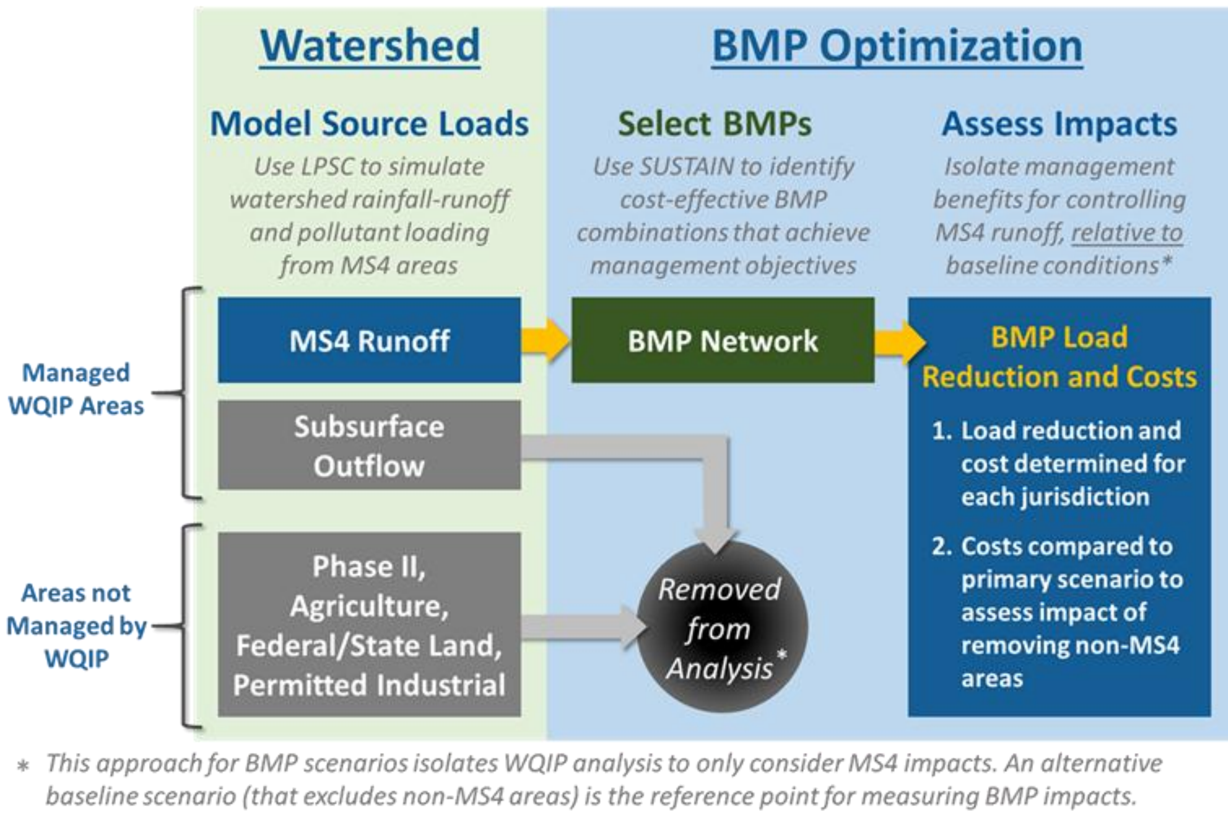


Figure 1 Conceptual Modeling Approach

The modeling analysis was performed following the same methodology as in the primary scenario (for the entire watershed), except BMPs were optimized to treat runoff from MS4 areas only and a two-tiered optimization approach was used. This approach provides BMP optimization first at the subwatershed level (Tier 1), then watershed-wide to meet the load reduction target (Tier 2).

Technical Notes and Assumptions

- Areas associated with each Non-MS4 category were delineated based on GIS analysis. Industrial areas are represented by facilities that are currently registered in the Industrial General Permit (IGP) program (from California's SMARTS database). GIS was used to identify the area associated with each facility (based on review of the SANDAG parcel layer and aerial photography). Current Phase II permit areas were also delineated based on review of the SANDAG parcel layer and aerial photography, as well as review of available maps showing the spatial extent of Phase II permitted areas. SANDAG land use data were used to identify agricultural areas and Federal/State/Indian lands.
- Non-Modeled Nonstructural strategies. Although these programs primarily reduce loads from MS4 areas, they implicitly provide benefits to MS4s and Non-MS4s through various programs. For example, MS4 industrial inspection activities help reduce pollutant loads from industrial areas. The ratio of MS4 and Non-MS4 pollutant loading within the watershed was used to estimate the load reduction associated with each MS4/Non-MS4 category. This adjustment was also needed to maintain the estimated 10 percent load reduction associated with this BMP category.
- Modeled Nonstructural BMPs (catch basin cleaning, street sweeping, irrigation reduction, downspout disconnects, and rain barrels incentives) and Green Infrastructure (GI) were assumed to reduce loads from MS4 areas only.
- Multiuse Treatment Areas (MUTAs) and Green Streets. These BMPs generally treat large drainage areas that may include MS4 and Non-MS4 areas. Within each BMP drainage area, MS4 and Non-MS4 loads were estimated based on the modeled pollutant load generated within each drainage area. Pollutant load estimates were based on land use characteristics and other factors that influence pollutant loading. The ratio of MS4 and Non-MS4 areas within each BMP drainage area was used to estimate the load for each MS4/Non-MS4 category.

Intentionally Left Blank

List of Appendices and Attachments for Chapter 4

Chapter 4 – Appendix A: San Diego River Watershed Monitoring and Assessment Plan

SAN DIEGO RIVER WATERSHED MONITORING AND ASSESSMENT PLAN

Prepared For:
San Diego River Watershed
Participating Agencies

Prepared By:
AMEC Environment and Infrastructure, Inc.
9177 Sky Park Court
San Diego, California 92123
January 2015

This page intentionally left blank

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

4 WATER QUALITY IMPROVEMENT PLAN MONITORING AND ASSESSMENT PROGRAM

This appendix of the Water Quality Improvement Plan (Plan) describes the Monitoring and Assessment Program for the San Diego River Watershed. The Participating Agencies in the watershed have developed an integrated Monitoring and Assessment Program to:

1) Measure the progress toward addressing the Highest Priority Water Quality Condition (HPWQC) established in Chapter 2;
2) Assess the progress toward achieving the goals, strategies, and schedules provided in Chapter 3; and
3) Evaluate each Participating Agency's overall efforts to implement the Plan.

The Permit supports an outcome-based approach through the Plan. Monitoring data collection and assessment provides the vehicle for determining whether intended outcomes are being realized or if adaptations of Participating Agencies' programs are necessary. Collection and assessment of monitoring data will guide future implementation of the Participating Agencies' management actions. Monitoring during wet and dry weather is conducted to collect observational and analytical data from storm drain outfalls and the receiving water. The data are utilized to help Participating Agencies determine whether discharges from storm drain outfalls are influencing receiving water quality, and if so, are storm drain discharges improving or degrading receiving water conditions over time. Participating Agencies assess the data in combination with their management actions to determine what actions are improving the quality of storm drain outfall discharges and receiving water conditions and where additional actions are necessary.

This appendix provides an overview of the two main components: (1) Monitoring, and (2) Assessment. As stated in Provision D of Order R9-2013-001(Permit):

> *"The purpose of this provision is for the Participating Agency to monitor and assess the impact on the conditions of receiving waters caused by discharges from the Participating Agency's MS4s under wet weather and dry weather conditions. The goal of the Monitoring and Assessment Program is to inform the Participating Agency about the nexus between the health of receiving waters and the water quality condition of the discharges from their MS4s. This goal will be accomplished through monitoring and assessing the conditions of the receiving waters, discharges from the storm drains, pollutant sources, and/or stressors, and effectiveness of the water quality improvement strategies implemented as part of the Water Quality Improvement Plans."*

Monitoring includes sampling, inspection, and data collection at beaches, creeks, lakes, estuaries, and storm drain outfalls to observe conditions, improve understanding, and inform the management within the watershed to improve water quality conditions.

The program incorporates monitoring to assess progress toward addressing the HPWQC per requirements of Permit Provision B.4. It also includes the compliance monitoring requirements of Permit Provision D, Illicit Discharge Detection and Elimination (IDDE) requirements of Permit Provision E.2, and Total Maximum Daily Load (TMDL) monitoring and assessment requirements in Permit Attachment E. Assessment under this program includes annual review of the monitoring data along with a comprehensive analysis of the data at the end of the Permit term.

4.1 WATER QUALITY IMPROVEMENT PLAN MONITORING PROGRAM

The Monitoring Program includes five major components:

> **Wet Weather** is defined as a storm event of >0.1 inch of rainfall and the following 72 hours after the end of rainfall.
>
> **Dry Weather** is defined as all days where the preceding 72 hours has been without measurable precipitation (>0.1 inch).

1) Monitoring to assess goals and schedules;
2) Receiving water monitoring program that measures the long-term health of the watershed during dry and wet weather conditions;
3) Storm drain outfall monitoring program that investigates the elimination of illicit dry weather flows from storm drain outfalls and the improvement in quality of the discharges from storm drains during wet weather;
4) Special studies that look further into the HPWQC presented in Chapter 2 of the Plan, and
5) Complementary Illicit Discharge Detection and Elimination investigations and inspections of potential pollutant sources that are implemented under the Jurisdictional Runoff Management Programs.

Table 4-1 presents an overview of the planned monitoring activities for the watershed. The overview includes monitoring programs, conditions, monitoring elements, and the implementation schedule for each program during this Permit term. In Chapter 2, bacteria was identified as the HPWQC for the watershed. As reflected in **Table 4-1** monitoring is being conducted to characterize bacteria levels in the discharges from storm drain outfalls, identify potential sources of bacteria, and assess the effectiveness of strategies designed to address bacteria. Additionally, these programs will generate data to track priority water quality conditions and general health and conditions within the watershed.

Table 4-1. Elements of Water Quality Improvement Plan Monitoring

Monitoring Programs			Condition	Monitoring Element	Permit Schedule[a] 2013-2014[b]	2014-2015	2015-2016	2016-2017	2017-2018
Monitoring to Assess Goals and Schedules			Dry and Wet	Varies by goal and jurisdiction	–	–	•	•	•
Receiving Water Monitoring	Long-Term Receiving Water Monitoring		Dry	Conventionals, bacteria, nutrients, metals, pesticides, toxicity (chronic), possible TIE/TREs, visual observations, field measurements	•[b]	–	–	–	–
Receiving Water Monitoring	Long-Term Receiving Water Monitoring		Dry	Hydromodification (channel conditions, discharge points, habitat integrity, evidence and estimate of erosion and habitat impacts)	•[b]	–	–	–	–
Receiving Water Monitoring	Long-Term Receiving Water Monitoring		Dry	Bioassessment (BMI taxonomy, algae taxonomy, physical habitat characteristics)	•[b]	–	–	–	–
Receiving Water Monitoring	Long-Term Receiving Water Monitoring		Wet	Conventionals, bacteria, nutrients, metals, pesticides, toxicity (chronic), possible TIE/TREs, field measurements	•[b]	–	–	–	–
Receiving Water Monitoring	Regional Monitoring Participation	Bight	Dry	Chemistry, toxicity, benthic infauna	•	•	–	–	•[c]
Receiving Water Monitoring	Regional Monitoring Participation	SMC	Dry	Bioassessment	•	•	•	•	•
Receiving Water Monitoring	Regional Monitoring Participation	2010 Hydromodification Monitoring Program (HMP)	Wet	Channel assessments; flow monitoring; sediment transport monitoring	•	•	•	–	–
Receiving Water Monitoring	Sediment Quality Monitoring		Dry	Chemistry, toxicity, benthic infauna	•[c]	•[c]	–	–	–

<table>
<tr><th colspan="3" rowspan="2">Monitoring Programs</th><th rowspan="2">Condition</th><th rowspan="2">Monitoring Element</th><th colspan="5">Permit Schedule[a]</th></tr>
<tr><th>2013-2014[b]</th><th>2014-2015</th><th>2015-2016</th><th>2016-2017</th><th>2017-2018</th></tr>
<tr><td rowspan="2">Receiving Water Monitoring</td><td rowspan="2">TMDL Monitoring</td><td rowspan="2">Bacteria TMDL for Forrester Creek, Lower San Diego River, and Dog Beach</td><td>Dry</td><td>Bacteria</td><td>•</td><td>•</td><td>•</td><td>•</td><td>•</td></tr>
<tr><td>Wet</td><td>Bacteria</td><td>•</td><td>•</td><td>•</td><td>•</td><td>•</td></tr>
<tr><td rowspan="3">Storm Drain Monitoring</td><td colspan="2">Storm Drain Field Screening</td><td>Dry</td><td>Visual: flow condition, presence and assessment of trash in and around the station, IC/IDs, descriptions</td><td>•</td><td>•</td><td>•</td><td>•</td><td>•</td></tr>
<tr><td colspan="2" rowspan="2">Storm Drain Outfall</td><td>Dry</td><td>Field parameters, conventionals, bacteria, nutrients, metals</td><td>-</td><td>-</td><td>•</td><td>•</td><td>•</td></tr>
<tr><td>Wet</td><td>Field parameters, conventionals, bacteria, nutrients, metals</td><td>•</td><td>•</td><td>•</td><td>•</td><td>•</td></tr>
<tr><td rowspan="4">Special Studies</td><td colspan="2" rowspan="4">San Diego Regional Reference Streams and Beaches</td><td rowspan="2">Dry</td><td>Field parameters, conventionals, bacteria instantaneous flow</td><td>2012-2014</td><td>•</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Streams only: nutrients, metals, bioassessment, including physical habitat and chlorophyll a</td><td>2012-2014</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="2">Wet</td><td>Field parameters, conventionals, bacteria</td><td>2012-2014</td><td>•</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Streams only: nutrients, metals, toxicity, flow and precipitation (duration of storm)</td><td>2012-2014</td><td>•</td><td>–</td><td>–</td><td>–</td></tr>
</table>

	Monitoring Programs	Condition	Monitoring Element	Permit Schedule[a] 2013-2014[b]	2014-2015	2015-2016	2016-2017	2017-2018
Special Studies	San Diego Wet Weather Epidemiology Study	Wet	Field parameters, bacteria, human genetic markers, viruses, human health data, flow and precipitation	•	•	•	–	–
IDDE Program	Illicit Discharge Detection and Elimination Program	Dry	Visual surveys, field parameter testing, analytical testing and follow-up investigations, if warranted	–	–	•	•	•

BMI=Benthic macroinvertebrates; IC/ID = illicit connection and/or illicit discharge; NA = not applicable; bacteria = fecal indicator; SMC = Southern California Stormwater Monitoring Coalition; Bight = Southern California Bight Regional Monitoring Program; TIE=Toxicity Identification Evaluation; TRE=Toxicity Reduction Evaluation

a. The Permit was adopted on May 8, 2013; the Permit became effective on June 27, 2013.
b. Completed under the Transitional Monitoring Program according to Permit Provisions D.1.a and D.2.a.
c. The 2018 Southern California Bight Regional Monitoring will occur during the summer of 2018 or 2019.

4.1.1 Monitoring to Assess Progress Toward Achieving Goals and Schedules

This section summarizes monitoring and assesses progress toward achieving goals related to the HPWQC, which is bacteria for the watershed, as described in Section 2.3. As outlined in Section 3.1, goals are based on the multiple compliance pathways set forth for the Bacteria TMDL in Attachment E.6 of the Permit. Compliance with the TMDL may be demonstrated via one of the compliance pathways identified in the Permit. The proposed compliance dates for both the TMDL's interim goals and final goals are set outside of this Permit cycle, as presented in Chapter 3. **Table 4-2** presents the interim TMDL goals and monitoring that may be used to track progress toward achieving the goals.

Each Participating Agency has established both wet and dry weather jurisdictional goals for bacteria, the HPWQC, during this Permit term to demonstrate progress towards compliance with the TMDL requirements. Generally, Participating Agencies have identified near-term goals to address potential bacteria sources and/or to reduce anthropogenic dry weather flow in storm drain outfalls. Data collection or monitoring elements that go beyond the prescribed Permit activities are tailored to measure progress towards meeting each goal. These elements, which are further detailed in the following subsections, may include visual surveys, inspections, physical sampling or measurements, and development of new outreach and source control programs related to bacteria reduction.

Table 4-2. Monitoring Related to Interim Bacteria TMDL Goals[a]

Compliance Pathway		Interim TMDL Goal	Monitoring Elements
1 OR	Receiving Water Conditions	No exceedances of the interim Receiving Water Limitations (RWLs) in the receiving water	Bacteria data collected at compliance points as described in Section 4.1.1.3 Bacteria TMDL Monitoring Program
2 OR	Storm Drain Discharges	No direct or indirect discharge from the Participating Agencies' storm drain outfalls to the receiving water	Visual observation of flow from outfalls to receiving waters as described in Section 4.1.3 Storm Drain Monitoring Program.
3 OR	Storm Drain Discharges	Pollutant load reductions for discharges from the Participating Agencies' storm drain outfalls greater than or equal to the final load reductions	Bacteria and flow data collected at outfalls as described in as described in Section 4.1.3 Storm Drain Monitoring Program.
4 OR	Receiving Water Conditions	Exceedances of the final receiving water limitations in the receiving waters due to loads from natural sources	Data from Sections 4.1.1, 4.1.2, 4.1.4, and 4.1.5.
5 OR	Receiving Water Conditions	No exceedances of the final RWLs in the receiving water	Bacteria data collected at compliance points as described in Section 4.1.1.3 Bacteria TMDL Monitoring Program
6	Water Quality Improvement Plan	Implementation of the Plan and use of adaptive management	Data from monitoring and Jurisdictional Runoff Management Programs

a. Participating Agencies may propose alternative TMDL interim milestones which differ from those included in Permit Attachment E.6.

4.1.1.1 Dry Weather Bacteria Monitoring

Participating Agencies have established dry weather goals for the 2013-2018 Permit term. **Table 4-3** summarizes the data that will be collected to assess these goals by jurisdiction.

Table 4-3. Dry Weather Monitoring Related to Jurisdictional Goals

Jurisdiction	First Permit Term Numeric Goals 2013-2018 (Chapter 3)	Assessment Metric	Monitoring Elements
City of El Cajon	Reduce controllable dry weather persistent flows by 10%	% reduction of flow volume or number of outfalls with flows mitigated from persistently flowing storm drain outfalls	Collect dry weather flow measurements
	Reduce gross pollutants that may contribute to bacteria loads by increasing the number of cubic yards of debris collected from drainage channels	Increased number of annual transient encampment removal events throughout the City's drainage channels	Quantify number of cubic yards of debris collected from drainage channels
City of La Mesa	Creek restoration – 900 linear feet of Alvarado Creek	Linear feet of creek restoration	Quantify linear feet of restoration completed in

Jurisdiction	First Permit Term Numeric Goals 2013-2018 (Chapter 3)	Assessment Metric	Monitoring Elements
			Alvarado Creek
City of Santee	Implement a dry weather inspection and investigation program. Dedicate 10 % of compliance inspection hours to dry weather inspections	Visual confirmation	Track visual inspections and investigations of dry weather flows
	'Complete Property' inspection program – Inspect 50% high priority, high-density use areas. Focused inspections on pavement, landscape, and trash enclosures	Visual and physical confirmation	Monitor targeted outfalls before and during implementation
	Eateries Inspection Program – Inspect 50% of high priority eateries. Focused inspections on grease storage, trash enclosures, and outdoor seating areas	Visual inspections on grease storage, trash enclosures, and outdoor seating areas	Monitor targeted outfalls before and during implementation
	Outdoor Water Use Efficiency and Conservation – Develop Residential Management Area program. Distribute outreach material	Pre and post surveys; reduction in water use	Perform pre- and post-surveys and quantify reduction in water use
City of San Diego	Develop green infrastructure policy, attain City Council approval, and construct green infrastructure best management practices (BMPs) to improve water quality	58 acres of drainage area treated through construction of 4 green infrastructure BMPs	Quantify total acres treated by constructed BMPs using information from final design drawings.
	Implement runoff reduction programs, including targeted education and outreach, enhanced inspections, rebates[a], and increased enforcement.	10% reduction in prohibited[b] dry weather flow from baseline measured at persistently flowing outfalls in the watershed	Collect flow measurements at persistently flowing outfalls
County of San Diego	Reduce by 20% the aggregate flow volume or the number of persistently flowing outfalls	% reduction of flow volume or number of outfalls with persistent flows	Conduct visual inspections and/or flow measurements at persistently flowing outfalls

a City of San Diego rebates include grass replacement, rainwater harvesting, downspout disconnect, and micro-irrigation.
b Does not include allowable discharges as defined in Provision A and Provision E.2.a of the Permit.

4.1.1.2 Wet Weather Bacteria Monitoring

Participating Agencies have established wet weather goals for the 2013-2018 Permit term. **Table 4-4** summarizes the data that will be collected to assess these goals by jurisdiction.

Table 4-4. Wet Weather Monitoring Related to Jurisdictional Goals

Jurisdiction	First Permit Term Numeric Goals 2013-2018 (Chapter 3)	Assessment Metric	Monitoring Elements
City of El Cajon	Non-structural BMP – Coordinate 1 Creek Cleanup	Reduce bacteria loads in Forrester Creek	Quantify waste material
	Non-structural BMP – Expand Pet Waste Outreach to 1 focused management area or to large property owners	Reduce bacteria loads in Forrester Creek	Quantify waste material
	Conduct a structural BMP feasibility study to assess dry weather treatment control BMPs and draft environmental impact report for treatment control BMPs	30-40% reduction in bacteria load by developing structural BMPs to help meet wet weather TMDL allocations	Monitor bacteria and flow from BMP input and output
	Implement programmatic BMPs to achieve source reduction of bacterial loads from storm drain outfalls	% bacterial load reductions for Total coliform, fecal coliform, and *Enterococcus*	Collect bacteria and flow data at storm drain outfalls
City of La Mesa	Creek restoration – 900 linear feet of Alvarado Creek	Linear feet of structural projects	Quantify linear feet of restoration in Alvarado Creek
City of Santee	Identify candidate locations for off-site compliance. Develop Water Quality Equivalencies (credit system)	Acreage retrofitted.	Quantify acreage
	Conduct bi-monthly river encampment sweeps with follow up trash removal. Increase efforts to provide referrals to local community services.	Trash removal rates/quantities (tonnage removed; visual surveys	Conduct visual trash surveys and quantify tonnage removed
City of San Diego	Develop green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality	58 acres of drainage area treated through construction of 4 green infrastructure BMPs	Quantify total acres treated by constructed BMPs using information from final design drawings.
County of San Diego	Reduce by 1% the baseline bacteria loads from distributed BMPs constructed between 2003 and 2009 during redevelopment	% bacterial load reduction based on quantitative model	Confirm installation of treatment control BMPs

4.1.2 *Receiving Water Monitoring*

The purpose of the receiving water monitoring program is to characterize trends in the chemical, physical, and biological conditions of a receiving water to determine whether beneficial uses are protected, maintained, or enhanced. Additionally, the receiving water monitoring component helps inform the Participating Agencies of the nexus between the health of receiving waters and the quality of discharges from their stormwater outfall. This program is designed to meet the requirements set forth in Provision D.1 of the Permit. Long-term monitoring occurs during both wet and dry weather conditions for water quality, along with physical and biological integrity. Sediment quality monitoring, if appropriate and participation in regional monitoring occurs as well. Attachment E of the Permit stipulates how TMDL monitoring requirements are to be incorporated into the receiving water monitoring program. Receiving water monitoring comprises the following programs:

- Long-term receiving water monitoring,
- Regional monitoring participation,
- Toxicity Identification Evaluation/Toxicity Reduction Evaluation, if appropriate,
- Sediment quality monitoring, if appropriate, and
- TMDL monitoring.

The receiving water programs are designed to answer one or more of the following questions:

- Are conditions in the receiving water protective, or likely protective, of beneficial uses?
- What are the extent and magnitude of the current or potential receiving water problems?
- Are the conditions in the receiving water getting better or worse?

4.1.2.1 *Long-Term Receiving Water Monitoring*

Long-term receiving water monitoring will track the overall health of the receiving waters. Dry and wet weather monitoring will continue at the historical mass loading station (SDR-MLS) located on the San Diego River. Participating Agencies have monitored SDR-MLS since 2001 to meet the requirements of previous permits and this site is co-located with the United States Geological Survey (USGS) monitoring station. The land uses in the surrounding drainage area for SDR-MLS are primarily residential with some industrial, commercial, and open space. The mass loading station location is in **Table 4-5.**

Table 4-5. San Diego River Watershed Long-term Receiving Water Station

Station ID	Latitude	Longitude	Cross Street Description	Channel Type	Jurisdiction
SDR-MLS	32.765240	-117.168617	Directly south of the Fashion Valley Trolley Station at the footbridge across San Diego River	Modified Natural Channel	City of San Diego

Source: Transitional Receiving Water Monitoring Plan (Weston, 2014a)

This site will be monitored three times during dry weather and three times during wet weather per permit cycle. This monitoring program is designed to monitor the HPWQC in the receiving water, along with a comprehensive list of constituents based on the Clean Water Act Section 303(d) list (303(d) list) impairments, CLRP, non-storm water action levels (NALs) or storm water action levels (SALs), and Table D-3 of the Permit. During both dry and wet weather, water samples will be analyzed for constituents as shown in **Table 4-1** and provided in detail in Attachment 4A-1. Toxicity identification evaluations (TIEs), if necessary, will be conducted in compliance with Provisions D.1.c.(4)(f) and D.1.d.(4) of the Permit and used to determine the causative agent(s) of toxicity. Once per term during dry weather, a bioassessment will be conducted to evaluate chemical, physical, and biological data, and hydromodification monitoring will record the stream conditions, habitat integrity, and impacts. The Receiving Water Monitoring Plan describes detailed monitoring methods and procedures, as presented in Attachment 4A-1. These methods and procedures may be modified on the basis of site-specific environmental conditions and updated analytical methodologies.

The 2013 and 2014 Transitional Monitoring Programs satisfied long-term receiving water monitoring requirements including dry and wet weather water quality sampling, bioassessment, and hydromodification monitoring for this Permit term. Detailed proposed monitoring methods and procedures are presented in the Receiving Water Monitoring Plan as Attachment 4A-1. These methods and procedures may be modified on the basis of site-specific environmental conditions and updated analytical methodologies.

4.1.2.2 Regional Monitoring Participation

Regional monitoring includes separate studies that will evaluate various aspects of receiving water health on a regional scale. Participating Agencies will participate in the following regional programs to meet the requirements of Permit Provision D.1.e (1).

Bight Regional Monitoring

The Bight regional monitoring program is a multi-agency collaborative effort to assess the ecological condition of the Southern California Bight from a regional perspective. The core program consists of monitoring of sediment chemistry, sediment toxicity, and benthic infauna. The goals of past Bight programs are to answer three primary questions:

- What are the extent and magnitude of direct impact from sediment contaminants?
- How do the extent and magnitude of the environmental impact vary by habitat?
- What is the trend in extent and magnitude of direct impacts from sediment contaminants?

Sediment quality monitoring was conducted during the summer of 2013 at a total of 22 sites in nine estuaries and lagoons in the San Diego region including the San Diego River Estuary under the Southern California Bight 2013 Regional Monitoring Survey (Bight '13) (Weston, 2014c). As described in Section 4.1.1.3, sediment monitoring data from Bight '13 will be used to fulfill part or all of the sediment monitoring requirements of the Permit. During this Permit term, Participating Agencies will participate in planning Bight '18 monitoring programs.

Stormwater Monitoring Coalition (SMC) Regional Monitoring

Since 2001, Participating Agencies have partnered with regulated stormwater municipalities in southern California, the Regional Boards of Southern California and the Southern California Coastal Water Research Project (SCCWRP) to form the Southern California Stormwater Monitoring Coalition (SMC). The goals of the SMC are to standardize monitoring, improve understanding of stormwater mechanics, and identify receiving water impacts from stormwater (SCCWRP, 2002). According to its 2014 Research Agenda, the SMC has identified 21 potential projects and is in the process of prioritizing projects on the basis of need and availability of funding (SMC, 2014). The Participating Agencies have elected to participate in the projects that are relevant to the watershed. The Participating Agencies will continue participation in the SMC Regional Freshwater Stream Bioassessment Monitoring Program (SMC Regional Bioassessment Program) that began as a five year program in 2008-2013 and will be implemented for another five years (2015-2019).

The 2009-2013 SMC Regional Bioassessment program was designed to address the following monitoring questions (AMEC, 2014):

- What is the extent of impact in streams of southern California?
- What are the stressors that impact southern California streams?
- Is the extent of stream impacts changing over time?

A final monitoring report was prepared on the basis of 2009-2013 results to identify lessons learned, data gaps, and recommendations to guide the design of the 2015-2019 program. In 2015, a new five-year SMC program will extend the initial survey to answer key management questions about the impacts of stormwater on stream conditions. The program will have an added emphasis on detecting trends, including non-perennial streams and sampling sediment chemistry and toxicity.

The non-perennial stream monitoring was initiated in April 2014, with site revisits in May and June 2014. Sampling included benthic macroinvertebrates (BMI), algae, physical habitat, and California Rapid Assessment Method (CRAM). The trend site monitoring was conducted during the standard index period (i.e., from mid-May through July). Sampling for trend site monitoring included all of the parameters and constituents of the original SMC Regional Bioassessment

Program (Weston, 2014b). The bioassessment monitoring was conducted at a total of 64 bioassessment stations; 30 stations were compliance stations; 28 stations were randomly placed Stormwater Monitoring Coalition (SMC) stations; and 6 stations were San Diego County reference stations (Weston, 2014b).

Hydromodification Regional Monitoring Program

Copermittees have developed a regional Hydromodification Management Plan (HMP) to address impacts to beneficial uses and stream habitat from increased erosive force potentially caused by a rise in runoff discharge rates and volume from Priority Development Projects (County of San Diego, 2011). The HMP was initially developed to meet the requirements of the 2007 Permit. The Monitoring Plan is defined in Chapter 8 of the HMP, and was updated by the Copermittees and accepted by the Regional Board in February of 2014. The HMP requires monitoring with a final report due to the Regional Board in December of 2016. Monitoring consists of channel sediment transport assessments, and continuous flow monitoring of pre-project, post-project, and reference conditions per Permit Provisions D.1.a and D.1c(6). Additional monitoring is required per Provision D.1.a(2).

4.1.2.3 Sediment Quality Monitoring

Sediment quality monitoring is designed to assess compliance with the sediment quality receiving water limits applicable to enclosed bays and estuaries in accordance with the State Board's Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality (Sediment Control Plan) (State Board, 2009). Sediment quality monitoring will be performed in compliance with Permit Provision D.1.e.(2), which requires preparation of a Sediment Quality Monitoring Plan that satisfies the requirements of the Sediment Control Plan. The requirements of the sediment quality monitoring are:

1) The elements required under Sections VII.D and VII.E of the Sediment Control Plan,
2) A Quality Assurance Project Plan, and
3) A schedule for completion of sample collection, analysis, and reporting.

The Sediment Quality Monitoring Plan and Quality Assurance Project Plan (Attachment 4A-2) describe detailed proposed monitoring procedures and analytical methods that are illustrative and may change on the basis of site environmental conditions. As indicated in **Table 4-1**, sediment quality monitoring of the San Diego River Estuary was conducted in the summers of 2013 and 2014.

The participating agencies propose to conduct one round of sediment sampling each Permit term. The second required round of sampling will be satisfied by conducting additional follow up sampling in the vicinity of potentially impacted sites identified in the first round. Sediment quality monitoring will employ the following general approach to meet the requirements of the Permit:

a) Conduct initial monitoring within each qualifying water body per the requirements of the state's Sediment Control Plan. These data will be used to assess the degree of potential impact at each site using the California Sediment Quality Objective (SQO) multiple-line-of-evidence approach in accordance with the assessment criteria specified in Sediment Control Plan Section V. These scores are derived using multiple metrics from three key lines of evidence: (1) sediment chemistry data, (2) toxicity data, and (3) benthic community data. Sites are then categorized as un-impacted, likely un-impacted, possibly impacted, likely impacted, or clearly impacted.

b) Confirm and characterize pollutant related impacts for any sites that are considered possibly impacted, likely impacted, or clearly impacted, following an integration of all lines of evidence. In accordance with Sediment Control Plan criteria, the data assessment in this phase is required to determine whether the score(s) indicate potential impacts due to toxic pollutants (e.g., freshwater-related contaminant sources from the stormwater conveyance system), or non-toxic pollutants (e.g., physical habitat, freshwater inundation, legacy contaminants, or other potential factors). This phase would be considered the first phase of the level stressor/source identification (SSID) based on existing data. The requirements of this phase are dependent on the site as categorized in the previous phase as follows:

(1) Stations deemed to be possibly, likely, or clearly impacted based on initial monitoring for which the impact or impairment is determined to likely not be caused or contributed to by storm drain discharges will be monitored once more in the current Permit term. Follow-up monitoring is required to verify the findings from the first round of monitoring.

i. If results from the follow-up monitoring are consistent (possibly impacted), or un-impacted, no additional follow-up will be required during the current Permit term.

If the second round of sampling reclassifies the station as likely or clearly impacted, an additional follow-up investigation may be needed or suspended pending future routine SQO monitoring. In this circumstance, results of the analytical assessments will be discussed with the Regional Board staff to determine whether/where any SSID studies should be undertaken, and to identify major elements of the approach for any identified studies. Prior to additional investigation, a site-specific Sediment Assessment Work Plan would be prepared that would outline specific steps and methodologies to be taken.

(2) Stations deemed by assessment to be likely or clearly impacted by storm drain discharges will require additional follow-up investigation and this is deemed the first phase of SSID. A site-specific Sediment Assessment Work Plan will be prepared that will outline specific steps and methodologies to be taken. Per the Sediment Control Plan, SSID comprises three steps: (1) confirmation and characterization of pollutant impacts, (2) pollutant identification, and (3) source identification and management actions.

c) In the annual Sediment Monitoring Report, describe the planned follow-up monitoring, including any planned SSID studies, and revisions the Sediment Monitoring Plan, accordingly.

During the transitional (pre-Water Quality Improvement Plan) monitoring phase, the Southern California Regional Bight '13 Monitoring Program (Bight '13) satisfied the initial monitoring requirements of the state's Sediment Control Plan. As presented in **Table 4-6**, up to three sites were monitored in the San Diego River Estuary in 2013 for the initial screening of sediment quality. Follow-up monitoring was conducted in summer 2014 to further characterize one site that was possibly impacted. Based on the monitoring and assessment completed, sediment conditions in San Diego River Estuary are generally protective of the beneficial uses and typical of a tidally influenced shallow lagoon (Weston, 2014). No further monitoring is planned for San Diego River Estuary during this Permit term because there was no evidence to indicate that urban runoff from the watershed had significantly impaired the estuarine beneficial use of the receiving water (Weston, 2014).

Table 4-6. Bight '13 Sample IDs, Site Locations, Dates Sampled, and Sample Depths

Lagoon/Estuary	# of Sites	Site ID	Sediment Sampling			Monitored Events	
			Latitude	Longitude	Depth (m)	Date Sampled	Date Sampled
San Diego River Estuary	**3**	8129	32.7568	-117.2353	1.1	7/31/2013	NA
		8134	32.7574	-117.2380	1.0	7/31/2013	NA
		8136	32.7579	-117.2274	1.0	7/31/2013	9/18/14

Source: Transitional Monitoring and Assessment Report Appendix H Sediment Monitoring Report (Weston, 2014c).
NA – Follow-up monitoring not required.

4.1.2.4 TMDL Monitoring

TMDL provisions, schedules, and monitoring requirements are provided in Attachment E of the Permit. The purpose of the monitoring program is to track progress toward achieving compliance with interim and final TMDL numeric targets. The Bacteria TMDL in Attachment E.6 is applicable to the watershed. Monitoring is designed to meet compliance with the monitoring requirements of the TMDL. Wet and dry weather sampling will be conducted each year at the compliance point located at the existing California Assembly Bill 411 (AB411) monitoring location along the Pacific Ocean shoreline (25 yards down current of where ocean currents meet river discharge in ankle to knee deep water) and four additional compliance points are located in the lower San Diego River and Forrester Creek. The data generated will be used to address the following questions:

- Are TMDL numeric targets for indicators being met at the compliance monitoring locations?
- Are levels of bacteria decreasing at the compliance monitoring locations?

The proposed Bacteria TMDL Monitoring Plan and Quality Assurance Project Plan describe detailed monitoring procedures and analytical methods that are illustrative and may be revised based on site-specific environmental conditions and updated methodology. They are presented in

Attachment 4A-3. Dry weather monitoring will be conducted weekly, for a minimum of 5 samples in a 30-day period during the recreation season (April 1 through October 31) to be consistent with AB411 monitoring frequencies, and monthly (at a minimum) during the wet season (October 1 through April 30) per the Permit requirements. Samples are to be collected on dry weather days, after an antecedent dry period of 72 hours with less than 0.1 inch of rainfall. Wet weather monitoring will be conducted at the compliance monitoring location during at least one storm event for each wet season, per the Permit Attachment E.6.

Fecal indicator bacteria are the target constituents for the Pacific Ocean Shoreline within the watershed, as indicated by the Permit. Grab samples will be collected in a manner consistent with the requirements of the AB411 program and analyzed for total coliform, fecal coliform, and *Enterococcus*. For details of the current approved TMDL monitoring program, refer to Attachment 4A-3.

Bacteria TMDL compliance monitoring has been conducted in the receiving water since the Permit became effective on June 27, 2013.

4.1.2.5 Toxicity Identification Evaluation/Toxicity Reduction Evaluation

Provision D.1.c(4)(f) of the Permit requires that the Copermittees discuss the need for conducting a Toxicity Identification Evaluation (TIE)/Toxicity Reduction Evaluation (TRE) if chronic toxicity is detected in receiving waters. A TIE is a set of procedures to identify specific chemicals or conditions responsible for toxicity; a TRE is a study designed to identify causative agents of effluent or ambient toxicity, isolate its sources, evaluate effectiveness of toxicity control options, and confirm reduction of toxicity. A work plan that outlines the process to identify chronic toxicity and prioritize the need to implement a TIE/TRE based on the magnitude and persistence of chronic toxicity is included as Attachment 4A-4.

4.1.3 Storm Drain Outfall Monitoring

The purpose of the Storm Drain Outfall Monitoring Program is to evaluate the potential impact from storm drain discharges on the beneficial uses of the waterbody. This program is designed to meet requirements set forth in Provision D.2 of the Permit and seeks to answer the following question:

- Do non-stormwater or stormwater discharges from the storm drain outfalls contribute to receiving water quality problems?

Table 4-7 provides the number of major outfalls to be monitored under each component of the Storm Drain Outfall Monitoring Program by each Participating Agency. Detailed proposed monitoring methods and procedures as presented in the Storm Drain Outfall Monitoring Plan (Attachment 4A-5). These methods and procedures may be modified on the basis of site-specific environmental conditions and updated analytical methodologies. Additionally, the number of major outfalls monitored per year as shown in **Table 4-7** are subject to change based on new information, updates to the Participating Agency's storm drain outfall inventories, changes in transient or persistent flow classifications, and/or changes or updates to the priority water quality conditions over the life of the Plan.

Table 4-7. Number of Major Storm Drain Outfalls per Jurisdiction

Jurisdiction	Number of Outfalls Monitored Per Year		
	Field Screening (Provision D.2.b(1))	Dry Weather Monitoring (Provision D.2.b(2))	Wet Weather Monitoring (Provision D.2.c)
City of El Cajon	TBD	TBD	1
City of La Mesa	11[a]	3	1
City of San Diego	502[b]	5	1
City of Santee	46[a]	5	1
County of San Diego	40[a]	5	1

a. For Participating Agencies with fewer than 125 major storm drain outfalls in the watershed, 80% of major outfalls must be screened twice per year.
b. For Participating Agencies with more than 500 major storm drain outfalls, at least 500 major outfalls must be screened once per year (citywide).

4.1.3.1 Storm Drain Outfall Dry Weather Monitoring

The purpose of the Storm Drain Outfall Dry Weather Monitoring Program is to evaluate the potential contribution from storm drain discharges on receiving water quality during dry weather conditions and to assess the ability of programs to effectively eliminate non-storm water discharges to waterbodies or waterways. Each Participating Agency has established a number of major storm drain outfalls that are prioritized based on non-stormwater flow status and threat to receiving water quality, and will be screened once or twice annually based on this prioritization and Permit requirements. Additionally, the highest priority major storm drain outfalls have been selected for further water quality testing to facilitate source investigations of these outfalls with persistent dry weather flows.

Dry Weather Field Screening

Field screening is visual monitoring of all storm drain outfalls to identify and effectively eliminate sources of persistently flowing non-stormwater discharges as required by Provision D.2.b(1). This program assesses the effectiveness of other jurisdictional programs to effectively prohibit non-stormwater discharges. Each Participating Agency will continue to perform a field screening of a certain number of outfalls on an annual basis to maintain an up-to-date inventory of persistently flow outfalls and to initiate follow-up IC/ID investigations the identify and mitigate the source(s). The frequency of field screening will vary from once to twice per year on a jurisdictional basis and is dependent on the number of major outfalls. **Table 4-7** presents the number of outfalls subject to field screening for each jurisdiction in the watershed.

Highest Priority Storm Drain Outfall Dry Weather Monitoring

Per Permit Provision D.2.b(2), Participating Agencies have prioritized the persistently flowing outfalls on the basis of their potential to impact receiving water quality. Highest priority storm drain outfalls with persistent non-stormwater flow will be monitored during dry weather within each jurisdiction, as presented in **Table 4-7**. Using this prioritized list, Participating Agencies will focus resources on abating identified sources to mitigate flow at the five highest priority major outfalls within each of their respective jurisdictions, per Permit Provision D.2.b.(2)(b)(i). Each of the selected outfalls will be monitored twice per year during dry weather conditions. During each event, field observations will be recorded, and when measureable flow is present, *in-situ* field measurements and analytical data will be collected. Analytical constituents will include constituents contributing to the HPWQC, 303(d) List impairments, TMDLs, NALs, and Table D-7 of the Permit; a detailed analyte list is provided in Attachment 4A-5. If historical data demonstrate or justify that analysis of a constituent is not necessary for a particular waterbody or outfall, then it will be removed and noted as an update to this program in the Annual Report.

Based on the data collected at the storm drain outfalls per jurisdiction as shown in **Table 4-7**, monitoring at these outfalls may be reprioritized to eliminate monitoring entirely or to have it be reduced to field screening activities only to address higher priority non-stormwater persistent flows. Reprioritization of outfalls may occur if one of the following conditions is met:

- Non-stormwater discharges have been effectively eliminated for three consecutive monitoring events; or
- Source(s)s of the persistent flows have been identified as not an illicit or a source of pollutants; or
- Pollutants in the persistent flow do not exceed NALs; or
- The threat to water quality has been reduced by the Participating Agency.

Each jurisdiction ranked its outfalls independently on the basis of the HPWQC, pollutant generating areas (PGAs), and available resources. Participating Agencies considered the following factors to prioritize persistently flowing outfalls:

- Potential to contribute to a HPWQC or Priority Water Quality Condition,
- Historical monitoring or inspection data,
- Controllability,
- Surrounding land uses/potential sources, and
- Flow rate.

4.1.3.2 Storm Drain Outfall Wet Weather Monitoring

The purpose of this program is to identify pollutants in stormwater discharges from the stormwater conveyance system, guide pollutant source identification efforts, and track progress in achieving the goals set forth in Chapter 3. The Participating Agencies' five monitoring locations for the wet weather storm drain outfall discharge monitoring component were chosen to be representative of the residential, commercial, industrial, and mixed-use land uses within the watershed pursuant to Provision D.2.c, as presented in **Table 4-7**.

A minimum of five outfalls will be monitored once per year during a storm event with greater than 0.1 inch of rainfall. During each event, observational and hydrologic data will be recorded, including duration of the storm, rainfall estimates, and estimated or measured flow rates and volumes. Grab samples will be collected to analyze for pH, temperature, specific conductivity, dissolved oxygen, turbidity, hardness, and indicator bacteria. A composite sample must be collected and analyzed for constituents contributing to the HPWQC, 303(d) List impairments, TMDLs, and SALs; a detailed analyte list is provided in Attachment 4A-5. If historical data demonstrate or justify that analysis of a constituent is not necessary for a particular waterbody or outfall, then it will be removed and noted as an update to this program in the Annual Report.

The 2013 Transitional Monitoring Programs began implementation of the wet weather storm drain outfall monitoring requirements at the five outfalls within the watershed. Monitoring at selected wet and dry weather storm drain outfalls will be conducted on an annual basis as described above and in Attachment 4A-5.

4.1.4 Special Studies

Special studies have been selected to further investigate the HPWQC to meet requirements of Provision D.3 of the Permit. Per Provision D.3, the purpose of the special studies is to "address pollutant and/or stressor data gaps and/or develop information necessary to more effectively address the pollutants and/or stressors that cause or contribute to Highest Priority Water Quality Conditions identified in the Water Quality Improvement Plan." The special studies will include a regional special study and a special study specific to the watershed. Both special studies selected for the San Diego River watershed will provide additional information on the HPWQC selected by the watershed's Participating Agencies.

4.1.4.1 San Diego Regional Reference Streams and Beaches Studies

Participating Agencies have elected to participate in the San Diego Regional Reference Streams and Beaches Study currently being conducted by the San Diego and Orange County Participating Agencies. These two regional studies fulfill the requirements for special studies per Provisions D.3.a(2) and D.3.a(3). The studies will develop reasonable and accurate TMDL numeric targets that account for "natural sources" to establish the concentrations or loads from streams minimally disturbed by anthropogenic activities or "reference" conditions. The Reference Stream Study also collected nutrients, metals, and toxicity data as secondary constituents. This study will provide a scientific basis for updating the reference conditions to be considered in evaluating compliance levels in the Bacteria TMDL. The results of this study will be used to support the forthcoming re-evaluation of the recently adopted Bacteria TMDL and to support numeric target development in future TMDLs or alternative regulatory approaches for nutrients and metals.

The San Diego Regional Stream Reference Study will address the following questions (SCCWRP, 2013) in streams minimally influenced by anthropogenic activities:

- How does the Water Quality Objective (WQO) exceedance frequency vary between summer dry weather, winter dry weather, and wet weather?
- How does the WQO exceedance frequency vary by hydrologic factors?
- How does the WQO exceedance frequency vary by input factors?
- How does the WQO exceedance frequency vary by biotic and abiotic factors?

The San Diego Regional Reference Beaches Study will address the following questions (SCCWRP, 2013) at beaches minimally influenced by anthropogenic activities.

- How does the WQO exceedance frequency vary between summer dry weather, winter dry weather, and wet weather?
- How does the WQO exceedance frequency vary by hydrologic factors, including:
    - Discharge flow rate (wet and dry weather), and
    - Status of estuary mouth (open/closed; dry weather only).
- What are the wet and dry weather exceedance frequencies of fecal indicator bacteria in estuaries?

For the stream study, a total of six locations were selected for wet weather monitoring and up to ten locations were selected for dry weather monitoring. Sites were selected to represent 95 percent undeveloped land uses (reference conditions), two major geologic settings, and the target catchment sizes. Wet weather sampling frequency at the six locations consists of three targeted events throughout the wet season (October 1 through April 31). Dry weather sampling frequency consists of weekly sampling for up to 40 weeks at flowing locations during winter and summer dry weather periods. Dry weather sampling occurs if there has been no measurable rainfall for at least 72 hours.

Water samples will be analyzed for a combination of conventional constituents, nutrients, metals, fecal indicator bacteria, microbial source testing, and algae. Of these constituents, *Enterococcus*, *E. coli*, fecal coliform, total coliform, Bacteroides, and *in-situ* parameters are of primary importance; all other analytes are considered secondary. During dry weather sampling, reference stream sites will be assessed for algal percent cover, algal biomass, ash-free biomass, and factors that control the growth of algae (stream bankful dimensions, canopy cover, and pebble count). Flow discharge rates were estimated for seven reference streams using recorded continuous water level data during both wet and dry weather conditions and measured velocity and flow during sampled wet weather events.

4.1.4.2 Wet Weather Epidemiology Study and Quantitative Microbial Risk Assessment

The special study specific to the watershed will examine the correlation between bacteria levels in stormwater discharges from the San Diego River and the health effects experienced by surfers at Ocean Beach, located near the mouth of the San Diego River. SCCWRP and the University of California at Berkeley, in collaboration with the Surfrider Foundation are conducting the study. It is primarily funded equally by the County of San Diego and City of San Diego with additional funding assistance from the remaining San Diego River Participating Agencies. The Wet Weather Epidemiology Study and Microbial Risk Assessment (Surfer Health Study) began in January 2014 and will continue through March of 2015. A final report is anticipated in June of 2016.

The Surfer Health Study will be conducted using a two-phased approach. Phase 1 consists of an epidemiological study involving recruitment of surfers for self-reported illness tracking and water quality sampling at the beaches. Phase 2 consists of a quantitative microbial risk assessment (QMRA), including source tracking through composite wet weather sampling of San Diego River and Tourmaline Creek, measurements and modeling of swimmer exposure, and modeling of illness response. The overall purpose of this study is to assess wet weather impacts on the water contact recreation (REC-1) beneficial use.

Specifically, the Surfer Health Study will address the following questions (SCCWRP, 2014):

- Is water contact associated with an increased risk of illness?
- Is illness risk greater following exposure to wet weather events as compared with dry weather?
- What is the association between levels of *Enterococcus* and illness following wet weather events?
- What level of *Enterococcus* corresponds to the same risk of illness as current water quality standards?

The epidemiology study portion involves recruitment of surfers to provide 22,000 exposure-days of health information. Surfer survey parameters will include location, timing, and duration of water exposure, and estimated volume of water ingestion. Survey parameters for illness will include symptoms of illness as well as potential confounding factors (e.g., household illness) and economic impact of illness (e.g., missed work days). During the same period, 120 days of fecal indicator bacteria measurements will be collected from the two study beaches. Roughly 200 surfers will be followed longitudinally for 16 weeks, providing information on marine water exposure and reported illness via website and smartphone application. Water quality sampling will be conducted daily at Tourmaline Surfing Park and Ocean Beach; sample locations consist of existing AB411 monitoring locations, with the addition of at least one sample site at Ocean Beach Pier. Beach water quality sampling will focus on existing protocols used in the AB411 monitoring program, with samples analyzed for *Enterococcus*, fecal coliform, and total coliform.

The QMRA study portion involves collection of 20-liter flow-weighted composite samples from at least six storm events from Tourmaline Creek and the San Diego River, which comprise the two largest watershed discharge sources at the two study beaches. Health risk assessments with uncertainty calculations will be conducted for surfers at the two study beaches.

Water samples will be analyzed for host-specific markers to facilitate source tracking. Additionally, samples will be analyzed for human pathogens such as viruses, and protozoans. The pathogen concentrations detected will be incorporated in a plume fate and transport model to estimate swimmer exposure. Physical water quality parameters, including temperature and salinity, will be measured at the stream discharge points at the study beaches; these data will also be included in the model. For details of the Surfer Health Study, refer to Attachment 4A-6.

4.1.5 Illicit Discharge Detection and Elimination Program

Each Participating Agency is required to develop an Illicit Discharge Detection and Elimination (IDDE) Program to address the potential contribution of pollutants from non-stormwater and stormwater discharges and to establish and enforce pollutant discharge prohibitions in compliance with Provision E.2 of the Permit. The outline of an IDDE Program is included in the Plan to establish a consistent framework for all Jurisdictional Runoff Management Programs (JRMP) within the watershed and to describe the data that may be generated to support assessments described in **Section 4.2**. The IDDE Program will be designed to have the following goals:

- Control the contribution of pollutants to and the discharges from the storm drains within its jurisdiction.
- Effectively prohibit non-stormwater discharges to the storm drain.
- Reduce the discharge of pollutants in stormwater to the maximum extent practicable.

4.1.5.1 Prevent and Detect Illicit Discharges and Connections

To prevent and detect ID/ICs, Participating Agencies have implemented protocols and programs in their jurisdictions to promote good housekeeping and clean practices to prevent ID/ICs. Each Participating Agency maintains a map of its stormwater conveyance system and a detailed inventory of its outfalls as critical investigative tools to better identify potential sources and impacts. Additionally, staff and contractors will be trained and a public hotline will be made available to continue to promote reporting of potential incidents on a broader scale. The Regional Stormwater Hotline (1-888-846-0800), operated by the County of San Diego on behalf of the Copermittees, is a valuable resource for pollution reporting. The Project Clean Water website (www.projectcleanwater.org) will continue to be emphasized as a resource to disseminate water quality-related information to the public. Each Participating Agency also relies on jurisdictional public reporting methods such as websites, call centers and/or mobile smartphone reporting systems. These programs are described in more detail in Participating Agencies' Jurisdictional Runoff Management Plans. **Table 4-8** presents three key tools of prevention implemented throughout the watershed.

Table 4-8. IC/ID Prevention Tools

Storm Drain System Mapping	Outfall Monitoring Station Inventory	Identifying and Reporting ID/ICs
The map will identify: • All segments of the stormwater conveyance system owned, operated, and maintained by the Participating Agency • Locations of all known connections with other stormwater conveyance systems not owned by the Participating Agency • Locations of inlets and outfalls that collect and/or discharge runoff within the stormwater conveyance system • All waterbody segments within the Participating Agency's jurisdiction that receive discharges from Participating Agency stormwater conveyance system outfalls • Locations of the stormwater conveyance system outfalls within the Participating Agency's jurisdiction • Locations of stormwater conveyance system outfalls with known persistent flows	The inventory will include: • GPS coordinates (latitude and longitude) of the stormwater conveyance system outfall • Watershed Management Area • Hydrologic subarea • Outlet size • Accessibility (safety, co-location of critical habitat, presence of tidal influence, etc.) • Approximate drainage area • Historical dry weather flow classification (persistent, transient, no, or unknown flow)	Actions will include: • Training personnel and contractors to identify ID/ICs during their daily routine • Promoting and facilitating public reporting of IC/IDs. • Providing a Regional Stormwater Hotline (1-888-846-0800) • Emphasizing the Project Clean Water website (www.projectcleanwater.org) These programs are described in more detail in Participating Agencies' Jurisdictional Runoff Management Plans.

4.1.5.2 Investigate and Eliminate Illicit Discharges and Connections

The Participating Agencies may modify these procedures as necessary to ensure that they are reflective of their own internal policies and procedures. Participating Agencies will prioritize, conduct follow-up investigations, and seek to identify sources of non-stormwater discharges on the basis of the following information:

- Field screening visual observations per Permit Provision D.2.a(1),
- Non-stormwater monitoring per Permit Provision D.2.a(2), and
- Reports or notifications of illicit discharges, illicit connections, or other sources of non-stormwater from hotlines or other sources.

Obvious illicit discharges (e.g., based on color, odor, or exceedance of an action level) and any discharges that pose an immediate threat to human health or the environment will be investigated immediately. Each Participating Agency will respond in accordance with its legal authority to eliminate illicit discharges and connections to the stormwater conveyance system and its Enforcement Response Plan, as appropriate.

Incident reports will be assessed in a timely manner. The validity of a report or notification will be based on the inspector's best professional judgment given the information that has been obtained. Invalid reports will be noted and reported in the JRMP Annual Report Form; valid reports will be prioritized for further investigation.

Follow-up investigations may include review of information provided in the incident report, recent sample results, and review of inventories or land use data and may involve collection of additional analytical samples. Prioritization of follow-up investigations will, at minimum, be based on the criteria provided in Permit Provision E.2.d(1):

1) Pollutants causing or contributing to bacteria, the HPWQC.
2) Pollutants causing or contributing to, or threatening to cause or contribute to, impairments in waterbodies on the 303(d) List and/or environmentally sensitive areas (ESAs) located within its jurisdiction;
3) Pollutants from sources or land uses known to exist within the area, drainage basin, or watershed that discharges to the portion of stormwater conveyance system within its jurisdiction; or
4) Pollutants causing or contributing to an exceedance of an NAL.

A field investigation must be conducted to seek to identify the sources of non-stormwater persistent flows monitored under Permit Provision D.2.b(2). The investigation may include follow up field investigations and/or review of inventories and other land use data to identify potential sources.

4.1.5.3 Records and Reporting

With each Annual Report, each Participating Agency must summarize all IC/ID investigations and those eliminated within its jurisdiction using the IC/ID investigations data-sharing template per Permit Provision D.2d.(4). The Participating Agencies developed a data-sharing template during the transitional monitoring period 2013–2015 to include all the information listed below, per the Permit requirements. Each Participating Agency must maintain records and a database of the following information per Permit Provisions D.2.d(2)(d) and D.2.d(2)(e):

- Location of incident, hydrologic subarea (HSA), portion of the stormwater conveyance system affected, and point of discharge or potential discharge to the receiving water; and
- Source of information, including dates of report, initiation of investigation, and follow-up investigation, identified or suspected source, known or suspected incident, result of the investigation, and documentation of the response.

4.1.6 Regional Clearinghouse

Participating Agencies will use existing data-sharing templates to facilitate compilation of watershed-wide datasets for assessment and reporting purposes. To support reporting under previous Permit cycles, regional data-sharing templates were developed for receiving water monitoring, storm drain outfall monitoring, field screening, and IC/ID reporting. Participating Agencies will make the following data and documentation available to the public on the Project Clean Water website:

- San Diego River Water Quality Improvement Plan and all updated versions with date of update,
- Annual Reports for the watershed,
- Jurisdictional Runoff Management Program documents for each Participating Agency within the watershed and all updated versions with date of update,
- BMP Design Manual for each Participating Agency within the watershed and all updated versions with date of update,
- Reports from special studies conducted in the watershed,
- Monitoring data uploaded to the California Environmental Data Exchange Network (CEDEN) with links to the uploaded data, and
- Geographic information system (GIS) data, layers, and/or shape files that are available for distribution and used to develop the maps to support the Plan, Annual Reports, and Jurisdictional Runoff Management Programs.

> Project Clean Water is a web-based portal that functions as a regional clearinghouse for San Diego County watersheds. It is used as a centralized point of access to share educational materials, water quality information, and Permit-required reports with the public.
>
> www.projectcleanwater.org

4.2 Water Quality Improvement Plan Assessment Program

The assessment portion of the Monitoring and Assessment Program will evaluate the data collected under the monitoring programs described in Section 4.1, and integrate the information collected as part of the Jurisdictional Runoff Management Programs. The data collected from these two programs will be used to assess the progress toward achieving the numeric goals and schedules identified in the Plan and to measure the progress toward addressing the HPWQC. **Figure 4-1** depicts how the watershed monitoring activities will support the assessments required by the Permit.

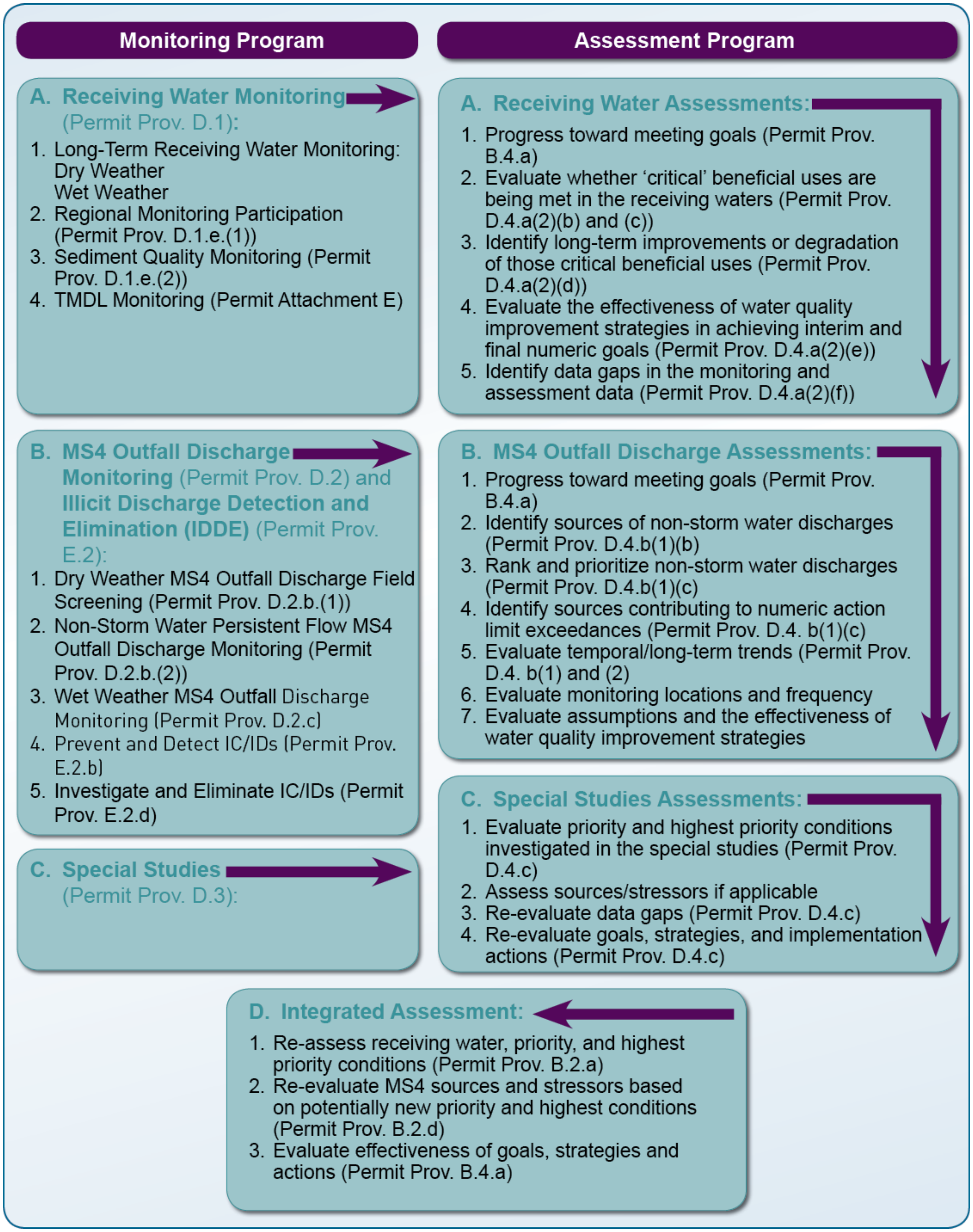


Figure 4-1. Monitoring and Assessment Program Components for the San Diego River Watershed

Table 4-9 summarizes the reporting and assessment requirements of the Permit. Some assessments will be reported annually, as part of the Annual Report, while others will be included in the Report of Waste Discharge that the Participating Agencies must submit 180 days prior to the end of this Permit.

The Monitoring and Assessment Program will be evaluated and adapted in the context of the Annual Report and the Report of Waste Discharge. The re-evaluation will consider data gaps and the results of all monitoring program elements. Modifications may be made to the program, but the core elements required by the Permit and described in **Section 4.1** must be maintained. This limits the amount of adaptation that is possible. Potential changes could be to modify the frequency of sampling, add a new analyte of concern, or move a monitoring location.

4.2.1 *Water Quality Improvement Plan Annual Report*

The Annual Report must be submitted for each reporting period no later than January 31 of the following year. The Annual Report will evaluate data and information from JRMP and monitoring programs to present key findings related to water quality in the receiving waters and storm drain discharges, evaluate the effectiveness of these programs, and present any recommended modifications to the Plan. The JRMP Annual Reports will reflect program activities conducted between July 1 and June 30 of the year following acceptance of the Plan. The Monitoring and Assessment Annual Report will reflect program activities conducted between October 1 and September 30 of the year following acceptance of the Plan. **Table 4-9** presents the assessments and information that must be included in each Annual Report required by the Permit.

Table 4-9. Water Quality Improvement Plan Annual Report Requirements

Assessment and Documentation	Detailed Data and Information
Summary of data collected, findings, interpretations, and conclusions from the assessments required per Provision F.b.(3)(a), (b), and (c)	• Receiving Water Assessments per Provision D.4.a. • Sediment Quality Assessments per Provision D.1.e(2) • TMDL Assessments per Provision E.6 • Storm Drain Discharge Assessments D.4.b • IDDE relevant information and findings • Special studies: findings and progress per Provision D.4.c • Re-evaluation of the priority water quality conditions, numeric goals, strategies, schedules, and/or monitoring and assessment, as needed per Provision D.4.d.(1)
Progress of implementing the Plan per Provision F.b.(3)(d)	• Progress towards interim and final numeric goals for the highest priority water quality priorities for the watershed • Status of water quality improvement strategies by each Participating Agency • Proposed modifications to water quality improvement strategies and supporting rationale • Water quality improvement strategies planned for implementation during the next reporting period • Proposed modifications to the Plan and/or each Participating Agency's jurisdictional runoff management program document • Previous modifications or updates incorporated into the Plan

Assessment and Documentation	Detailed Data and Information
	and/or each Participating Agency's jurisdictional runoff management program document
A completed Jurisdictional Runoff Management Program Annual Report Form for each Copermittee in the watershed, certified by a Principal Executive Officer, Ranking Elected Official, or Duly Authorized Representative per Provision F.b.(3)(e)	• City of El Cajon • City of La Mesa • City of San Diego • City of Santee • County of San Diego
Any data or documentation utilized in developing the Annual Report for each Participating Agency, upon request by the Regional Board. Monitoring data must be uploaded to the California Environmental Data Exchange Network (CEDEN) and available for access on the Regional Clearinghouse per Provision F.b.(3)(f)	• Receiving water and data collected per Permit Provision D. 1 • Storm drain discharge monitoring data collected per Permit Provision D.2 • Special Study data • IC/ID investigation data

4.2.1.1 Receiving Water Assessment

The assessment of receiving waters involves evaluating the physical, chemical, and biological conditions of the receiving waters and sediments. The Participating Agencies must assess the status and trends of receiving water quality conditions in coastal waters, enclosed bays, estuaries, and streams in the watershed. The receiving water assessment to be presented in the Annual Report will:

- Assess whether or not the conditions of the receiving waters are meeting the numeric goals established in the Plan,
- Identify the most critical beneficial uses that must be protected to ensure the overall health of the receiving water,
- Evaluate whether or not those critical beneficial uses are being protected,
- Identify short-term and/or long-term improvements or degradation of those critical beneficial uses,
- Consider whether or not the strategies established in the Plan contribute toward progress in achieving the interim and final numeric goals of the Plan, and
- Identify data gaps in the monitoring data needed to assess the provisions above.

4.2.1.2 *STORMWATER DRAIN DISCHARGE ASSESSMENTS*

The storm drain discharge assessments include evaluating both the dry weather monitoring data associated with the IDDE program collected as part of the Jurisdictional Runoff Management Program and the wet weather monitoring data collected by the Participating Agencies. Details of these two separate assessments are provided below. Each Participating Agency will assess its dry weather stormwater conveyance system monitoring programs individually and compile results annually as part of the Annual Report. Each Participating Agency must assess and report the progress of its IDDE program (required pursuant to Permit Provision E.2) toward effectively prohibiting non-stormwater and illicit discharges into the stormwater conveyance systems within its jurisdiction, including the elements in **Table 4-10**.

Table 4-10. Key Elements of the Storm Drain Discharge Assessments

Non-stormwater Assessment	Illicit Discharge	Wet Weather Outfall Assessment
• Identify sources of non-stormwater discharges on the basis of field screening data or IDDE activities • Rank and prioritize non-stormwater discharges • Identify sources contributing to numeric action limit exceedances • Estimate volumes and loads of non-stormwater discharges • Evaluate non-stormwater discharge monitoring locations • Evaluate the effectiveness of the water quality improvement strategies	• All IC/ID investigations • IC/IDs eliminated within the jurisdiction	• Estimate volumes and loads of stormwater discharges • Evaluate temporal trends • Evaluate stormwater discharge monitoring locations and frequency • Evaluate Plan analysis • Evaluate the effectiveness of water quality improvement strategies

4.2.1.3 *SPECIAL STUDIES ASSESSMENTS*

As part of the Annual Report, the Participating Agencies will evaluate the results and findings from the special studies. They will use the resulting data to (1) assess their relevance to the Participating Agencies' characterization of receiving water conditions, (2) understand sources of pollutants and/or stressors, and (3) control and reduce the discharges of pollutants from the storm drain outfalls to receiving waters. As with the other monitoring programs, the results of the special studies assessment may warrant modifications of or updates to the Plan.

The special studies will attempt to answer questions concerning the natural "reference" concentrations of bacteria and other pollutants in the region, and to identify the current known sources of in the watershed. The special studies will help guide the implementation of the strategies for the HPWQC.

4.2.1.4 *Modifications or Updates to Water Quality Improvement Plan Programs*

Participating Agencies may recommend modifications or updates to priorities, goals, strategies, monitoring, or JRMP program activities in the Annual Report.

4.2.2 *Report of Waste Discharge*

Submittal of the Report of Waste Discharge serves as an application for renewal of the Permit and, therefore, must be submitted by all listed Participating Agencies 180 days prior to the expiration date of the Permit. The Report of Waste Discharge will include information required for the permit renewal process per Permit Provision F.5, an integrated assessment of Plan programs, and possibly the Regional Monitoring and Assessment Report as required under Permit Provision F.3c.

4.2.3 *Integrated Assessment*

The Participating Agencies will integrate the data collected as part of the Monitoring and Assessment Program, along with information collected during the implementation of the JRMP. The integrated assessment will evaluate the main components of the Plan and will follow the assessment process outlined in the Permit, as summarized in **Table 4-11**.

The integrated assessment builds on the receiving water assessment, storm drain discharge assessment, and special studies assessment described in Sections 4.2.2, and includes an additional evaluation of temporal/long-term trends of wet weather stormwater conveyance system outfalls. Additionally, the integrated assessment will evaluate the data collected as part of the transitional monitoring program implemented after the approval of the 2013 Permit and before the implementation of the monitoring program detailed in Section 4.1.

The integrated assessment for all three Plan components: (1) Priority Water Quality Conditions, (2) Goals and Schedules, and (3) Strategies and will be performed during the development of the Report of Waste Discharge. The priority water quality conditions will be re-evaluated using the receiving water and storm drain discharge assessments. The goals and schedules in Chapter 2 will be reviewed on the basis of the results of the receiving water and storm drain discharge assessments, along with data collected as part of the JRMP. This evaluation will highlight the progress in achieving the compliance goals. Finally, both water quality monitoring data and maintenance/observational data related to BMP effectiveness will be used to assess the strategies implemented by the Participating Agencies. Strategies will be evaluated in the Annual Report on the basis of the data collected as part of the JRMP and any new relevant BMP effectiveness data collected by the Participating Agencies.

Table 4-11. Integrated Assessment Components

Component	Permit Assessment Methodology	Evaluation Assessment
Priority Water Quality Conditions	Re-assess receiving water, priority, and highest priority conditions. (1) Re-evaluate the receiving water conditions per methodology and any new methodology described in Chapter 2. (2) Re-evaluate the impacts of storm drain discharges on receiving waters, including an evaluation of temporal/long-term trends of the cumulative wet weather storm drain outfall water quality data sets (Provision D.4.b.(2)(d)). (3) Identify beneficial uses in receiving waters that must be protected per Receiving Water Assessment presented in Chapter 2. Re-evaluate stormwater conveyance system sources and stressors based on potentially new priority and highest priority conditions. (4) Re-evaluate the identification of stormwater conveyance system sources and/or stressors performed in Chapter 2.	• Receiving Water Assessments • Storm Drain Discharge Assessments
Goals and Schedules	Evaluate effectiveness of goals. (1) Evaluate the progress toward achieving interim and final numeric goals for protecting impacted beneficial uses in receiving waters.	• Receiving Water Assessments • Storm Drain Discharge Assessments • JRMP Assessments
Strategies	Evaluate effectiveness of strategies and actions. (1) Identify the non-stormwater and stormwater pollutant loads from the storm drain outfalls on the basis of the Storm Drain Discharge Assessment (Section 4.2.1.2). (2) Identify the non-stormwater and stormwater pollutant load reductions, or other improvements that are necessary to attain the interim and final numeric goals. (3) Identify the non-stormwater and stormwater pollutant load reductions, or other improvements, that are necessary to demonstrate that non-stormwater and stormwater discharges are not causing or contributing to exceedances of receiving water limitations. (4) Evaluate the progress of the strategies toward achieving interim and final numeric goals for protecting beneficial uses in receiving waters.	• Storm Drain Discharge Assessments • Special Studies Assessments for BMP Effectiveness • JRMP Assessments

4.2.4 *REGIONAL MONITORING REPORT*

The regional monitoring and reporting requirement from Provision F.3.c of the Permit requires integration of all data on a regional scale to recommend modifications to the implementation or assessment of the Plan and jurisdictional runoff management programs. The report must assess the following:

- The beneficial uses of the receiving waters within the San Diego Region that are supported and not adversely affected by the Participating Agency's storm drain discharges,
- The beneficial uses of the receiving waters within the San Diego Region that are adversely affected by the Participating Agency's storm drain discharges,
- The progress toward protecting beneficial uses of the receiving waters within the San Diego Region from Participating Agency's storm drain discharges, and
- Pollutants or conditions of emerging concern that may impact beneficial uses of the receiving waters within the San Diego Region.

REFERENCES

AMEC. 2014. San Luis Rey River Bacteria TMDL Quality Assurance Project Plan (QAPP). Prepared for the County of San Diego. June.

AMEC. 2014. Draft Southern California Stormwater Monitoring Coalition (SMC) Annual Report 2013-2014. Prepared for SMC. December.

Assembly Bill 411, Chapter 765. 1997 (AB411). An Act to Amend Sections 115880, 115885, and 115915 of the Health and Safety Code, Relating to Public Beaches. Sacramento, California. October.

Geosyntec. 2012. San Diego River Watershed Comprehensive Load Reduction Plan (CLRP). Prepared for the County of San Diego, Cities of El Cajon, La Mesa, Santee, San Diego, and Caltrans. October.

San Diego County Municipal Copermittees. 2011. Report of Waste Discharge Application for Renewal of NPDES Municipal Stormwater Permit for San Diego County. June 24. San Diego, CA.

San Diego Regional Water Quality Control Board (Regional Board). 2010. Revised TMDL for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (including Tecolote Creek). Resolution No. R9-2010-0001. Approved February 10, 2010. http://www.waterboards.ca.gov/sandiego/water_issues/programs/tmdls/docs/bacteria/updates_022410/2010-0210_BactiI_Resolution&BPA_FINAL.pdf.

San Diego Regional Water Quality Control Board (Regional Board). 2013. Resolution No. R9-2013-0001, National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Storm Drains Draining the Watershed in the San Diego Region (Permit). May 14.

Southern California Coastal Water Research Project (SCCWRP). 2013. San Diego Regional Reference Stream Study Quality Assurance Project Plan, Revised.

State Water Resources Control Board (State Water Board), 2009. Water Quality Control Plan for Enclosed Bays and Estuaries – Part I Sediment Quality. August.

State Water Resources Control Board (State Water Board), 2013. California Environmental Protection Agency, Surface Water Ambient Monitoring Program, Tools for Assessing the Biological Integrity of Surface Waters. Website visited December 2013. Website last updated October 16, 2014. http://www.waterboards.ca.gov/water_issues/programs/ swamp/tools.shtml. Accessed on November 4, 2013.

Southern California Coastal Water Research Project (SCCWRP). 2013. San Diego Regional Reference Stream Study Quality Assurance Project Plan, Revised.

Southern California Coastal Water Research Project (SCCWRP). 2014. Work Plan for San Diego Wet Weather Epidemiology Study and Quantitative Microbial Risk Assessment.

Weston. 2014a. Transitional Receiving Water Monitoring Plan. Prepared for the San Diego County Copermittees. October.

Weston. 2014b. Transitional Monitoring and Assessment Report Appendix H Draft Bioassessment Monitoring Report. Prepared for the San Diego County Copermittees. December.

Weston. 2014c. Transitional Monitoring and Assessment Report Appendix I Draft Sediment Monitoring Report. Prepared for the San Diego County Copermittees. December.

Attachment 4A-1: San Diego River Watershed Receiving Water Monitoring Plan

SAN DIEGO RIVER WATERSHED RECEIVING WATER MONITORING PLAN

Prepared For:
San Diego River Watershed
Participating Agencies

Prepared By:
AMEC Environment and Infrastructure, Inc.
9177 Sky Park Court
San Diego, California 92123
January 2015

Based Upon:
Transitional Receiving Water Monitoring Work Plan
Prepared by:
Weston Solutions, Inc.
5817 Dryden Place, Suite 101
Carlsbad, California 92008
January 2015

This page intentionally left blank

TABLE OF CONTENTS

PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

LIST OF ACRONYMS AND ABBREVIATIONS

>	less than
<	greater than
AFDM	ash-free dry mass
APHA	American Public Health Association
AWWA	American Water Works Association
BMI	benthic macroinvertebrate
BOD	biochemical oxygen demand
BSA	bovine serum albumin
Caltrans	California Department of Transportation
CDFG	California Department of Fish and Game
CEDEN	California Environmental Data Exchange Network
COC	chain of custody
cm^2	square centimeter
CRAM	California Rapid Assessment Method
CSBP	California Stream Bioassessment
EDD	electronic data deliverable
EDTA	ethylenediaminetetraacetic acid
ELAP	Environmental Laboratory Accreditation Program
GIS	geographic information system
GPS	Global Positioning System
IBI	Index of Biological Integrity
ID	identification
m	meter
mL	milliliter
MLS	Mass Loading Station
mm	millimeter
MS4	municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
PBO	piperonyl butoxide
Permit	San Diego Regional Water Quality Control Board Order Number R9-2013-0001, 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
pH	hydrogen ion concentration
PVC	polyvinyl chloride
O/E	observed to expected

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RWQCB	Regional Water Quality Control Board
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SCCWRP	Southern California's Coastal Water Research Project
SDCRC	San Diego County Regional Copermittees
SDR-MLS	San Diego River Mass Loading Station
SDWQCB	San Diego Regional Water Quality Control Board
SMC	Stormwater Monitoring Coalition
SOP	standard operating procedure
SPE	solid phase extraction
STS	sodium thiosulfate
SWAMP	Surface Water Ambient Monitoring Program
TIE	toxicity identification evaluation
TMDL	total maximum daily load
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
WEF	Water Environment Federation

1 INTRODUCTION

The purpose of this Monitoring Plan is to describe the long-term receiving water monitoring, as required by the San Diego Regional Water Quality Control Board (RWQCB) Order No. R9-2013-0001, *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*, hereafter referred to as the Permit. The goal of the San Diego River Watershed Receiving Water Monitoring Program is to characterize current conditions and assess progress in the receiving waters, and effectiveness of water quality improvement strategies implemented as part of the San Diego River Watershed Water Quality Improvement Plan.

1.1 *PROGRAM OVERVIEW*

The Receiving Water Monitoring Plan includes the following monitoring to satisfy the requirements of Provision D of the Permit:

- Long-term dry and wet weather receiving water monitoring at one mass loading station (MLS) in accordance with the Permit (Provisions D.1.b, c, and d)
- Rapid stream bioassessment and in accordance with the Permit (Provision D.1.c.(5)) which includes Regional monitoring participation in the Stormwater Monitoring Coalition (SMC) Regional Monitoring Program and Southern California Bight Regional Monitoring Program (Provision D.1.e.(1))
- Continue dry weather hydromodification monitoring in accordance with the Permit (Provision D.1.c.(6))

1.2 *MONITORING LOCATIONS*

The San Diego River Watershed Participating Agencies have selected the San Diego River Mass Loading Station (MLS) (SDR-MLS) as the long-term receiving water monitoring location. SDR-MLS is co-located with the U.S. Geological Survey (USGS) gauging station in a modified natural channel, adjacent to the Fashion Valley Mall in the City of San Diego. Location details are provided in Table 1-1. A map of the location is presented in Figure 1-1.

Table 1-1. List of Receiving Water Monitoring Locations for the Permit Term

Watershed	Station ID	Latitude	Longitude	Cross Street Description	Channel Type	Jurisdiction
San Diego River	SDR-MLS	32.765240	-117.168617	Directly south of the Fashion Valley Trolley Station at the footbridge.	Modified natural channel	City of San Diego

This page intentionally left blank

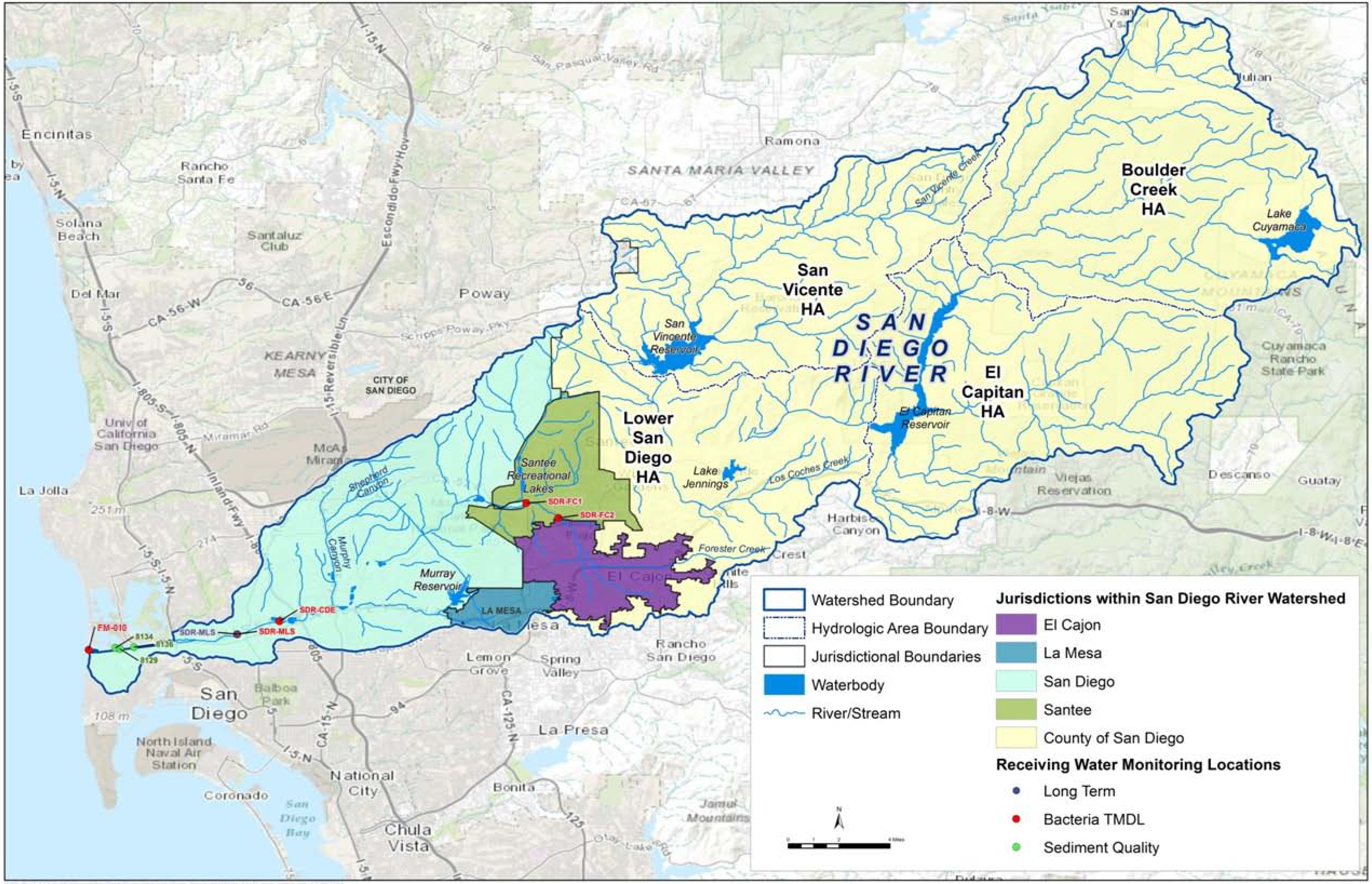


Figure 1-1. Receiving Water Monitoring Locations

This page is intentionally blank

2 Monitoring Methods

This section describes monitoring methods and procedures used to implement the long-term receiving water monitoring program. Long-term receiving water monitoring will be conducted at the MLS for the San Diego River Watershed, in accordance with the Permit (Provisions D.1.b, c, and d).

2.1 *Water Quality Sampling*

This section discusses the sampling procedures and analytical methods for water quality sampling. All sampling and analyses conducted for long-term receiving water monitoring locations will be in accordance with applicable United States Environmental Protection Agency (USEPA) regulations and guidance. Attachment A provides a complete list of constituents, potential methods, sample volumes, holding times, and target reporting limits for the San Diego River Watershed Receiving Water Monitoring Program.

2.1.1 *Dry Weather*

Each long-term monitoring location will be monitored during three dry weather events: once during September prior to the start of the wet season, once during a dry period in the wet season, and once in May or June after the end of the wet season. Dry weather monitoring will be conducted in days with less than 0.1 inches of rainfall and 72 hours of antecedent dry conditions.

In the event that dry weather flow is not observed at a station during the September monitoring event prior to the start of the wet season, the first dry weather sampling event will occur during a qualifying event (e.g., at least 72 hours after a storm event) if dry weather flow is observed during the wet season.

2.1.2 *Wet Weather*

Each long-term station will be monitored during three wet weather events: during the first viable rainfall event of the wet season on or after October 1, during one event at least 30 days after the first rainfall event, and during one rainfall event after February 1. A flow- or time-weighted composite will be collected.

2.1.3 *Flow Monitoring*

Flow rates may be monitored using American Sigma (or comparable) flowmeters with an ultrasonic sensor, bubbler, or submerged pressure transducer as the primary measuring device. The primary sensor will continuously measure stage (i.e., stream height) and relay that information to the flowmeter. The flowmeter will continually calculate flow rates by inserting the stage information into the preprogrammed discharge equation. Using this system, the flowmeter will be able to actuate the sampler to achieve a flow-weighted composite sample, if desired. Sampling and flow equipment will be monitored remotely, and data will be transferred to a permanent data system by cellular modem or manual download.

Equipment installed and used for monitoring during dry weather will remain in place for at least the duration of the monitoring event. The monitoring year is approximately October 1 through September 30. If collected, continual flow data will be downloaded remotely from each station once every two weeks to verify equipment functionality and to reduce data gaps, ensure accuracy, and identify maintenance and calibration needs. Flow data will be entered into the data management system. Equipment will be maintained throughout this period to ensure that it is in proper working order. Additional flow monitoring details, including example methods used for stream rating and channel surveys, are provided in Attachment B.

2.1.4 Grab Samples

Grab samples will be collected for those constituents that are not amenable to composite sampling. Per the Permit, the constituents to be collected as grab samples are indicated in Attachment A and include:

- Temperature
- Hydrogen ion concentration (pH)
- Specific conductance
- Dissolved oxygen
- Turbidity
- Total coliform
- Fecal coliform
- *Enterococcus*

Samples will be collected from the horizontal and vertical center of the channel if possible and will be kept clear of uncharacteristic floating debris.

Microbiology samples will be collected using sterile techniques. Nitrile or latex-type gloves will be worn during sample handling. During the sample event, a 100-milliliter (mL) sterile bacteria bottle will be used to collect the sample directly from the receiving water. Care will be employed to not allow contact with area structures or bottom sediments. The container will be opened only for the time needed to collect the sample and will be closed immediately following sample collection. If it is suspected that the container was compromised at any time, the sample container will be discarded, and a new sample will be collected using a new sample bottle. The sample must be filled only to the 100-mL mark on the sample bottle (not over-topped or under-filled).

Field measurements will be performed for pH, specific conductance, temperature, dissolved oxygen, and turbidity using a water quality probe or similar device. Calibration of the instruments will be conducted prior to each sampling event in accordance with the manufacturer's specifications and calibrated following each sampling event. Calibration records will be kept on file.

A field observation data sheet will be completed for each sample collected to be representative of station conditions. Field observations include trash assessments, which will be performed at each station in accordance with the *Monitoring Workplan for the Assessment of Trash in San Diego County* (San Diego County Regional Copermittees [SDCRC], 2007a).

2.2 *Composite Samples*

A flow- or time-weighted composite sample will be collected at each station during the dry weather and wet weather monitoring events. During the monitoring event, sample aliquots will be collected in proportion to the rate of flow (i.e., flow-weighted) using automated equipment and Teflon-lined tubing. Dry weather flow-weighted composite samples will be collected over a typical 24-hour period, with a minimum of three sample aliquots collected per hour. Wet weather flow-weighted composite samples will be collected by taking sample aliquots across the hydrograph of the storm event. Based on the anticipated size of the storm, a flow-proportioned pacing will be programmed into the automated sampling equipment. The first sample aliquot will be taken at or shortly after the time that stormwater runoff begins, and each subsequent aliquot of equal volume will be collected every time the pre-selected flow volume (flow-proportional pacing) discharges past the monitoring location. Some variation may occur depending on actual storm intensity and duration.

The flow-weighted composite samples will be analyzed for all the constituents not identified for grab sampling. The complete list of constituents for the San Diego River Watershed for dry weather and wet weather is provided in Attachment A.

2.3 *Sample Analysis*

Samples will be analyzed for the bacteria, chemistry, toxicity, and general field parameters provided in Attachment A. Attachment A includes the methods and target reporting limits for each constituent. Chemical, toxicity, and bacterial analysis of samples will be performed by a laboratory certified for the appropriate fields of testing by the California Environmental Laboratory Accreditation Program (ELAP). The laboratory(s) will also be a participant in the SMC Intercalibration Program.

General physical and chemical constituents will be analyzed by accredited laboratories, with the exception of field-measured constituents (i.e., pH, specific conductance, temperature, turbidity, and dissolved oxygen). Field measurements will be collected by field staff during sampling activities using an YSI 6600 series water quality probe or similar type device.

2.4 *Quality Assurance / Quality Control*

Quality assurance (QA) and quality control (QC) for sampling processes will include proper collection of the samples to minimize the possibility of contamination. All samples will be collected in laboratory-supplied, laboratory-certified, contaminant-free sample bottles. Field staff will wear powder-free nitrile or similar gloves at all times during sample collection.

QC samples will be collected to ensure that valid data are collected. Depending on the parameter, QC samples will consist of blanks and duplicate samples to remain compliant with Surface Water Ambient Monitoring Program (SWAMP) protocols. QC requirements will be reviewed and discussed with the appropriate staff to verify the proper working order of equipment, refresh monitoring personnel in monitoring techniques, and determine whether the data quality objectives are being met.

The QA objectives for analyses conducted by the participating analytical laboratories are detailed in their Laboratory QA Manuals. The objectives for accuracy and precision involve all aspects of the testing process, including the following:

- Methods and standard operating procedures (SOPs)
- Calibration methods and frequency
- Data analysis, validation, and reporting
- Internal QC
- Preventive maintenance
- Procedures to ensure data accuracy and completeness

The results of the laboratory QC analyses will be reported with the final data. Any QC samples that fail to meet the specified QC criteria in the methodology will be identified, and the corresponding data will be appropriately qualified in the final report. All QA/QC records for the various testing programs will be kept on file for review by regulatory agency personnel.

2.4.1 Training and Certification

All field personnel will have current and relevant experience in all aspects of standard field monitoring, including use of relevant field equipment such as field instruments and monitoring equipment. Field personnel will be trained and will have experience in the sample collection and handling/storage, and chain-of-custody procedures. Proper field sampling and sample-handling techniques will be reviewed prior to sampling, and only those staff with proficiency will be permitted to conduct the field work. Training will be documented in the health and safety plan for each member of the field team.

All personnel are responsible for complying with the QA/QC requirements that pertain to their organizational/technical functions. Each technical staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of his or her particular function and a general knowledge of laboratory operations, test methods, QA/QC procedures, and records management.

2.4.2 Chain-of-Custody Procedures

Samples will be considered to be in custody if they are (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a container and secured with an official seal such that the sample could not be reached without breaking the seal. The principal documents used to identify samples and to document possession will be chain-of-custody (COC) records, field logbooks, and field tracking forms. COC procedures will be used for samples throughout the collection, transport, and analytical process.

COC procedures will be initiated during sample collection. A COC record will be provided with each sample or group of samples. Each person who will have custody of the samples will sign the form and ensure that the samples will not be left unattended unless properly secured. Documentation of sample handling and custody includes the following:

- Sample identifier
- Sample collection date and time
- Any special notations on sample characteristics or analysis
- Initials of the person collecting the sample
- Date the sample was sent to the analytical laboratory
- Shipping company and waybill information

Completed COC forms will be placed in a plastic envelope and kept inside the cooler containing the samples. Once delivered to the analytical laboratory, the COC form will be signed by the person receiving the samples. The condition of the samples will be noted and recorded by the receiver. COC records will be included in the final reports prepared by the analytical laboratories and are considered an integral part of the report. An example chain of custody form is provided in Attachment C

2.4.3 Field Quality Control

For all conventional water quality analyses except field measurements performed on grab samples, field blanks and field duplicates will be analyzed in accordance with SWAMP guidelines as described in Attachment B.2.i(1) of the Permit.

For toxicity testing, only field duplicates will be collected. The use of controls and reference toxicant testing are QA/QC measures that have been put in place to identify changes in test organism sensitivity due to stress or other factors.

2.4.4 Equipment Calibration

All instruments used for field and laboratory analyses will be calibrated in accordance with the manufacturer's specifications. Calibration of the flow monitoring and sampling equipment will be conducted immediately prior to deployment or use and will be field verified during each data download or sampling event. The calibrations will be conducted in accordance with the manufacturer's specifications.

Field measurements for pH, specific conductance, dissolved oxygen, turbidity, and temperature will be made using a water quality probe in accordance with the manufacturer's specifications. The water quality probe will be calibrated with calibration solutions, and it will be verified that the expiration date has not been exceeded.

2.4.5 Equipment Decontamination and Cleaning

QA/QC for sampling processes begins with proper collection of the samples to minimize the possibility of contamination. All water samples will be collected in laboratory-certified, contaminant-free bottles. Appropriate sample containers and field measurement and sampling gear will be transported to the sampling location in clean storage containers. Field measurements will be taken and recorded using the appropriate decontaminated equipment. If sampling poles are used for collecting water samples, they will be decontaminated between sampling locations.

2.5 *Toxicity Identification Evaluations*

Toxicity identification evaluations (TIEs), if necessary, will be conducted in compliance with Provisions D.1.c.(4)(f) and D.1.d.(4) of the Permit and used to determine the causative agent(s) of toxicity. Provision D.4.a.(2) indicates the need for a TIE. As necessary, TIEs will be conducted in accordance with the guidelines for characterizing chronically toxic effluents (USEPA, 1991; USEPA, 1992; USEPA, 1993a; USEPA, 1993b).

Phase I TIE testing typically involves manipulating the sample(s) using the methods in Table 2-1.

Treatment blanks will be created for each TIE treatment to determine the effects of the manipulation on laboratory dilution water. The results of these blanks will be used to determine whether any changes in toxicity of the control (dilution water) are impacted by the chemical or physical manipulation of the sample. A baseline test, run concurrently with the TIE treatments, will be performed to assess the toxicity of the unmanipulated sample(s). Baseline tests are intended to confirm the presence of toxicity in the sample and to benchmark the toxicity for comparison to toxicity in TIE treatments.

Table 2-1. Typical Phase I TIE Manipulations

Physical and Chemical Manipulation (Test) on Water Samples	Purpose of Test
Filtration	Detects filterable compounds (e.g., total suspended solids [TSS] related)
Aeration	Detects volatile, oxidizable, sublatable, or spargeable compounds
Ethylenediaminetetraacetic acid (EDTA) addition	Detects cationic metals (e.g., cadmium)
Sodium thiosulfate (STS) addition	Detects oxidative compounds (e.g., chlorine)
Solid phase extraction (SPE) over C18 column, followed by methanol elution	Detects non-polar organics and some surfactants
Piperonyl butoxide (PBO) addition	Detects organophosphate pesticides and pyrethroids
Carboxyl esterase addition	Detects pyrethroids
Bovine serum albumin (BSA) addition	Protein BSA is used as a control for the carboxyl esterase
Temperature reduction	Increases toxicity of pyrethroid pesticides
pH reduction	Detects pH-dependent toxicants (e.g., ammonia or sulfides)

2.6 *Dry Weather Hydromodification Monitoring*

This section describes the sampling and data collection methods for the dry weather receiving water hydromodification monitoring requirements as outlined in Provision D.1.c.(6) of the Permit.

In addition to the hydromodification monitoring conducted as part of the Participating Agencies' Hydromodification Management Plans, hydromodification monitoring for SDR-MLS is required at least once during the Permit term. The Participating Agencies must collect the following hydromodification monitoring observations and measurements within an appropriate domain of analysis during at least one dry weather monitoring event for each long-term receiving water monitoring location:

- Channel conditions, including: Channel dimensions, hydrologic and geomorphic conditions, and presence and condition of vegetation and habitat
- Location of discharge points
- Habitat integrity
- Photo documentation of existing erosion and habitat impacts, with location (i.e., latitude and longitude coordinates) where photos were taken
- Measurement or estimate of dimensions of any existing channel bed or bank eroded areas, including length, width, and depth of any incisions
- Known or suspected cause(s) of existing downstream erosion or habitat impact, including flow, soil, slope, and vegetation conditions, as well as upstream land uses and contributing new and existing development

The monitoring will coincide with the spring receiving water dry weather monitoring event in May or June and the dry weather receiving water bioassessment monitoring. The domain of analysis at each long-term monitoring location for dry weather hydromodification monitoring will be within the same reach of the channel as that used for dry weather bioassessment monitoring.

Table 2-2 provides an outline of the hydromodification monitoring requirements and the methods for each assessment category. Detailed methods for each assessment category are described in the following sections.

Table 2-2. Hydromodification Monitoring Requirements

Assessment Requirement Category	Method
Channel Conditions	
Channel Dimensions	Channel survey (cross-sectional and thalweg survey)
Hydrologic and geomorphic conditions	Southern California Coastal Water Research Project (SCCWRP) channel assessment tool
Presence and condition of vegetation and habitat	California Rapid Assessment Method (CRAM)
Location of discharge points	Table of MS4 outfalls to stream segment
Habitat integrity	CRAM
Photo documentation of existing erosion and habitat impacts, with location (i.e., latitude and longitude coordinates) where photos were taken	Channel survey and photo documentation
Measurement of estimate of dimensions of any bed or bank eroded areas, including length, width, and depth of any incisions	Channel survey
Known or suspected cause(s) of existing downstream erosion or habitat impact, including flow, soil, slope, and vegetation conditions, as well as upstream land uses and contributing new and existing development	Geographic information system (GIS) desktop analysis and SCCWRP channel assessment tool

2.6.1 *Channel Dimensions*

Channel surveys will be conducted at each monitoring location to gather basic hydraulic measurements of the receiving water channels. Channel surveys will be conducted using a DeWalt self-leveling rotary laser. The cross-section survey involves placing endpoints at the highest point of the channel on each bank. A measuring tape will be stretched between the endpoints such that the zero end of the tape is attached to the endpoint on the left bank of the channel (looking downstream). Channel depth will be measured across the channel from a stadia rod that is vertical and level from the channel bottom. The channel thalweg surveys will be conducted for the reach upstream and downstream of the cross-section. The average channel slope will be calculated from the survey data.

2.6.2 *Hydrologic and Geomorphic Conditions*

The geomorphic assessment will be conducted to characterize the susceptibility of the channel and gather basic hydraulic measurements of the receiving water channels. The geomorphic assessment comprises the channel survey and the Southern California Coastal Water Research Project (SCCWRP) channel assessment tool. The SCCWRP Field Manual (Bledsoe et al., 2010) will be used to assess the vertical and lateral susceptibility of the receiving water channels. The domain of analysis for each monitoring location is derived from the desk and field components of the screening tool and will be within reach of the channel used for dry weather bioassessment monitoring. A suite of field measurements will also be made to characterize the channel bed and banks, and overall stability state. Sediment samples will be collected to characterize bed materials. Fixed-interval pebble counts will be performed for each reach where the channel bed is composed of gravel or coarser material (Bunte and Abt, 2001), and channel beds composed of fine material will be noted as sand or cohesive materials (bed gradations are not required for channels with D50 less than (<) 2 millimeters [mm]).

2.6.3 *Presence and Condition of Vegetation and Habitat Integrity*

The presence and condition of vegetation and habitat integrity will be determined from the data collected during dry weather bioassessment monitoring. For dry weather bioassessment monitoring, the sampling will follow the protocols previously outlined in Section 2.5. Physical habitat quality assessments of the monitoring locations using the California Rapid Assessment Method (CRAM) will provide a numerical summary score of the physical conditions for each monitoring location. This method involves assessing the quality of the in-stream habitat features as well as the buffer zones (250 meters perpendicular to flow from each bank and 500 meters upstream and downstream of the monitoring reach), hydrologic source quality, and biotic structure quality. For each monitoring reach sampled, the physical habitat of the stream and its adjacent banks will be assessed to provide a record of the overall physical condition of the reach. Parameters such as substrate complexity, channel alteration and human influence, frequency of riffles, and width and quality of riparian zones will provide a more comprehensive understanding of the condition of the stream. Additionally, specific characteristics of the sampled riffles will be measured, including substrate size classes, stream depth, gradient, sinuosity, and flow volume. A final CRAM score will be calculated that can range from 25 to 100 points, with higher scores indicating higher quality conditions. CRAM ratings of good, fair, and poor are defined by the score (i.e., for the CRAM score range of 25-100, <50=low, 50-75=moderate, and >75=high).

2.6.4 *Photo Documentation*

A channel survey will be conducted and photographs will be used to document the conditions in the receiving water channels, including any existing erosion and habitat impacts. Photographs will be taken using a digital camera with a built-in Global Positioning System (GPS), altimeter, and compass. Photo documentation will be conducted using the general procedures outlined in San Diego Water Board Stream Photo Documentation Procedures for 401 Water Quality Certifications Standard Operating Procedure.

The following information will be recorded for each photograph:

- Project name
- General location
- Photographer and team members
- Photo number
- Date
- Time

At a minimum, photographs will be taken of the following:

- Long view up or down the stream (from stream level) showing changes in the stream bank and vegetation
- Long view and medium view of streambed changes (e.g., thalweg, gravel, meanders)
- Long views from a bridge or other elevated position
- Medium and close views of structures and plantings
- Medium views of bars and banks, with a person (preferably holding a stadia rod) in view for scale
- Close views of streambed with a ruler or other common object in the view for scale

2.6.5 *Dimensions of Bed or Bank Eroded Areas*

Measurements or estimates of dimensions of any bed or bank eroded areas, including length, width, and depth of any incisions, will be conducted during the channel survey. Bed or bank eroded areas will be documented with photographs as described in the channel survey section above.

2.6.6 *Location of Discharge Points/Known or Suspected Causes of Erosion or Habitat Impact*

Known or suspected cause(s) of existing downstream erosion or habitat impact, including flow, soil, slope, and vegetation conditions, as well as upstream land uses and contributing new and existing development, will be assessed during a GIS desktop exercise and the SCCWRP channel assessment tool.

2.7 *Dry Weather Receiving Water Bioassessment Monitoring*

Dry weather receiving water bioassessment monitoring will be conducted in accordance with the Permit (Provisions D.1.a.(1), D.1.a.(3)(a), D.1.c.(5), and D.1.e.(1)(a)). Dry weather receiving water bioassessment monitoring will include bioassessment at each long-term receiving water monitoring location and participation in the SMC Regional Monitoring Program. Bioassessment surveys will be conducted during the spring/summer dry season bioassessment index period, typically from May through July. Benthic macroinvertebrates (BMIs) and physical habitat data will be collected following the *SWAMP Bioassessment Procedures: Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California* (Ode, 2007) using the reach-wide benthos method. Benthic algae (i.e., periphyton) monitoring will be conducted in accordance with the *SWAMP Standard Operating Procedures for Collecting Stream Algae Samples and Associated Physical Habitat and Chemical Data for Ambient Bioassessments in California* (Fetscher et al., 2009). Samples will be collected and processed for ash-free dry mass (AFDM), chlorophyll-a analysis, and periphyton taxonomy. Reach-wide algal cover will be quantified as part of the SWAMP physical habitat assessment. Physical habitat quality of the monitoring locations will be quantified using CRAM for riverine wetlands (Collins et al., 2012).

The SWAMP sampling protocol includes the collection of stream BMI and also assesses the physical quality and condition of the streambed and banks in detail. (Note: A physical habitat index based on the SWAMP procedure has not been developed at the time of this report). CRAM assessments incorporate broader buffer zone and land use attributes than do SWAMP assessments, and also provide a numerical quality score for each monitoring location. BMIs reside in streams for periods ranging from a month to several years, and have varying sensitivities to the multiple stressors associated with urban runoff. Using species-specific tolerance values and community species composition, numerical biometric indices are calculated, allowing for comparison of relative habitat health among streams in a region. By assessing the invertebrate community structure of a stream, a cumulative measure of stream habitat health and ecological response is obtained.

The data include a taxonomic listing of all BMIs identified in the surveys, and calculation of the biological metrics listed in the California Stream Bioassessment Procedure (CSBP). Additionally, calculation of two indices that rate the overall BMI community quality will be performed. These include the Index of Biotic Integrity (IBI) (Ode et al., 2005) and the observed to expected (O/E) ratio of taxa (Hawkins, Western Center for Monitoring and Assessment, 2010).

2.7.1 *2015 SMC Regional Monitoring Program*

The 2015 SMC Regional Monitoring Program is currently being developed. The SMC Bioassessment Technical Workgroup is working to determine which components of the 2009-2013 SMC Regional Monitoring Program were effective tools for achieving the program's goals and what monitoring elements may be suspended or added for future assessments. Beginning in 2015, SMC will confirm the monitoring locations under this program.

2.7.2 *Monitoring Reach Delineation*

Using SWAMP methodology, every monitoring reach is 150 meters in length and will be sampled from downstream to upstream. If a portion of a reach is inaccessible, the reach length may be reduced to as little as 100 meters. The bioassessment reaches are placed as closely as possible to the water quality and flow monitoring locations.

2.7.3 *Macroinvertebrate Sample Collection*

BMI samples will be collected at evenly spaced 15-meter transects for a total of 11 transects in the 150-meter reach. The samples will be collected in an alternating margin-center-margin pattern. Collections will be made using a 1-foot-wide, 0.5-millimeter (mm)-mesh, D-frame kick-net. A 1-square-foot area upstream of the net will be sampled by disrupting the substrate and scrubbing the cobble and boulders, so that the organisms will be dislodged and swept into the net by the current. The duration of the sampling generally ranges from 1 to 3 minutes, depending on the substrate complexity. Every monitoring location will be sampled from downstream to upstream. The samples will be combined into a single composite sample for the reach, transferred to 1-quart jars, preserved with 95 percent ethanol, and returned to the laboratory for processing. Photographs will be taken of every monitoring location.

2.7.4 *Multihabitat Periphyton Sample Collection*

Periphyton (benthic algae) will be collected using the reach-wide procedure and within the same transects used for BMI collection, but offset 1 meter upstream to avoid disturbed substrate. Depending on the substrate type and the stream habitat, one of three sampling devices will be used to collect the substrate sample: a 12.6-square centimeter (cm^2) rubber delimiter, a 4-centimeter (cm) diameter polyvinyl chloride (PVC) delimiter, or a syringe scrubber.

After all transects are sampled, the subsamples will be composited. The macroalgae will be gathered and separated from the composited liquid. A subsample of the macroalgae will be taken for the soft-bodied taxonomic identification sample. The composite liquid volume will be recorded, and the remaining macroalgae will be finely cut up and thoroughly mixed with the composite liquid. The homogenized sample will be used for the diatom taxonomic identification sample, as well as the two filtered biomass samples. The diatom and soft-bodied algae samples will be fixed accordingly before being delivered to the laboratory for taxonomic identification. Taxonomic identification will be performed by a qualified taxonomist. The remaining homogenized portion of the composite will be filtered in the field, and the filters will be placed on ice and/or frozen until delivery to the chemistry laboratory for chlorophyll-a and ash-free dry mass analysis.

A separate soft-bodied algae sample will be collected for qualitative taxonomic identification. The qualitative sample consists of a composite of all soft-bodied algae found within the reach. The sample will be left unpreserved and put on ice or refrigerated until delivery to the laboratory for taxonomic identification. Qualitative taxonomic identifications will be performed by a qualified taxonomist for the receiving water and SMC monitoring locations.

2.7.5 *PHYSICAL HABITAT QUALITY ASSESSMENT*

For each monitoring reach sampled, the physical habitat of the stream and its adjacent banks will be assessed to provide a record of the overall physical condition of the reach. Parameters such as substrate complexity, channel alteration and human influence, frequency of riffles, and width and quality of riparian zones will provide a more comprehensive understanding of the condition of the stream. Additionally, specific characteristics of the sampled riffles will be measured, including substrate size classes, stream depth, gradient, sinuosity, and flow volume.

CRAM assessments of each monitoring location also will be performed. This method assesses the quality of the in-stream habitat features as well as the buffer zones (250 meters perpendicular to flow from each bank and 500 meters upstream and downstream of the monitoring reach), hydrologic source quality, and biotic structure quality. A final CRAM score will be calculated that can range from 25 to 100 points, with the higher scores indicating higher quality conditions.

Water quality measurements will be taken at each of the monitoring locations using a YSI Model 6600 (or comparable) data sonde. Measurements will include water temperature, specific conductance, pH, and dissolved oxygen. Samples will be collected for laboratory analysis following the protocols outlined in the SMC Regional Monitoring Program Workplan. Stream flow velocity will be measured with a Marsh-McBirney Model 2000 (or comparable) portable flowmeter, or will be visually estimated when the water is too shallow for the flowmeter.

2.7.6 *LABORATORY PROCESSING AND ANALYSIS*

Laboratory processing of BMI samples will follow the SWAMP Bioassessment Procedures: *Standard Operating Procedures for Laboratory Processing and Identification of Benthic Macroinvertebrates in California* (Woodward et al., 2012). At the laboratory, samples are poured over a No. 35 standard testing sieve (0.5-mm stainless-steel mesh), and the ethanol is retained for reuse. The sample is gently rinsed with fresh water, and large debris such as wood, leaves, or rocks are removed. The sample is transferred to a tray marked with grids approximately 50 cm^2 in size. One grid is randomly selected, and the sample material contained within that grid is removed and processed. In cases where the test organisms appear extremely abundant, a fraction of the grid may be removed.

The material from the grid is examined under a stereomicroscope, and all the invertebrates are removed, sorted into major taxonomic groups, and placed in vials containing 70 percent ethanol. If there are less than 600 test organisms in the grid, another grid is selected and processed. This process is repeated until 600 organisms are removed from the sample, or until the entire sample is sorted. Organisms from a grid in excess of 600 are also removed, counted, and recorded as "remaining test organisms," so that estimated total organism abundance and density for the sample can be calculated. Terrestrial organisms, vertebrates, water-column associated organisms (e.g., copepods), and nematodes are not removed from the samples. Processed material from the sample is placed in a separate jar and labeled "sorted," and the unprocessed material is returned to the original sample container and archived. Sorted material is retained for QA purposes. All organisms are identified to Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) standard taxonomic effort Level II (SAFIT, 2006).

2.7.7 Quality Assurance/Quality Control

QA/QC procedures for the Bioassessment Monitoring and SMC Program will be consistent with those outlined in Section 2.2.4. In addition, QA of the benthic infauna sample sorting will be performed on all of the samples to ensure at least a 90 percent removal rate of organisms. Organisms removed during sorting QA also will be identified. Taxonomic QA will be performed on 10 percent of the samples.

This page intentionally left blank

3 DATA MANAGEMENT, ASSESSMENT, AND REPORTING

The Monitoring and Assessment Annual Report, which will be submitted to the RWQCB on January 31 annually, will include descriptions of monitoring conducted during the applicable monitoring year.

3.1 Data Management

Field Data Records and Analytical Data Reports will be sent to and kept by the Program Manager or specified contracted agency. Data will be submitted in a standardized California Environmental Data Exchange Network (CEDEN)-compatible format to the County of San Diego for their records.

This page intentionally left blank

4 REFERENCES

Bledsoe, B.P., R. J. Hawley, E. D. Stein, and D.B. Booth. 2010. *Hydromodification Screening Tools: Field Manual for Assessing Channel Susceptibility*. ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/606_HydromodScreeningTools_FieldManual.pdf

Bunte, Kirstin and Steven R. Abt. 2001. Sampling surface and subsurface particle-size distributions in wadable gravel-and cobble-bed streams for analyses in sediment transport, hydraulics, and streambed monitoring. http://www.treesearch.fs.fed.us/pubs/4580

Collins, J.N., E.D. Stein, M. Sutula, R. Clark, A.E. Fetscher, L. Grenier, C. Grosso, and A. Wiskind. March 2012. *California Rapid Assessment Method (CRAM) for Wetlands*, v.6.0. 157 pp. Available at: http://www.cramwetlands.org/documents/

Fetscher, A., L. Busse, and P. Ode. 2009. *Standard Operating Procedures for Collecting Stream Algae Samples and Associated Physical Habitat and Chemistry Data for Ambient Bioassessments in California*.

Hawkins, Charles P. 2010. Western Center for Monitoring and Assessment. Accessed at: http://129.123.10.240/wmcportal/DesktopDefault.aspx

Linsley, R., M. Kohler, and J. Paulhus. 1982. *Hydrology for Engineers*, 3rd Edition. McGraw-Hill Publishing, New York, NY.

Oberg, K.A., S.E. Morlock, and W.S. Caldwell. 2005. *Quality-Assurance Plan for Discharge Measurements Using Acoustic Doppler Current Profilers*. U.S. Geological Survey.\ Scientific Investigations Report 2005-5183.

Ode, P., A. Rehn, and J. May. 2005. A Quantitative Tool for Assessing the Integrity of Southern Coastal California Streams. *Environmental Management*, 35:493-504.

Ode, P.R. 2007. *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California.* California State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) Bioassessment SOP 001. Available at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/swamp_sop_bio.pdf http://www.swrcb.ca.gov/swamp/docs/phab_sopr6.pdf

Rantz, S. 1982. Measurement and Computation of Streamflow, Volume 1, Measurement of Stage and Discharge. United States Geologic Survey Water Supply Paper 2175.

Regional Water Quality Control Board, San Diego (RWQCB). 2007. California Regional Water Quality Control Board San Diego Region, Order No. R9-2007-0001, NPDES No. CAS0108758,

RWQCB. 2013. California Regional Water Quality Control Board San Diego Region, Order No. R9-2013-0001, NPDES No. CAS0109266, 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. May 2013.

SAFIT (Southwestern Association of Freshwater Invertebrate Taxonomists). 2006. *Southwestern Association of Freshwater Invertebrate Taxonomists List of Macroinvertebrate Taxa from California and Adjacent States and Ecoregions; and Standard Taxonomic Effort*.

San Diego County Regional Copermittees, 2014. Transitional Receiving Water Monitoring Work Plan. Prepared by Weston Solutions, Inc.

SCCWRP (Southern California Coastal Water Research Project). 2007. *Regional Monitoring of Southern California's Coastal Watersheds Workplan*. Stormwater Monitoring Coalition Bioassessment Working Group, Technical Report 539. December 2007.

SCCWRP (Southern California Coastal Water Research Project). 2009. *Southern California Regional Watershed Monitoring Program, Bioassessment Quality Assurance Project Plan*.

SCCWRP (Southern California Coastal Water Research Project). 2013. *Regional Watershed Monitoring Program – Proposal for 2014 Sampling*. Distributed to the Stormwater Monitoring Coalition Bioassessment Technical Workgroup, December 9, 2013. Point of Contact: Raphael Mazor, raphaelm@sccwrp.org SDCRC (San Diego County Regional Copermittees), 2007a. *Monitoring Workplan for the Assessment of Trash in San Diego County*. Prepared by Weston Solutions, Inc.

USEPA (United States Environmental Protection Agency). 1991. *Methods for Aquatic Toxicity Identification Evaluations. Phase I Toxicity Characterization Procedures*. EPA/600/6-91/003. EPA Office of Research and Development. Second Edition. February 1991.

USEPA (United States Environmental Protection Agency). 1992. *Toxicity Identification Evaluation. Characterization of Chronically Toxic Effluents, Phase I*. EPA/600/6-91/005F. EPA Office of Research and Development. May 1992.

USEPA (United States Environmental Protection Agency). 1993a. *Methods for Aquatic Toxicity Identification Evaluations. Phase II Toxicity Characterization Procedures for Samples*

USEPA (United States Environmental Protection Agency). 1993b. *Methods for Aquatic Toxicity Identification Evaluations. Phase III Toxicity Characterization Procedures for Samples Exhibiting Acute and Chronic Toxicity*. EPA/600/R-92/081. EPA Office of Research and Development. September 1993.

USEPA (United States Environmental Protection Agency). 1995. *Short-term Methods for Measuring the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms*. EPA/600/R-95/136. EPA Office of Research and Development. Narragansett, RI.

USEPA (United States Environmental Protection Agency). 2000. *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates*. Second Edition. EPA/600/R-99/064. March 2000.

USEPA (United States Environmental Protection Agency). 2002a. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*. 4th Edition. EPA Office of Water. EPA-821-R-02-013.

Woodward, M.E., J. Slusark, and P.R. Ode. 2012. *Standard Operating Procedures for Laboratory Processing and Identification of Benthic Macroinvertebrates in California*. SWAMP Bioassessment Procedures 2012: October 2012. Available at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/bmi_lab_sop_final.pdf

ATTACHMENT A
DRY WEATHER AND WET WEATHER CONSTITUENTS, POTENTIAL METHODS, VOLUMES, HOLDING TIMES, AND TARGET REPORTING LIMIT

This page intentionally left blank

Table A-1. Analyte List for Long-Term Receiving Water Monitoring

Analyte	Volume Required	Potential Analytical Method*	Target Reporting Limit	Units	Max Holding Time	Dry Weather Receiving Water Monitoring	Wet Weather Receiving Water Monitoring
Conventional Parameters							
Chloride	250 mL	USEPA 300.0	0.5	mg/L	28D	X[4]	X[4]
Color	500 mL	SM 2120B	3	Color Units	48H	X[4]	X[4]
Dissolved Organic Carbon	250 mL	SM 5310 C	0.50	mg/L	28D	X[7]	X[7]
Dissolved Oxygen	In field	Meter	0.01	mg/L	NA	X[1,2,4,6C,9]	X[1,2,4,9]
pH	In field	Meter	0.01	pH	NA	X[1,2,4,6B,6C,9]	X[1,2,4,9]
Specific Conductivity	In field	Meter	1	µS/cm	NA	X[1,2,9]	X[1,2,9]
Sulfates	250 mL	USEPA 300.0	0.5	mg/L	28D	X[4,7]	X[4,7]
Temperature	In field	Meter	0.1	°C	NA	X[1,2,9]	X[1,2,9]
Total Hardness	Calculation from Calcium and Manganese	SM 2340B	0.662	mg/L	NA	X[7,9]	X[7,9]
Total Organic Carbon	250 mL	SM 5310 C	0.30	mg/L	28D	X[7]	X[7]
Turbidity	In field or lab: 250 mL	Meter	0.1	NTU	NA or 48H	X[1,2,6B,6C,7,9]	X[1,2,7,8,9]
Indicator Bacteria							
Enterococcus	100 mL	SM 9230C	20	MPN/100mL	8H	X[3,4,5,6A,6B,6C,7,9]	X[3,4,5,7,9]
Fecal Coliform	100 mL	SM 9221E	20	MPN/100mL	8H	X[3,4,5,6A,6B,6C,7,9]	X[3,4,5,7,9]
Total Coliform	100 mL	SM 9221B	20	MPN/100mL	8H	X[3,4,5,6A,7,9]	X[3,4,5,7,9]

Table A-1. Analyte List for Long-Term Receiving Water Monitoring (Continued)

Table A-1. Analyte List for Long-Term Receiving Water Monitoring (Continued)

Analyte	Volume Required	Potential Analytical Method*	Target Reporting Limit	Units	Max Holding Time	Dry Weather Receiving Water Monitoring	Wet Weather Receiving Water Monitoring
Inorganic Analytes							
Arsenic (Dissolved)	250 mL	USEPA 200.8	0.0004	mg/L	6M	X[7]	X[7]
Arsenic (Total)	250 mL	USEPA 200.8	0.0004	mg/L	6M	X[7]	X[7]
Cadmium (Dissolved)	250 mL	USEPA 200.8	0.0001	mg/L	6M	X[6B,6C,7]	X[7]
Cadmium (Total)	250 mL	USEPA 200.8	0.0001	mg/L	6M	X[6B,6C,7]	X[7,8]
Chromium (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[6B,6C,7,12]	X[7]
Chromium (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[6B,6C,7,12]	X[7]
Chromium III (Dissolved)	NA	Calculated from Chromium and Chromium VI	NA	NA	NA	X[6B,6C]	-
Chromium III (Total)	NA	Calculated from Chromium and Chromium VI	NA	NA	NA	X[6B,6C]	-
Chromium VI (Dissolved)	250 mL	USEPA 218.6	0.0003	mg/L	28D	X[6B,6C]	-
Chromium VI (Total)	250 mL	USEPA 218.6	0.0003	mg/L	28D	X[6B,6C]	-
Copper (Dissolved)	250 mL	USEPA 200.8	0.0005	mg/L	6M	X[6B,6C,7]	X[7]
Copper (Total)	250 mL	USEPA 200.8	0.0005	mg/L	6M	X[6B,6C,7]	X[7,8]
Iron (Dissolved)	250 mL	USEPA 200.7	0.01	mg/L	6M	X[6C,7]	X[7]
Iron (Total)	250 mL	USEPA 200.7	0.01	mg/L	6M	X[6C,7]	X[7]

Table A-1. Analyte List for Long-Term Receiving Water Monitoring (Continued)

Analyte	Volume Required	Potential Analytical Method*	Target Reporting Limit	Units	Max Holding Time	Dry Weather Receiving Water Monitoring	Wet Weather Receiving Water Monitoring
Lead (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[6B,6C,7]	X[7]
Lead (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[6B,6C,7]	X[7,8]
Manganese (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[4,6C]	X[4]
Manganese (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[4,6C]	X[4]
Mercury (Dissolved)	250 mL	USEPA 245.1	0.00005	mg/L	28D	X[7]	X[7]
Mercury (Total)	250 mL	USEPA 245.1	0.00005	mg/L	28D	X[7]	X[7]
Nickel (Dissolved)	250 mL	USEPA 200.8	0.0008	mg/L	6M	X[6B,6C,7]	X[7]
Nickel (Total)	250 mL	USEPA 200.8	0.0008	mg/L	6M	X[6B,6C,7]	X[7]
Selenium (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[4,7]	X[4,7]
Selenium (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[4,7]	X[4,7]
Silver (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[6B,6C]	-
Silver (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[6B,6C]	-
Thallium (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[7]	X[7]
Thallium (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M	X[7]	X[7]
Zinc (Dissolved)	250 mL	USEPA 200.8	0.005	mg/L	6M	X[6B,6C,7]	X[7]
Zinc (Total)	250 mL	USEPA 200.8	0.005	mg/L	6M	X[6B,6C,7]	X[7,8]
Nutrients							
Ammonia	250 mL	USEPA 350.1	0.1	mg/L	28D	X[4,7]	X[4,7]
Dissolved Phosphorus	250 mL	USEPA 365.1	0.01	mg/L	48H	X[4]	X[4]

Table A-1. Analyte List for Long-Term Receiving Water Monitoring (Continued)

Analyte	Volume Required	Potential Analytical Method*	Target Reporting Limit	Units	Max Holding Time	Dry Weather Receiving Water Monitoring	Wet Weather Receiving Water Monitoring
Nitrate	250 mL	USEPA 353.2	0.1	mg/L	48H	X[4,7,10]	X[4,7,8,11]
Nitrite	250 mL	USEPA 353.2	0.1	mg/L	48H	X[4,7,10]	X[4,7,8,11]
Orthophosphate	250 mL	USEPA 365.1	0.002	mg/L	48H	X[4,7]	X[4,7]
TKN	250 mL	USEPA 351.2	0.1	mg/L	28D	X[4,7]	X[4,7]
Total Nitrogen	Calculation	Calculated from TKN, Nitrate, and Nitrite	NA	NA	NA	X[4,5,6C]	X[4,5]
Total Phosphorus	250 mL	USEPA 365.1	0.01	mg/L	28D	X[4,5,6C,7]	X[4,5,7,8]
Solid Parameters							
TDS	500 mL	SM 2540C	10	mg/L	7D	X[4,7]	X[4,7]
TSS	1000 mL	SM 2540D	5	mg/L	7D	X[7]	X[7]
Synthetic Organic Compounds							
MBAS	500 mL	SM 5540C	0.05	mg/L	48H	X[6C,7]	X[7]
Organophosphate Pesticides	2 L	USEPA 625M	0.01	µg/L	7/40D	X[7]	X[7]
Synthetic Pyrethroids	2 L	GC/MS NCI-SIM	2-10	ng/L	7/40D	X[7]	X[7]

Table A-1. Analyte List for Long-Term Receiving Water Monitoring (Continued)

Analyte	Volume Required	Potential Analytical Method*	Target Reporting Limit	Units	Max Holding Time	Dry Weather Receiving Water Monitoring	Wet Weather Receiving Water Monitoring
Toxicity							
Larval Survival and Growth with *Pimephales promelas*	15 L	EPA-821-R-02-013	NA	Pass/Fail	36H	X[4,13]	X[4,13]
Survival and Reproduction with *Ceriodaphnia dubia*	4 L	EPA-821-R-02-013	NA	Pass/Fail	36H	X[4,13]	X[4,13]
Growth with *Selenastrum capricornutum*	4 L	EPA-821-R-02-013	NA	Pass/Fail	36H	X[4,13]	X[4,13]

NA = Not applicable; mL = milliliter; L = liter; D = day; H = hour; M = month

* The methods presented in the table are potential methods. Other equicalent EPA-approved methods may be substituted as long as the target reporting limits are met for the corresponding constituents.

1. Parameter listed in Table D-2 of the Permit.
2. Analytes that are field measured are not required to be analyzed by a laboratory.
3. Parameter contributes to a highest priority water quality condition identified in the San Diego River Watershed Water Quality Improvement Plan.
4. Parameter listed as a cause for impairment of receiving waters in the San Diego River Watershed on the 303(d) list.
5. Parameter for CLRP developed for a TMDL in the San Diego River Watershed.

6A. Parameter listed in NALs for discharges from MS4s to Ocean Surf Zone (Permit Provision C.1.a(1))

6B. Parameter listed in NALs for discharges from MS4s to Bays, Harbors, and Lagoons/Estuaries (Permit Provision C.1.a(2))

6C. Parameter listed in NALs for discharges from MS4s to Inland Surface Waters (Permit Provision C.1.a(3))

7. Parameter listed in Table D-3 of the Permit.
8. Parameter listed in SALs for discharges from MS4s to receiving waters (Table C-5 of the Permit).
9. Grab samples may be collected for pH, temperature, specific conductivity, dissolved oxygen, turbidity, hardness, and indicator bacteria.
10. Nitrite and nitrate may be combined and reported as nitrite+nitrate.
11. Nitrite and nitrite will be reported as nitrite+nitrate.
12. Analysis of Chromium in MS4 discharges is not explicitly required in the Permit. Chromium is analyzed to calculate Chromium III.
13. Parameter listed in Table D-4 of the Permit. SDR-MLS is located in freshwater so only freshwater constituents are represented.

This page intentionally left blank

ATTACHMENT B
STREAM RATING AND CHANNEL SURVEY DETAILS

This page intentionally left blank

STREAM RATINGS

Per the San Diego County Regional Copermittees' (SDCRC) Transitional Receiving Water Monitoring Program Work Plan, stream ratings may be conducted as described herein (SDCRC, 2014).

The flow rate at each of the monitoring locations will be determined by stream stage (water level) sensors that are typically secured to the bottom of the channel. To quantify flow rates on the basis of stream stage, a relationship between flow and stage will be derived using the standardized stream rating protocols developed by the U.S. Geological Survey (USGS) (Rantz, 1982; Oberg et al., 2005). Instantaneous flow measurements will be taken at various stages at each of the monitoring locations. The measurements will be combined to produce and calibrate the rating curve for each monitoring location.

To accurately measure flow in streams, the following elements are needed to develop the rating curves:

- An accurate survey of the stream channel cross-section and longitudinal slope
- Accurate level measurements based on a fixed point
- Measurements of velocity and flows at several points throughout the rating curve, including low flow, mid flow, and peak flow conditions

To measure instantaneous flows during low flow and base flow conditions, two velocity measurement instruments are typically used—a Marsh-McBirney Model 2000 Portable Flowmeter connected by a cable to an electromagnetic open channel velocity sensor and the SonTek (YSI) FlowTracker Acoustic Doppler Velocimeter. The FlowTracker is a high-precision, shallow-water flowmeter that measures velocity in three dimensions and features an automatic discharge computation.

To make an instantaneous flow measurement, a tape measure is stretched across the stream, perpendicular to flow and secured on both banks of the stream. The tape is positioned so that it is suspended approximately 1 foot above the surface of the water. The distance on the tape directly above the waterline (i.e., where the water meets the bank) is recorded as the initial point. The first measurement is made at the first point where there is adequate water depth (i.e., at least 0.2 foot) and measurable velocity. At this point, three measurements are made, including water depth, velocity, and distance from the bank (the initial point). Subsequent depth, velocity, and distance measurements are made incrementally across the entire width of the channel. Data from the field measurements are entered into a computer model that calculates the stream's cross-sectional profile from the depth and distance from bank measurements. Total flow across the channel is determined by integrating the velocity measurements over the cross-sectional surface area of the stream channel. The result is an instantaneous flow measurement in cubic feet per second.

A StreamPro Acoustic Doppler Current Profiler (ADCP) is used to measure mid- and high-stage flow conditions. The StreamPro ADCP is the USGS instrument of choice for measuring flows nationwide (Oberg et al., 2005). The instrument is pulled across the stream either by walking across a bridge or attaching the unit to a tagline. Data are collected in real time and transmitted by a wireless data link to a PC. Data can be viewed in real time and are typically post-processed following the field event in the office.

Rating curves are extended to high stream stages not measured using site-specific survey information and the Chézy–Manning formula (Linsley et al., 1982). The Chézy–Manning formula is an empirical formula for open channel flow, or flow driven by gravity, as follows:

$$Q = (1.486/n)AR^{2/3}\,S^{1/2}$$

where:

Q = flow
n = Manning Roughness coefficient
A = cross-sectional area
R = hydraulic radius
S = hydraulic slope

The hydraulic radius is derived as follows:

$$R = A/P$$

where:

A = cross-sectional area of flow (ft2)
P = wetted perimeter (ft)

The Chézy–Manning formula was developed for conditions of uniform flow in which the water surface profile and energy gradient are parallel to the streambed and the area, hydraulic radius, and depth remain constant throughout the reach. Field surveys of the channel geometry of each MLS will be conducted to compute the channel characteristics for each station.

CHANNEL SURVEYS

Channel surveys will be conducted at each monitoring location to gather basic hydraulic measurements of the receiving water channels and to derive stream discharge using the Chézy–Manning formula. Channel surveys will be conducted using a DeWalt self-leveling rotary laser. The cross-section survey involves placing endpoints at the highest point of the channel on each bank. A measuring tape is stretched between the endpoints such that the zero end of the tape is attached to the endpoint on the left bank of the channel (looking downstream). Channel depth is measured across the channel from a stadia rod that is vertical and level from the channel bottom. The channel thalweg surveys are conducted for the reach upstream and downstream of the cross-section. The average channel slope is calculated from the survey data.

Channel survey data are used with the Chézy–Manning formula to produce a rating curve for each sampling location. Each rating curve is calibrated using instantaneous flow measurements by adjusting the formula roughness coefficient.

UNITED STATES GEOLOGICAL SURVEY WATERSHEDS

USGS flow monitoring gauges are located in the larger watersheds, specifically Santa Margarita, San Luis Rey, Los Peñasquitos Creek, San Diego River, and Tijuana River. The USGS gauging stations are used to estimate the annual flow volumes for the watersheds. The SDR-MLS is within relative proximity to the USGS San Diego River flow monitoring station. The SDR-MLS flow data will be compared with USGS data, as it will also be used to validate flow monitoring data collected at SDR-MLS.

This page intentionally left blank

ATTACHMENT C
EXAMPLE CHAIN-OF-CUSTODY FORM

This page intentionally left blank

EXAMPLE - CHAIN-OF-CUSTODY FORM

Date: _________ ***Page*** ____ ***of*** ____

Analyzing Laboratory: ____________________________

Project Name / Project Number					**Container Type / Volume**	**Total Number of Containers**	**Analysis / Test Requested**									**Laboratory Use Only**	
Project Manager / Contact																		
Client																		
Address																		
Phone / Fax / Email																		
Site ID (Location)	**Sample ID**	**Date**	**Time**	**Matrix**											**Preservation**	**Temp (C) Upon Receipt**	**Laboratory ID**

Sample Matrix Code: FW = Freshwater; SW = Storm Water; SLT = Saltwater; SED = Sediment; BIO = Biologic; O = Other (Specify) __________________

Container Code: G = Glass; P = Plastic; B = Bags; O = Other (Specify) ______________

Shipped By: ☐ Courier ☐ FedEx ☐ UPS ☐ USPS ☐ Client Drop-Off ☐ Other ________________

Turnaround Time: ☐ 2-day ☐ 5-day ☐ 7-day ☐ 10-day ☐ 14-day ☐ Standard ☐ Other _______________________

Reporting Requirements: ☐ PDF ☐ EDD ☐ Hard Copy ☐ Email ☐ Other _______________________

Sampled By:
Name (Print): _____________________________
Signature: _____________________________

Comments/Special Instructions:

Relinquished By				**Received By**			
Print Name	Signature	Firm	Date/Time	Print Name	Signature	Firm	Date/Time
1				1			
2				2			
3				3			
4				4			
5				5			

Attachment 4A-2: San Diego River Watershed Sediment Quality Monitoring Plan

San Diego River Watershed Sediment Monitoring Plan

Prepared For:
San Diego River Watershed
Participating Agencies

Prepared By: Weston
Solutions, Inc.
5817 Dryden Place, Suite 101
Carlsbad, California 92008
September 2, 2014

Revised By:
AMEC Environment and Infrastructure, Inc.
9177 Sky Park Court
San Diego, California 92123
January 2015

This page intentionally left blank

TABLE OF CONTENTS

Page

APPENDICES

A Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality
B Sediment Monitoring Plan QAPP

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
AVS:SEM	acid-volatile sulfides and simultaneously extracted metals
Bight	Southern California Bight Regional Monitoring Program
BRI	Benthic Response Index
CA EPA	California Environmental Protection Agency
CA LRM	California Logistic Regression Model
CEDEN	California Environmental Data Exchange Network
COC	chain-of-custody
Copermittees	San Diego Regional Copermittees
CSI	Chemical Score Index
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DGPS	Differential Global Positioning System
DO	dissolved oxygen
DTCS	Department of Toxic Substances Control
EC_{50}	median effective concentration
IBI	Index of Biotic Integrity
ID	inner diameter
LC_{50}	median lethal concentration
LOE	line of evidence
$MgSO_4$	magnesium sulfate
MLOE	multiple lines of evidence
MS4	Municipal Separate Storm Sewer System
MW	molecular weight
NPDES	National Pollutant Discharge Elimination System
OEHHA	Office of Environmental Health Hazard Assessment
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls pH hydrogen ion concentration
P_{MAX}	maximum probability model
QA	quality assurance
QA/QC	quality assurance/quality control
QAMP	Quality Assurance Management Plan
QAPP	Quality Assurance Project Plan
QC	quality control

ACRONYMS AND ABBREVIATIONS (Continued)

RBI	Relative Benthic Index
RIVPACS	River Invertebrate Prediction and Classification System
RL	Reporting Limit
RWQCB	Regional Water Quality Control Board
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists
SDRWQCB	San Diego Regional Water Quality Control Board
SOPs	Standard Operating Procedures
SPME	solid phase microextraction
SQOs	Sediment Quality Objectives
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TIE	toxicity identification evaluation
TMDL	Total Maximum Daily Load
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
WQIP	Water Quality Improvement Plan

UNITS OF MEASURE

cm	centimeter
°C	degrees Celsius
ft	feet or foot
L	liter
m^2	square meters
µg/kg	microgram per kilogram
mg	milligram
mg/kg	milligram per kilogram mg/L milligram per liter
mL	milliliter
mm	millimeter
ppt	parts per thousand
%	percent

INTRODUCTION

The San Diego County Regional Copermittees (Copermittees) are required to conduct sediment quality monitoring in accordance with the requirements of the San Diego Regional Water Quality Control Board (RWQCB) Order No. R9-2013-0001 (Permit), effective June 27, 2013. The Copermittees are required, either individually, in association with multiple Copermittees, or through participation in a water body monitoring coalition to perform sediment quality monitoring to assess compliance with the sediment quality receiving water limits applicable to MS4 discharges to enclosed bays and estuaries. Provision D.1.e.(2) of the Permit requires the Copermittees to develop a Sediment Monitoring Plan for incorporation into the Water Quality Improvement Plan (WQIP) which satisfies the requirements of the Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality (Sediment Control Plan; State Water Quality Control Board [SWRCB] and California Environmental Protection Agency [CA EPA], 2009; see Appendix A).

Provision D.1.e.(1)(b) of the Permit also requires the Copermittees to participate in the Southern California Bight Regional Monitoring Program (Bight). The Bight Program can be used to simultaneously fulfill all or part of the sediment quality monitoring requirement (Provision D.1.e(2)) as long as the Bight Program utilizes the Sediment Control Plan to assess the health of San Diego County lagoons. Depending on the outcome of the sediment quality objectives (SQOs) assessments at Bight stations located in San Diego County lagoons, follow-up monitoring may be necessary to meet all of the Permit requirements.

The following Sediment Monitoring Plan describes the sediment quality sample collection and analysis activities that will be implemented by the Copermittees during the Permit term. As required by the Permit, this Sediment Monitoring Plan includes the elements listed in Sections VII.D and VII.E of the Sediment Control Plan (Receiving Water Limits Monitoring Frequency and Sediment Monitoring, respectively), a Sediment Monitoring Quality Assurance Project Plan (QAPP) (Appendix B), and a schedule for completion of monitoring and submission of the Sediment Monitoring Report. Once the sediment quality monitoring is complete, the Copermittees will incorporate a Sediment Monitoring Report into the WQIP Annual Report.

1.1 BACKGROUND

In 2003, the SWRCB initiated a program to develop SQOs for enclosed bays and estuaries. The primary objective is to protect benthic communities and aquatic life from exposure to contaminants in sediment that have been directly discharged into the water body or indirectly discharged into waters draining into the water body. The SQOs, which are outlined in the Sediment Control Plan, are based on a multiple lines of evidence (MLOE) approach in which the lines of evidence (LOE) are sediment toxicity, sediment chemistry, and benthic community condition, as described in the Sediment Control Plan (see Appendix A) and in Section 3.2. The MLOE approach evaluates the severity of biological effects and the potential for chemically mediated effects to provide a final station level assessment. The Sediment Control Plan was approved by the SWRCB and the Office of Administrative Law on September 16, 2008, and on January 5, 2009, respectively, and was subsequently approved by the United States Environmental Protection Agency (USEPA) on August 25, 2009.

1.2 MONITORING OBJECTIVE

The primary objective of the sediment monitoring program is to assess compliance with the sediment quality receiving water limits applicable to MS4 discharges to enclosed bays and estuaries of San Diego County. Sediment toxicity, chemistry, and benthic community condition will be assessed using SQOs as described in the Sediment Control Plan (Appendix A). The goals of the SQOs are to determine whether pollutants in sediments are present in quantities that are toxic to benthic organisms and/or will bioaccumulate in marine organisms to levels that may be harmful.

The goal of the Sediment Monitoring Plan is to provide the key elements that are required to successfully conduct field sediment sampling, processing, testing, and analysis of the results. Analyses of chemistry, toxicity, and benthic community condition require that samples be collected, preserved, processed, and analyzed using proper field and laboratory equipment, methods, and techniques. Additionally, representative station locations ensure the proper characterization of benthic conditions. The Sediment Monitoring Plan and Sediment Monitoring QAPP (Appendix B) describe the collection and analysis of surface sediment samples necessary to provide representative assessments of in situ conditions for the enclosed bays and estuaries of San Diego County.

MATERIALS AND METHODS

The materials and methods described in this section are designed to meet the requirements of the Sediment Control Plan, Sections VII.D and VII.E, as required by Permit Provision D.1.e.(2)(a). The methodology is outlined in Section V of the Sediment Control Plan. If sediment quality monitoring is conducted as part of the Bight Program, the work plans and associated QA/QC documents pertaining to the Bight Program should be followed.

Quality assurance methods and procedures needed to maintain consistency in sample collection, processing, and analysis to produce scientifically defensible data are provided in the Sediment Monitoring Quality Assurance Project Plan (QAPP) (Appendix B). The QAPP provides acceptability criteria for the collection and analysis of duplicate field samples, field or equipment rinse blanks, laboratory methods, and laboratory spikes. The QAPP should be used as a reference to ensure proper methods are used consistently throughout the monitoring program.

1.3 FIELD COLLECTION PROGRAM

1.3.1 Station Selection

The Sediment Control Plan applies to subtidal surficial sediments located seaward of the intertidal zone in enclosed bays and estuaries. It does not apply to ocean waters, inland surface waters, sediments consisting of less than 5 percent (%) fines or substrates composed of gravel, cobble, or consolidated rock, or to sediment classified as a pollutant due to physical processes such as burial or sedimentation. SQOs have been fully developed for only two of California's six enclosed bay habitats: euhaline (salinity = 25 to 32 parts per thousand [ppt]) bays and coastal lagoons south of Point Conception and polyhaline (18 to 25 ppt) central San Francisco Bay. In addition, the benthic species assemblage used to calculate the benthic LOE for southern California marine bays is Habitat C (Bay et al., 2014), and one of the criteria for Habitat C is a salinity greater than 27 ppt. In order to select a sampling station applicable to the SQQ assessment using Habitat C for the benthic LOE, it is recommended to verify that a proposed sampling station is both subtidal and has salinity greater than 27 ppt. Salinity measurements should be taken at a spring high and low tide to get an estimate of the salinity range for a proposed station. If feasible, it is recommended that salinity should be monitored throughout an entire spring tidal cycle to ensure it meets the salinity criteria prior to sampling. This monitoring can be accomplished by deploying a continuous monitoring device such as an YSI water quality data sonde. Water depth should also be measured when visiting the station at a spring low tide or deploying a continuous monitoring device over a spring tidal cycle to ensure the station is subtidal.

The Sediment Control Plan does not give guidance as to how many stations should be sampled in each lagoon. The number of sampling stations may vary within based on the spatial extent of the area likely to be impacted. If the Bight Program is utilized to fulfill the Sediment Quality Monitoring requirement of the Permit, then the number of stations will be dictated by the Bight Program. For example, in the 2008 Bight Program, five stations were analyzed per lagoon; however, in the 2013 Bight Program the number of stations per lagoon varied from one to three stations. If a stressor identification study becomes necessary following the original SQO assessment of a lagoon (see Section 4.0), then the number of stations will be based on what suspected pollutants are driving the impacted scores (e.g. algae, physical factors, or chemical factors) and to have enough samples to statistically support meaningful findings.

1.3.1.1 San Diego River Monitoring Stations

Although the number of stations selected may vary, three monitoring stations were selected in the San Diego River Estuary in accordance with station selection methods described in Section 2.1.1. The selected stations are presented in Table 2-1.

Table 2-1. San Diego River Estuary Selected Monitoring Stations*

Site ID	Latitude	Longitude
8129	32.7568	-117.2353
8134	32.7574	-117.2380
8136	32.7579	-117.2274

*Specific station locations and number of stations selected are subject to change based on the spatial extent of the study area, study requirements, and safety and access considerations

1.3.2 Permitting

Scientific collecting permits from the California Department of Fish and Wildlife are required to collect benthic infaunal samples containing invertebrate specimens. A minimum of 24 hours (business days only) prior to collecting benthic infaunal samples in the field, a copy of the Notification of Intent to Collect for Scientific Purposes form should be faxed or emailed to the Marine Region (Monterey, CA) office of the CDFW. Additionally, written authorization may be required from state agencies or private landowners in order to gain access to water bodies that are surrounded by private land, have locked fences or gates, contain threatened or endangered species, or require the use of a private boat launch. Nesting seasons of threatened and endangered bird species may prevent sampling from being conducted or may restrict access around nesting areas during certain times of year, typically mid to late summer months.

1.3.3 Monitoring Season and Frequency

Section VII.E.6 of the Sediment Control Plan requires that samples for SQO programs be collected between June and September. Physical environments and benthic community composition and abundance within enclosed bays and estuaries are generally stable and most similar from year to year during this time (Bay et al., 2014).

According to Section VII.D of the Sediment Control Plan, sediment monitoring associated with Phase I stormwater discharges and major discharges will be conducted at least twice during the Permit cycle except at stations that have consistently been classified as unimpacted or likely unimpacted using the MLOE approach described in Section 3.2. At the unimpacted or likely unimpacted stations, monitoring may be reduced to a frequency of once during the Permit cycle. The participating agencies propose to conduct one round of sediment sampling each permit term. The second required round of sampling will be satisfied by conducting additional follow up sampling in the vicinity of potentially impacted sites identified in the first round. For the San Diego River Estuary, this requirement is met for the 2013-2018 MS4 Permit term based on sampling and assessments conducted through the participation in the Bight'13 monitoring program and the subsequent follow up sediment sampling carried out in 2014.

1.3.4 Sampling Vessels

Vessels used to collect sediment samples should be both stable and maneuverable and should have a sufficiently shallow draft to navigate into shallow waters (e.g. large inflatable boat). The vessels should be equipped with a side or rear davit from which to deploy and retrieve surface sampling equipment, and should accommodate a minimum of two persons in addition to all appropriate sampling and safety equipment.

1.3.5 Navigation

All station locations will be pre-plotted prior to sampling activities. Stations will be identified using a Differential Global Positioning System (DGPS). The system uses U.S. Coast Guard differential correction data, and is accurate within 10 feet (ft). All final station locations will be recorded in the field using positions from the DGPS.

1.3.6 Sediment Sampling and Handling

Benthic sediments will be collected as surface grabs using an appropriate sampler, such as a stainless steel Van Veen grab sampler. The size of the grab sampler to be used for sediment programs in Southern California should be 0.1 square meter (m^2) across the top of the sampler. An appropriate sampler for the collection of benthic sediments will have the following characteristics:

- Constructed of a material that does not introduce contaminants.
- Causes minimal surface sediment disturbance.
- Does not leak or mix during sample retrieval.
- Has a design that enables safe/easy sample verification that samples meet all applicable sampling criteria (e.g., collects sediments to at least 5 centimeters (cm) below the sediment surface, has access doors allowing visual inspection and removal of undisturbed surface sediment).

A sample will be determined to be acceptable if the surface of the grab is even, there is minimal surface disturbance, and there is a penetration depth of at least 5 cm. Rejected grabs will be discarded, and the station will be re-sampled. Upon retrieval, if the grab is acceptable, the overlying water will be carefully drained, and the sediment will be processed depending on analysis and use. Sediment grabs will be collected for the following analyses: benthic infauna, chemistry, grain size, and toxicity. Station location and grab event data should be written on preformatted field data sheets (hard copies or via computer). At a minimum, field data should include station identification, station location, date, time of sample collection, depth of water, depth of penetration of grab in sediment (e.g. 5 cm), sediment composition, sediment odor and color, and sample type (e.g. sediment chemistry).

In the event that a pre-plotted sample station is found to be unsuitable for collecting sediment, because of factors such as inaccessibility, the salinity does not meet the SQO criteria, disturbance to wildlife, or safety considerations, the station may be abandoned and an alternate station may be selected. Reasons for abandonment should be recorded on field data sheets.

The entire contents of a grab sample will be collected for benthic community analyses. Samples collected for benthic infaunal analysis will be rinsed through a 1.0-millimeter (mm) mesh screen. The material retained on the screen will be transferred to a labeled glass or plastic sample container. A 7% magnesium sulfate ($MgSO_4$) seawater solution will be added to the sample container to 85-90% of its volume to relax the collected specimens. The sample container will be inverted several times to distribute the relaxant solution. After 30 minutes, add enough sodium borate buffered formaldehyde to top off the sample container and gently invert the container several times to ensure the sample is mixed. This will make a 10% formalin solution.

Sediment samples for toxicity testing and chemistry will be collected from the top 5 cm of a grab sample using a pre-cleaned stainless steel scoop. Sediment within 1 cm of the sides of the grab will be avoided to prevent interaction of any contaminants and the steel sampling device. According to the Sediment Control Plan, the preferred method of collection for sediment-water interface toxicity tests (see Section 2.2.2.2) is to collect intact cores directly from the sediment sampler by pressing polycarbonate core tubes (7.3-cm inner diameter [ID] and 16 cm in length) into the top 5 cm of sediment. However, homogenizing sediment for sediment-water interface testing is also acceptable according to the Sediment Control Plan. This method is more practical to implement in the field and is consistent with previous sediment quality objective methodology (e.g., Bight protocols and previous lagoon monitoring implemented by the Copermittees). Minimum sample volumes and types of sample containers to be used in the sediment collection is provided in the Sediment Monitoring QAPP (see Appendix B)

All sampling equipment will be cleaned prior to sampling. Between sampling stations, the grab sampler will be rinsed with station water. Stainless steel scoops will be rinsed with seawater and rinsed with de-ionized water between stations. All sediment samples will be logged on a chain-of-custody (COC) form (see Section 2.1.7). Sediment chemistry and toxicity samples will be placed in a cooler on ice until delivered or shipped to the appropriate laboratories. Prior to shipping, sample containers will be placed in sealable plastic bags and securely packed inside the cooler with ice. The original signed COC forms will remain with the samples during shipment. Sediment samples will be shipped or delivered to the analytical laboratory within appropriate holding times (refer to Sediment Monitoring QAPP in Appendix B).

1.3.7 Documentation of Chain-of-Custody

This section describes the program requirements for sample handling and COC procedures. Samples are considered to be in custody if they are: (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a secured container. The principal documents used to identify samples and to document possession are COC records, field log books, and field tracking forms. COC procedures will be used for all samples throughout the collection, transport, and analytical process, and for all data and data documentation, whether in hard copy or electronic format.

COC procedures will be initiated during sample collection. A COC record will be provided with each sample or sample group. Each person who has custody of the samples will sign the form and ensure that the samples are not left unattended unless properly secured. Minimum documentation of sample handling and custody will include the following:

- Sample identification.
- Sample collection date and time.
- Any special notations on sample characteristics.
- Initials of the person collecting the sample.
- Date the sample was sent to the laboratory.
- Shipping company and waybill information.

The completed COC form will be placed in a sealable plastic envelope that will travel inside the ice chest containing the listed samples. The COC form will be signed by the person transferring custody of the samples. The condition of the samples will be recorded by the receiver. COC records will be included in the final analytical report prepared by the laboratory and will be considered an integral part of the report.

1.4 LABORATORY TESTING

All samples will be tested in accordance with USEPA or American Society for Testing and Materials (ASTM) protocols. If appropriate protocols do not exist, the Copermittees should use other methods approved by the SWRCB or San Diego RWQCB. Analytical laboratories will be certified by the California Department of Health Services in accordance with Water Code 13176. Additional information pertaining to laboratory testing is presented in the Sediment Monitoring QAPP (see Appendix B).

1.4.1 Physical and Chemical Analysis

Physical and chemical measurements of sediment were selected to comply with the Sediment Control Plan and to provide data on chemicals of potential concern in bays and estuaries located in San Diego County. The physical and chemical analyses of sediments will include, at a minimum, the constituents outlined in Table 2-2. Reporting limits (RLs) must be equal to or less than those listed in Table 2-2 in order to generate the chemistry LOE outlined in Section 2.3.3.1. Concentrations associated with the RLs in Table 2-2 are expressed in dry-weight. Physical analyses of sediment will include grain size and percent solids. Grain size will be analyzed to determine the general size classes that make up the sediment (e.g., gravel, sand, silt, and clay), whereas percent solids will be measured to convert chemical concentrations from a wet-weight to a dry-weight basis. Chemical analyses of sediment will include total organic carbon (TOC), and the select trace metals, chlorinated pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) shown in Table 2-2.

Table 2-2. Chemical and Physical Parameters for Sediment Samples

Parameter	Reporting Limit
Physical/Conventional Tests	
Grain Size	1.00 %
Percent Solids	0.10 %
Total Organic Carbon (TOC)	0.01 %
Metals	
Cadmium (Cd)	0.09 mg/kg
Copper (Cu)	52.8 mg/kg
Lead (Pb)	25.0 mg/kg
Mercury (Hg)	0.09 mg/kg
Zinc (Zn)	60.0 mg/kg
Organochlorine Pesticides	
2,4′-DDD	0.50 µ g/kg
2,4′-DDE	0.50 µ g/kg
2,4′-DDT	0.50 µ g/kg
4,4′-DDD	0.50 µ g/kg
4,4′-DDE	0.50 µ g/kg
4,4′-DDT	0.50 µ g/kg
Chlordane-alpha	0.50 µ g/kg
Chlordane-gamma	0.54 µ g/kg
Dieldrin	2.5 µ g/kg
trans-Nonachlor	4.6 µ g/kg
PCB Congeners	
2,4'-Dichlorobiphenyl	3.0 µ g/kg
2,2',5-Trichlorobiphenyl	3.0 µ g/kg
2,4,4'-Trichlorobiphenyl	3.0 µ g/kg
2,2',3,5'-Tetrachlorobiphenyl	3.0 µ g/kg
2,2',5,5'-Tetrachlorobiphenyl	3.0 µ g/kg
2,3',4,4'-Tetrachlorobiphenyl	3.0 µ g/kg
2,2',4,5,5'-Pentachlorobiphenyl	3.0 µ g/kg
2,3,3',4,4'-Pentachlorobiphenyl	3.0 µ g/kg
2,3',4,4',5-Pentachlorobiphenyl	3.0 µ g/kg
2,2',3,3',4,4'-Hexachlorobiphenyl	3.0 µ g/kg
2,2',3,4,4',5'-Hexachlorobiphenyl	3.0 µ g/kg
2,2',4,4',5,5'-Hexachlorobiphenyl	3.0 µ g/kg
2,2',3,3',4,4',5-Heptachlorobiphenyl	3.0 µ g/kg
2,2',3,4,4',5,5'-Heptachlorobiphenyl	3.0 µ g/kg
2,2',3,4',5,5',6-Heptachlorobiphenyl	3.0 µ g/kg
2,2',3,3',4,4',5,6-Octachlorobiphenyl	3.0 µ g/kg
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	3.0 µ g/kg
Decachlorobiphenyl	3.0 µ g/kg
PAHs (low molecular weight)	
Acenaphthene	20.0 µ g/kg
Anthracene	20.0 µ g/kg
Phenanthrene	20.0 µ g/kg
Biphenyl	20.0 µ g/kg

Table 2-2. Chemical and Physical Parameters for Sediment Samples (Continued

Parameter	Reporting Limit
Naphthalene	20.0 µ g/kg
2,6-Dimethylnaphthalene	20.0 µ g/kg
Fluorene	20.0 µ g/kg
1-Methylnaphthalene	20.0 µ g/kg
2-Methylnaphthalene	20.0 µ g/kg
1-Methylphenanthrene	20.0 µ g/kg
PAHs (high molecular weight)	
Benzo(a)anthracene	80.0 µ g/kg
Benzo(a)pyrene	80.0 µ g/kg
Benzo(e)pyrene	80.0 µ g/kg
Chrysene	80.0 µ g/kg
Dibenzo(a,h)anthracene	80.0 µ g/kg
Fluoranthene	80.0 µ g/kg
Perylene	80.0 µ g/kg
Pyrene	80.0 µ g/kg

DDD Dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethylene
DDT dichlorodiphenyltrichloroethane
mg/kg milligrams per kilogram
µ g/kg micrograms per kilogram

1.4.2 Toxicity Testing

To evaluate the benthic condition of San Diego County's bays and lagoons, sediment toxicity testing will be conducted in accordance with ASTM and USEPA methods. Toxicity testing involves a short-term survival test, a sublethal endpoint test, and an assessment of sediment toxicity. For each test type, more than one specific test is acceptable. The appropriate species tested for a sample will depend on the characteristics of the sample such as grain size, salinity, and suspected toxic constituents, if any. When historical data are available for a sample location, it is recommended that the same species be used in order to make comparisons and to conduct trend analysis. In addition, when testing is conducted as part of a regional monitoring program such as the Bight program, the species selection will be dictated by the program.

If significant toxicity is observed in the solid phase or sediment-water interface test, a toxicity identification evaluation (TIE) may be conducted as part of stressor identification studies described in Section 4.0.

1.4.2.1 Short-Term Survival Testing

SQO analysis requires that at least one short-term survival test be conducted. There are three acceptable short-term survival tests, each of which is a 10-day test exposing amphipods to whole sediment. The three acceptable test organisms are Eohaustorius estuarius, Leptocheirus plumulosus, and Rhepoxynius abronius. The E. estuarius short-term survival test has been the 10-day test method used in previous San Diego County lagoon monitoring programs where the SQO analytical tool was used to assess lagoon health. These amphipod bioassays will be conducted in accordance with procedures outlined in Methods for Assessing Toxicity of

Sediment-Associated Contaminants with Estuarine and Marine Amphipods (USEPA, 1994) and ASTM method E1367-03 (ASTM, 2006) or an equivalent method. Test conditions are summarized in Table 2-3.

A water-only reference toxicity test should be conducted concurrently with the whole sediment amphipod test to assess the relative sensitivity of test organisms used in the evaluation of project sediments. Amphipod reference toxicant tests are typically conducted using cadmium. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing.

Table 2-3. Summary of Conditions for 10-Day Whole Sediment Amphipod Bioassay

Test Conditions 10-Day Whole Sediment Bioassay				
Test Species		E. estuarius	L. plumulosus	R. abronius
Test Procedures		USEPA (1994); ASTM E1367-03 (2006)		
Test Type/Duration		Static - Acute Whole Sediment/10 days		
Sample Storage Conditions		4 °C, dark, minimal head space		
Age/Size Class		3-5 mm	2-4 mm; immature	3-5 mm
Grain Size Tolerance		0.6-100% sand	0-100% sand	10-100% sand
Recommended Water Quality Parameters	Temperature	15 ± 1 °C	25 ± 1 °C	15 ± 1 °C
	Salinity	20 ± 2 ppt	20 ± 2 ppt	28 ± 2 ppt
	Dissolved Oxygen	Maintaining 90% saturation		
	Total Ammonia	< 60 mg/L	< 60 mg/L	< 30 mg/L
Test Chamber		1 L glass		
Exposure Volume		2 cm sediment, 800 mL seawater		
Replicates/Sample		5		
No. of Organisms/Replicate		20		
Photoperiod		Continuous light		
Feeding		None		
Water Renewal		None		
Aeration		Constant gentle aeration		
Acceptability Criteria		Mean control survival > 90%; >80% survival in each replicate		

mg/L milligram per liter

1.4.2.2 Sublethal Testing

The second type of testing required for SQO analysis is a sublethal test. Either a 48-hour development test exposing embryos of the bivalve *Mytilus galloprovincialis* to the sediment-water interface may be conducted or a 28-day survival and growth test exposing the polychaete worm *Neanthes arenaceodentata* to whole sediment. Test condition summaries for the bivalve and polychaete tests are presented in Table 2-4 and Table 2-5, respectively. The *M. galloprovincialis* sediment-water interface test has been the sublethal test method used in previous San Diego County lagoon monitoring programs where the SQO analytical tool was used to assess lagoon health.

Mytilus galloprovincialis Sediment-Water Interface Development Sublethal Test

Sediment-water interface bioassays are performed to estimate the potential toxicity of contaminants fluxing from test sediments into the overlying water. The sediments will be tested in a 48-hour sediment-water interface test using the bivalve M. galloprovincialis in accordance with procedures outlined in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms (USEPA, 1995) and Assessment of Sediment Toxicity at the Sediment-Water Interface (Anderson et al., 1996). Sediment-water interface bioassays will be tested on intact cores collected in the field or on homogenized sediment samples as described in Section 2.1.6.

A water-only reference toxicity test should be conducted concurrently with the sediment-water interface bivalve test to assess the relative sensitivity of test organisms used in the evaluation of the project sediments. Bivalve reference toxicant tests are typically conducted using copper. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing.

Table 2-4. Test Conditions for the 48-Hour M. galloprovincialis Sediment-Water Interface Bioassay

<table>
<tr><th colspan="3">Test Conditions
10-Day Whole Sediment Bioassay</th></tr>
<tr><td colspan="2">Test Species</td><td>M. galloprovincialis</td></tr>
<tr><td colspan="2">Test Procedures</td><td>USEPA (1995), Anderson et al. (1996)</td></tr>
<tr><td colspan="2">Test Type/Duration</td><td>Static - Acute sediment-water interface/48 hours</td></tr>
<tr><td colspan="2">Sample Storage Conditions</td><td>4 °C, dark, minimal head space</td></tr>
<tr><td colspan="2">Age/Size Class</td><td>< 4 hour old larvae</td></tr>
<tr><td rowspan="4">Recommended Water Quality Parameters</td><td>Temperature</td><td>15 ± 1 °C</td></tr>
<tr><td>Salinity</td><td>32 ± 2 ppt</td></tr>
<tr><td>Dissolved Oxygen</td><td>Maintaining 90% saturation</td></tr>
<tr><td>Total Ammonia</td><td>< 4 mg/L</td></tr>
<tr><td colspan="2">Test Chamber</td><td>Polycarbonate core tube 7.3-cm inner diameter, 16 cm high</td></tr>
<tr><td colspan="2">Exposure Volume</td><td>5 cm sediment, 300 mL water</td></tr>
<tr><td colspan="2">Replicates/Sample</td><td>4</td></tr>
<tr><td colspan="2">No. of Organisms/Replicate</td><td>Approximately 250 larvae</td></tr>
<tr><td colspan="2">Photoperiod</td><td>16 hours light: 8 hours dark</td></tr>
<tr><td colspan="2">Feeding</td><td>None</td></tr>
<tr><td colspan="2">Water Renewal</td><td>None</td></tr>
<tr><td colspan="2">Aeration</td><td>Constant gentle aeration</td></tr>
<tr><td colspan="2">Acceptability Criteria</td><td>Mean control normal-alive > 80%</td></tr>
</table>

Neanthes arenaceodentata Whole Sediment Survival and Growth Sublethal Test

The N. arenaceodentata test will be conducted in accordance with ASTM method E1562 (ASTM, 2002) with modifications described in Farrar and Bridges (2011) that have been found to contribute manageability and precision to the ASTM procedure. A water-only reference toxicity test should be conducted concurrently with the whole sediment polychaete test to assess the relative sensitivity of test organisms used in the evaluation of the project sediments. Polychaete reference toxicant tests are typically conducted using cadmium. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing.

Table 2-5. Test Conditions for the 28-Day Whole Sediment N. arenaceodentata Bioassay

Test Conditions 10-Day Whole Sediment Bioassay		
Test Species		N. arenaceodentata
Test Procedures		ASTM E1562 (2002), Farrar and Bridges (2011)
Test Type/Duration		Static - Acute Whole Sediment/28 days
Sample Storage Conditions		4 °C, dark, minimal head space
Age/Size Class		≤ 7 days post-emergence
Grain Size Tolerance		5-100% sand
Recommended Water Quality Parameters	Temperature	20 ± 1 °C
	Salinity	30 ± 2 ppt
	Dissolved Oxygen	Maintaining 90% saturation
	Total Ammonia	< 20 mg/L
Test Chamber		300 mL glass
Exposure Volume		2 cm sediment, 125 mL seawater
Replicates/Sample		10
No. of Organisms/Replicate		1
Photoperiod		12 hours light: 12 hours dark
Feeding		Twice per week
Water Renewal		Weekly
Aeration		Constant gentle aeration
Acceptability Criteria		Mean control survival ≥ 80%; positive growth in

1.4.3 Benthic Infauna Analysis

The benthic infauna samples will be transported from the field to the laboratory and stored in a formalin solution for a minimum of 48 hours and no longer than 5 days. The samples will then be transferred from formalin to 70% ethanol for laboratory processing. The organisms will initially be sorted using a dissecting microscope into five major phyletic groups: polychaetes, crustaceans, molluscs, echinoderms, and miscellaneous minor phyla. While sorting, technicians will keep a count for quality control purposes, as described in the following paragraph. After initial sorting, samples will be distributed to qualified taxonomists who will identify each organism to species or to the lowest possible taxon. Taxonomists will use the most recent version of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) taxonomic listing for nomenclature and orthography.

A QA/QC procedure will be performed on each of the sorted samples to ensure a 95% sorting efficiency. A 10% aliquot of a sample will be re-sorted by a senior technician trained in the QA/QC procedure. The number of organisms found in the aliquot will be divided by 10% and added to the total number found in the sample. The original total will be divided by the new total to calculate the percent sorting efficiency. When the sorting efficiency of the sample is below 95%, the remainder of the sample (90%) will be re-sorted.

1.4.3.1 Quality Assurance/Quality Control

All quality assurance/quality control (QA/QC) samples must be conducted in accordance with the Quality Assurance Management Plan (QAMP) for the State of California's Surface Water Ambient Monitoring Program (SWAMP). The data quality objectives for all analyses conducted by the participating analytical laboratories will be detailed in the Sediment Monitoring QAPP (see Appendix B). The results of the laboratory quality control (QC) analyses will be reported with the final data. Any QC samples that fail to meet the specified QC criteria in the methodology or the Sediment Monitoring QAPP will be identified, and the corresponding data will be appropriately qualified in the final report. All QA/QC records for the various testing programs will be kept on file for review by regulatory agency personnel.

DATA REVIEW, MANAGEMENT, AND ANALYSIS

1.5 DATA REVIEW AND MANAGEMENT

All quality assurance/quality control (QA/QC) data must be conducted in accordance with the Quality Assurance Management Plan (QAMP) for the State of California's SWAMP and the data quality objectives as outlined in the Sediment Monitoring QAPP (see Appendix B). Data will be reviewed to determine that appropriate corrective actions have been taken, when necessary. The laboratories will supply analytical results in both hard copy and electronic formats. Laboratories will have the responsibility of ensuring that both formats are accurate. Monitoring data and analytical results will be uploaded into California Environmental Data Exchange Network (CEDEN).

1.6 DATA ANALYSIS

Sediment toxicity, chemistry, and benthic community condition will be assessed using California's SQOs as described in the Sediment Control Plan (Appendix A). The goals of the SQOs are to determine whether pollutants in sediments are present in quantities that are toxic to benthic organisms and/or will bioaccumulate in marine organisms to levels that may be harmful to humans. SQOs have been fully developed for only one of Southern California's enclosed bay habitats: euhaline (salinity = 25 to 32 ppt) bays and coastal lagoons south of Point Conception. In addition, the benthic species assemblage used to calculate the benthic LOE for southern California marine bays is Habitat C (Bay et al., 2014), and one of the criteria for Habitat C is a salinity greater than 27 ppt. The data analysis methods described below should be limited to those subtidal areas of the coastal lagoons/estuaries where the for the SQO salinity criteria can be met.

The SQOs are based on a MLOE approach in which sediment toxicity, sediment chemistry, and benthic community condition are the LOE. The MLOE approach evaluates the severity of biological effects and the potential for chemically mediated effects to provide a final station level assessment. Brief descriptions of the specific methods associated with each LOE are described below. Detailed calculations and descriptions of each LOE are provided in the Sediment Control Plan (SWRCB and CA EPA, 2009) (see Appendix A).

1.6.1 Sediment Toxicity

Sediment toxicity will be assessed using two tests: a short-term survival test using one of three species of marine amphipods (E. estuarius, L. plumulosus, or R. abronius) and a sublethal test using either N. arenaceodentata (a species of polychaete worm) or M. galloprovincialis (a species of marine bivalve). Sediment toxicity test results from each station will be statistically compared to control test results; normalized to the control survival; and categorized as nontoxic, low, moderate, or high toxicity according to Table 3-1. The average of the two test response categories (nontoxic, low toxicity, moderate toxicity, and high toxicity) will be calculated to determine the final toxicity LOE category. If the average falls midway between the two categories, it will be rounded up to the higher of the two. For example, if the test response category for the short-term survival test is low toxicity, and the test response category for the sublethal test is moderate toxicity, the final category for sediment toxicity would be moderate toxicity.

Table 3-1. Sediment Toxicity Categorization Values

Test Type	Endpoint	Statistical Significance	Nontoxic[1]	Low Toxicity2	Moderate Toxicity[2]	High Toxicity[2]
Short-Term Survival Tests	E. estuaries Survival	Significant	90 to 100	82 to 89	59 to 81	<59
		Not significant	82 to 100	59 to 81	-	<59
	L. plumulosus Survival	Significant	90 to 100	78 to 89	56 to 77	<56
		Not significant	78 to 100	56 to 77	-	<56
	R. abronius Survival	Significant	90 to 100	83 to 89	70 to 82	<70
		Not significant	83 to 100	70 to 82	-	<70
Sublethal Tests	N. arenaceodentata Growth	Significant	90 to 1002	68 to 90	46 to 67	<46
		Not significant	68 to 100	46 to 67	-	<46
	M. galloprovincialis Normal-Alive	Significant	80 to 100	77 to 79	42 to 76	<42
		Not significant	77 to 79	72 to 76	-	<42

[1] Expressed as percent.
[2] Expressed as percent of control.

1.6.2 Sediment Chemistry

Sediment chemistry will be assessed using the analyte list presented in Table 3-2. Concentrations of chemicals detected in sediments will be compared to the California Logistic Regression Model (CA LRM) and the Chemical Score Index (CSI). The CA LRM is a maximum probability model (P_{max}) that uses logistic regression to predict the probability of sediment toxicity. The CSI is calculated independently of the CA LRM and is a predictive index that relates sediment chemical concentration to benthic community disturbance. Sediment chemistry results according to CA LRM and CSI are categorized as having minimal, low, moderate, and high exposure to pollutants (Table 3-2). The final sediment LOE category is the average of the two chemistry exposure categories. If the average falls midway between the two categories, it is rounded up to the higher of the two. For example, if the CA LRM is low exposure and the CSI is moderate exposure, then the final sediment LOE category is moderate exposure.

Table 3-2. Sediment Chemistry Guideline Categorization

Sediment Chemistry Guideline		Sediment LOE Category
CA LRM	CSI	
<0.33	<1.69	Minimal Exposure
0.33 - 0.49	1.69 - 2.33	Low Exposure
0.50 - 0.66	2.34 - 2.99	Moderate Exposure
>0.66	>2.99	High Exposure

1.6.3 Benthic Community Condition

Benthic community condition will be assessed using a combination of four benthic indices: the Benthic Response Index (BRI; abundance-weighted average pollution tolerance of sample organisms), the Relative Benthic Index (RBI; the weighted sum of community parameters and abundance of indicator species), the Index of Biotic Integrity (IBI; a measure that identifies benthic community characteristics outside of reference ranges), and a predictive model based on the River Invertebrate Prediction and Classification System (RIVPACS; a comparison of assemblages in a sample to expected species composition). The four indices will be calculated following the January 21, 2008, guidance provided by Southern California Coastal Water Research Project (SCCWRP) entitled Determining Benthic Invertebrate Community Condition in Embayments for Southern California marine bays. Each benthic index result is categorized according to four levels of disturbance, including reference, low, moderate, and high disturbance.

- Reference: Equivalent to a least affected or unaffected station.
- Low Disturbance: Some indication of stress is present, but is within measurement error of unaffected condition.
- Moderate Disturbance: Clear evidence of physical, chemical, natural, or anthropogenic stress.
- High Disturbance: High magnitude of stress.

Specific categorization values, which are tailored to southern California marine bays, are assigned for each index (Table 3-3), and are based on the specific taxa found within a given sample. To determine the benthic community condition, the four indices will be integrated into a single category. The median of the four benthic index response categories are computed to determine the benthic condition. If the median falls between two categories, the value is rounded to the next higher category to provide the most conservative estimate of benthic community condition.

Table 3-3. Benthic Index Categorization Values for Southern California Marine Bays

Benthic Community Guideline				Index
BRI	IBI	RBI	RIVPACS	
<39.96	0	>0.27	>0.90 to <1.10	Reference
39.96 - 49.14	1	0.17 - 0.27	0.75 - 0.90 or 1.10 - 1.25	Low Disturbance
49.15 - 73.26	2	0.09 - 0.16	0.33 - 0.74 or >1.25	Moderate Disturbance
>73.26	3 or 4	<0.09	<0.33	High Disturbance

1.6.4 Integration of Multiple Lines of Evidence

The station level assessment that indicates whether the aquatic life SQO at a station has been met will be determined by the combination of the three LOE categories to assess the severity of biological effects and the potential for chemically mediated effects. The severity of biological effects will be determined by combining the toxicity and benthic community condition LOEs (Table 3-4). The potential for chemically mediated effects will be determined by combining the toxicity and chemistry LOEs (Table 3-5).

Table 3-4. Determination of Severity of Biological Effects

Combination of Toxicity LOE and Benthic Condition LOE		Toxicity LOE: Non-toxic	Low Toxicity	Moderate Toxicity	High Toxicity
Benthic Community Condition LOE	Reference	Unaffected	Unaffected	Unaffected	Low Effect
	Low Disturbance	Unaffected	Low Effect	Low Effect	Low Effect
	Moderate Disturbance	Moderate Effect	Moderate Effect	Moderate Effect	Moderate Effect
	High Disturbance	Moderate Effect	High Effect	High Effect	High Effect

Table 3-5. Determination of Potential for Chemically Mediated Effects

Combination of Toxicity LOE and Sediment Chemistry LOE		Toxicity LOE: Non-toxic	Low Toxicity	Moderate Toxicity	High Toxicity
Sediment Chemistry LOE	Minimal Exposure	Minimum Potential	Minimum Potential	Low Potential	Moderate Potential
	Low Exposure	Minimum Potential	Low Potential	Moderate Potential	Moderate Potential
	Moderate Exposure	Low Potential	Moderate Potential	Moderate Potential	Moderate Potential
	High Exposure	Moderate Potential	Moderate Potential	High Potential	High Potential

Based on the determinations of the severity of biological effects and the potential for chemically mediated effects, a station level assessment (Table 3-6) will be made that categorizes the station as one of the following:

- Unimpacted: Confident that sediment contamination is not causing significant adverse impacts to aquatic life living in station sediments.
- Likely unimpacted: Sediment contamination at the station is not expected to cause adverse impacts to aquatic life, but some disagreement among the LOE reduces the certainty that the station is unimpacted.
- Possibly impacted: Sediment contamination at the station may be causing adverse impacts to aquatic life, but the impacts are either small or uncertain due to disagreement among the LOE.
- Likely impacted: Evidence for a contaminant-related impact to aquatic life at the station is persuasive, even if there is some disagreement among the LOE.
- Clearly impacted: Sediment contamination at the station is causing clear and severe adverse impacts to aquatic life.

- Inconclusive: Disagreement among the LOE suggests that either the data are suspect or additional information is needed before a determination can be made.

Table 3-6. Determination of Final Station Assessment

Combination of Severity of Biological Effects and Potential for Chemically-Mediated Effects		Severity of Biological Effects			
		Unaffected	Low Effect	Moderate Effect	High Effect
Potential for Chemically-Mediated Effects	Minimal Potential	Unimpacted	Likely Unimpacted	Likely Unimpacted	Inconclusive
	Low Potential	Unimpacted	Likely Unimpacted	Possibly Impacted	Possibly Impacted
	Moderate Potential	Likely Unimpacted	Possibly Impacted or Inconclusive[1]	Likely Impacted	Likely Impacted
	High Potential	Inconclusive	Likely Impacted	Clearly Impacted	Clearly Impacted

[1] When chemistry classification is minimal exposure, benthic response is reference, and toxicity is high.

All 64 possible combinations are presented in Attachment B of the Sediment Control Plan.

If a station is consistently classified as Unimpacted or Likely Unimpacted according to the SQO assessments, then the protective condition has been achieved. In cases where segments contain stations categorized as Possibly Impacted but not Clearly Impacted or Likely Impacted, confirmation monitoring will be conducted prior to requiring stressor identification studies. If a follow-up assessment result is Unimpacted or Likely Unimpacted, the protective condition has been achieved at that location. If the final station assessment result is Possibly Impacted, Likely Impacted or Clearly Impacted, the station is considered degraded and the Copermittees may need to conduct a stressor identification study. Stations categorized as Inconclusive should not be used to evaluate whether the protective condition at a station has been met. Additional information should be gathered at stations classified as Inconclusive in order to understand why the LOE results show a level of disagreement.

If stations are categorized as Possibly Impacted within a monitored segment, reach, or water body that also contain stations that are not categorized as Clearly or Likely Impacted, then confirmation monitoring should be conducted in order to confirm the level of impact at these stations prior to initiating a stressor identification study. As stated in the Sediment Quality Assessment Technical Support Manual (Bay et al., 2014), “the Possibly Impacted station assessment is the least certain of all categorizations, and therefore requires the most caution during interpretation. Stations may be classified as Possibly Impacted due to low levels of effect for each LOE, indicating a low magnitude of impacts. Alternatively, a Possibly Impacted classification may be the result of a large disagreement between LOEs, potentially due to confounding factors or noncontaminant stressors.” Following the confirmation monitoring, if the station assessment is categorized as Possibly Impacted, Likely Impacted, or Clearly Impacted then the Copermittees may need to conduct a stressor identification study. If additional monitoring or specialized studies at Possibly Impacted stations indicate that factors other than toxic pollutants in sediments are causing observed negative responses then it may be possible to designate the station as meeting the protective condition.

STRESSOR IDENTIFICATION

The highest priority for stressor identification will be assigned to those water body segments with the highest percentage of Clearly Impacted or Likely Impacted stations. In cases where segments contain sediments categorized as Possibly Impacted but not Clearly Impacted or Likely Impacted, confirmation monitoring will be conducted prior to requiring stressor identification studies. By reviewing the available data sets, deductive reasoning can be used to narrow the focus of future actions. Based on the outcome of the additional data analysis, steps forward for stressor identification should be coordinated with the San Diego RWQCB. If a stressor identification study is required, the Copermittees should develop a clearly defined work plan prior to beginning work. No formal guidance is given in the Sediment Control Plan on how to conduct a stressor identification study; however, the Sediment Control Plan does give some general guidance on types of stressor identification studies that can be implemented. These studies include confirmation and characterization of pollutant-related impacts, pollutant identification, and source identification and management actions. These types of studies are summarized in the following sections.

1.6.5 Pollutant Confirmation and Characterization

When the analyses described in Section 3.2 indicate that pollutants are a likely cause of an SQO exceedance at a station, a variety of tools can be used to determine whether the reason for the narrative objective not being met is due to generic stressors other than toxic pollutants, such as physical alterations or other pollutant-related stressors. Physical disturbances, such as decreased salinity, dredging impacts, and grain size, are confounding factors that may produce conditions mimicking the effects of pollutants. In these cases, the benthic community LOE will indicate degradation, but the toxicity and chemistry LOEs may not. Pollutant-related stressors, such as ammonia, TOC, nutrients, and pathogens, may also be confounding factors. In these cases, the benthic community LOE will indicate degradation, toxicity may be indicated, and chemical concentrations will be low. To determine whether a station is impacted from toxic pollutants, one or more of the following tools may be included in the stressor identification analysis as part of the confirmation:

- Evaluate the spatial extent of the area of concern in relation to anthropogenic sources.
- Evaluate the body burden of the pollutants accumulated in the animals used for exposure testing.
- Evaluate the chemical constituent results in relation to the mechanistic benchmarks.
- Compare chemistry and biology LOE to determine whether correlations exist.
- Alternative biological assessment, such as bioaccumulation experiments, pore water toxicity, or pore water chemistry analyses, may be conducted.
- Phase I TIEs, which are often useful in determining the causative agent or class of compounds causing toxicity may be conducted.

According to the SQO guidelines, “If there is compelling evidence that the SQO exceedances contributing to a receiving water limit exceedance are not due to toxic pollutants, then the assessment area shall be designated as having achieved the receiving water limit.”

1.6.6 Pollutant Identification

Pollutant identification investigations may be conducted using one or more of the following types of data: statistical, biological, or chemical investigation data. These investigations should be station-specific and should be based on:

- Correlations between individual chemicals and biological endpoints.
- Gradient analysis of chemical concentrations and the biological responses in comparison to distance from a chemical hotspot.
- Additional TIE procedures.
- Sediment pore water investigations into the bioavailability of pollutants (e.g., acid-volatile sulfides and simultaneously extracted metals [AVS:SEM] analysis, solid phase microextraction [SPME], and/or laboratory desorption studies.
- Verification studies such as spiking or in situ toxicity and bioaccumulation studies.

In cases where stressor identification studies conducted on stations categorized as Possibly Impacted are inconclusive, the Copermittees may iplement a one-time augmentation to the study or suspend stressor identification studies in favor of additional routine SQO monitoring.

1.6.7 Pollutant Source Identification and Management

Stressor identification studies should include determinations of whether sources are ongoing or legacy and determinations of the number and nature of ongoing sources. If a single or multiple dischargers are responsible for stressor pollutant discharges, the discharger(s) may need to address the SQO exceedance and to reduce the pollutant loading.

According to Section VII.H of the Sediment Control Plan, the San Diego RWQCB may develop station-specific sediment management guidelines to estimate the level of the stressor pollutant in order to meet the SQOs. Guideline development should be initiated only following identification of the stressor, and should have an overall goal of establishing a relationship between the organism’s exposure and the biological effect. Upon establishing this relationship, a pollutant-specific guideline may be designated that corresponds with minimum biological effects. Approaches that can be used to establish relationships between exposure and biological effect include the following: correspondence with sediment chemistry, correspondence with bioavailable pollutant concentration, correspondence with tissue residue, and literature review. Additionally, the Sediment Control Plan states that the chemistry LOE, “including the threshold values (e.g. CSI and CALRM) shall not be used for setting cleanup levels or numeric values for technical TMDLs.”

REPORTING

Provision D.1.e.(2)(c) of the Permit requires incorporation of Sediment Monitoring Report into the WQIP Annual Report. The Sediment Monitoring Report will contain an evaluation, interpretation, and tabulation of monitoring data, including an assessment of whether receiving water limits outlined in the Permit were attained; a sample location map; and a statement of certification that monitoring data and results have been uploaded into CEDEN.

Based on the conclusions of the Sediment Monitoring Report, a human health risk assessment may be necessary to determine whether human health objectives have been obtained at each sample location. Provision A.2.a.(3)(b)(ii) states that "pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health." The potential risk assessments must consider any relevant information, such as guidelines set forth in the CA EPA's Office of Environmental Health Hazard Assessment (OEHHA) fish consumption policies, CA EPA's Department of Toxic Substances Control (DTSC) risk assessment, and the USEPA human health risk assessment policies.

Based on the monitoring and assessment completed as part or Bight'13 study and follow-up monitoring conducted in 2014, sediment conditions in San Diego River Estuary are generally protective of the beneficial uses and typical of a tidally influenced shallow lagoon (Weston, 2014). [*]

[*] No further monitoring is planned for San Diego River Estuary during this permit term because there was no evidence, from the follow-up investigation conducted in 2014, to indicate that urban runoff from the watershed had significantly impaired the receiving water (Weston, 2015)

* ".. benthic community in the three samples collected at SDR14 [potentially impacted location] showed low diversity and high abundances of a few dominant species. …. Since a current valid benthic assemblage cannot be used to calculate the benthic LOE for the three SDR14 samples, final SQO site assessments could not be determined using the SQOs. However, … because …results indicate low chemistry exposure and no toxicity, even if the benthic LOE results indicated a high disturbance, the mean final SQO site assessment would still be categorized as Likely Unimpacted. The current composition of the benthic community appears to be a result of natural biological variation or physical disturbances such as the influence of tidal exchanges on the landscape of the estuary or freshwater inputs rather than related to chemically mediated effects from organochlorine pesticides, PCBs or metals. Overall, the water quality at SDR14 (Site 8136) was typical of a tidally-influenced shallow lagoon and there was no evidence from the chemistry data that urban runoff from the watershed had significantly impaired the lagoon's receiving waters." (Weston, 2015)

SCHEDULE

The schedule for completing the sediment quality monitoring requirements of the Permit and for submitting the Sediment Monitoring Report is shown in Table 6-1:

Table 6-1. Sediment Monitoring Plan Schedule

Activity/Deliverable	Dates(s)
San Diego RWQCB Order No. R9-2013-0001	Adopted May 8, 2013 and effective June 27, 2013
Southern California Bight Regional Monitoring Program	July 2013
Draft Sediment Monitoring Plan	September 2014
Draft Sediment Monitoring QAPP	September 2014
Final Sediment Monitoring Plan	November 2014
Final Sediment Monitoring QAPP	November 2014
Follow-up confirmation monitoring	September 2014
Final Sediment Monitoring Plan incorporated into WQIPs	January 2014
Draft Sediment Monitoring Report	December 2014
Final Sediment Monitoring Report incorporated into Transitional Monitoring and Assessment Report	January 31, 2015
Potential Stressor ID Studies	Not required
Potential Human health risk assessment	Not required

REFERENCES

Anderson, B.S., Hunt, J.W., Hester, M., Phillips, B.M. 1996. Assessment of sediment toxicity at the sediment-water interface. In: G.K. Ostrander (ed.) Techniques in Aquatic Toxicology. Lewis Publishers, Ann Arbor, MI.

ASTM (American Society for Testing and Materials). 2002. E1562 Standard Guide for Conducting Acute, Chronic, and Life-Cycle Aquatic Toxicity Tests with Polychaetous Annelids. Annual Book of Standards, Water and Environmental Technology, Vol. 11.05, West Conshohocken, PA.

ASTM (American Society for Testing and Materials). 2006. E1367-03 Standard Guide for Conducting 10-Day Static Sediment Toxicity Tests With Marine and Estuarine Amphipods. Annual Book of Standards, Water and Environmental Technology, Vol. 11.05, West Conshohocken, PA.

Bay, S.M., Greenstein, D.J., Ranasinghe, J.A., Diehl, D.W., Fetscher, A.E. 2014. Sediment Quality Assessment Technical Support Manual. Southern California Coastal Water Research Project. Costa Mesa, CA. January 2014.

Farrar, J.D., Bridges, T.S. 2011. 28-Day Chronic Sublethal Test Method for Evaluating Whole Sediments Using an Early Life Stage of the Marine Polychaete Neanthes arenaceodentata. ERDC TN-DOER-R14. U.S. Army Corps of Engineers, Vicksburg, MS.

SDRWQCB (San Diego Regional Water Quality Control Board). 2013. Order No. R9-2013-0001. NPDES No. CAS0109266. 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. June 27, 2013.

SWRCB (State Water Resources Control Board) – CA EPA (California Environmental Protection Agency). 2009. Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality. August 25, 2009.

USEPA (United States Environmental Protection Agency). 1994. Methods for Assessing Toxicity of Sediment-Associated Contaminants With Estuarine and Marine Amphipods. EPA/600/R-94/025. EPA Office of Research and Development, Narragansett, Rhode Island. June 1994.

USEPA (United States Environmental Protection Agency). 1995. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. EPA/600/R-95/136. EPA Office of Research and Development. Weston. December 2015. Transitional Monitoring and Assessment Report Appendix K Sediment Monitoring Report.

Appendix A

Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality

Appendix B

Sediment Monitoring Plan
Quality Assurance Project Plan

APPENDIX B

SAN DIEGO RIVER WATERSHED MANAGEMENT AREA RESPONSIBLE COPERMITTEES SEDIMENT MONITORING QUALITY ASSURANCE PROJECT PLAN

Prepared on:

November 2014
Revised in January 2015

GROUP A:
PROJECT MANAGEMENT

ELEMENT 1 TITLE AND APPROVAL SHEET

Final

Appendix B

San Diego River Watershed Management Area Responsible Copermittees
Sediment Monitoring
Quality Assurance Project Plan

January 2015

APPROVAL SIGNATURES

San Diego River WMA Responsible Copermittes:

Title	Name	Signature	Date
Senior Project Manager			
Project Manager			

Contractor:

Title	Name	Signature	Date
Contractor Sr. Project Manager			
Contractor Project Manager			
Contractor Quality Assurance Officer			

ELEMENT 2 TABLE OF CONTENTS

Section **Page**

ELEMENT 2 TABLE OF CONTENTS (Continued)

Section **Page**

LIST OF TABLES

LIST OF FIGURES

Figure No. **Page**

LIST OF ACRONYMS

ASTM	American Society for Testing and Materials
Bight	Southern California Bight Regional Monitoring Program
BPJ	best professional judgement
CA EPA	California Environmental Protection Agency
CA LRM	California Logistic Regression Model
CEDEN	California Environmental Data Exchange Network
COC	chain of custody
Copermittees	San Diego County Regional Copermittees
CRM	certified reference materials
CSI	Chemical Score Index
CVAA	cold vapor atomic absorption
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DGPS	Differential Global Positioning System
DQO	data quality objective
DTSC	Department of Toxic Substances Control
EC_{50}	median effect concentration
EPA	Environmental Protection Agency
GC/ECD	gas chromatography/ electron capture detector
GC/MS	gas chromatography/ mass spectrometry
HDPE	high density polyethylene
ICP/MS	inductively coupled mass spectrometry
ID	inner diameter
LC_{50}	median lethal concentration
LCS	laboratory control sample
LOE	line(s) of evidence
$MgSO_4$	magnesium sulfate
MLOE	multiple lines of evidence
MS/MSD	matrix spike/matrix spike duplicate
MS4	municipal separate storm sewer system
OEHHA	Office of Environmental Health Hazard Assessment
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RL	reporting limit
RCs	Responsible Copermittees
RPD	relative percent difference
RWQCB	Regional Water Quality Control Board
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists
SDR	San Diego River
SRM	standard reference material
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board

SIM	selective ion capture
SM	Standard Method
SOP	standard operating procedure
SP	solid phase
SQO	sediment quality objective
SWI	sediment water interface
TBD	to be determined
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
WMA	Watershed Management Area
WQIP	Water Quality Improvement Plan

Units of Measure

ppt	parts per thousand
ft	feet
m^2	square meters
L	liter
cm	centimeter
mm	millimeter
%	percent
mL	milliliter
^oC	degrees Celsius
kg	kilogram
mg	milligram
µg	microgram

ELEMENT 3 DISTRIBUTION LIST

Table 1 identifies those individuals who will receive one copy of the approved Sediment Monitoring Quality Assurance Project Plan (QAPP). The Titles and roles listed in the table can be expanded based on the monitoring and team assembled.

Table 1. Quality Assurance Project Plan Distribution List

Title	Name (Affiliation)	Telephone No.	QAPP No.
San Diego River Watershed Responsible CopermitteesProject Manager			01
Contractor Project Manager			02
Contractor Project Quality Assurance (QA) Officer			03
Contractor Field Task Manager			04
Laboratory Contractor Quality Assurance (QA) Officer			05

ELEMENT 4 PROJECT/TASK ORGANIZATION

1.6.8 Involved Parties and Roles

This section details the specific roles of key individuals who will be conducting and managing the sediment monitoring project. The Titles and roles listed in the table can be expanded based on the monitoring and team assembled.

Table 2. Key Personnel Responsibilities and Contact Information

Name	Organizational Affiliation	Title	Contact Information (telephone number, fax number and email address)
	San Diego River WMA Responsible Copermittees	Project Manager	
	Contractor	Project Manager	
	Contractor	Field Task Manager	
	Contractor	QA Officer	
	Laboratory Contractor	QA Officer	

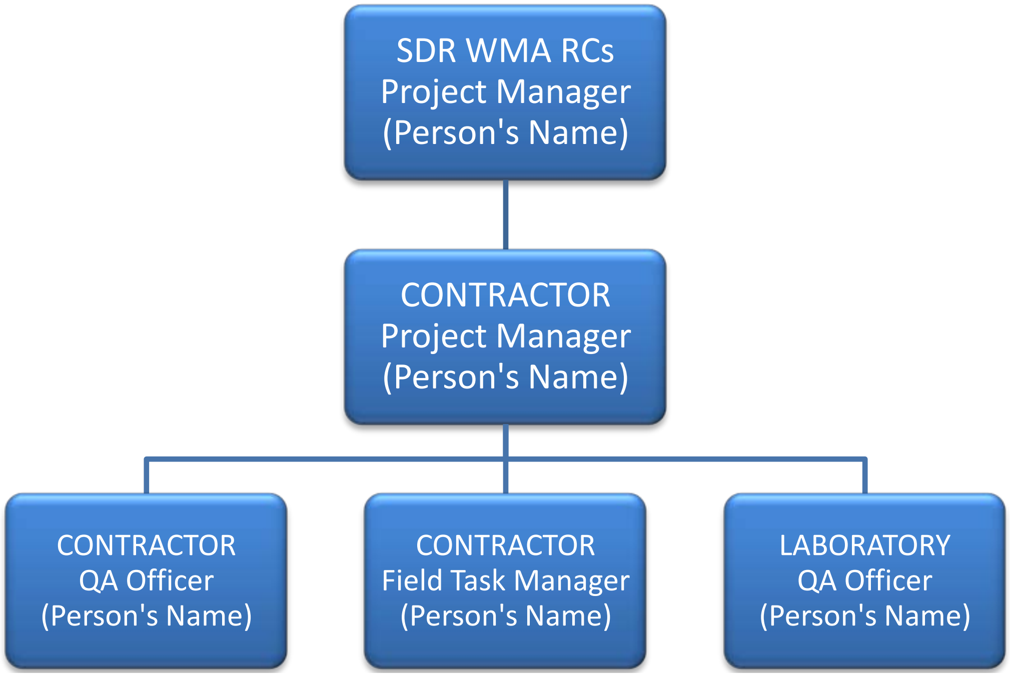


Figure 1. Organizational Chart

1.6.9 Quality Assurance Officer Role

The project Quality Assurance (QA) Officer will be responsible for the overall QA and quality control (QC) procedures found in this plan as part of the sampling and field analyses, laboratory analysis, and the overall quality of the data.

1.6.10 Persons Responsible for QAPP Update and Maintenance

Changes and updates to this QAPP may be made after a review of the evidence for change by the Contractor Project Manager and QA Officer with the concurrence of San Diego River WMA Responsible Copermittees Project Manager. The Contractor Project Manager, with input from the QA Officer, will be responsible for making the changes, submitting drafts for review by the San Diego River WMA Responsible Copermittees Project Manager, preparing a final amended copy, and submitting the final for signature. Project work must be halted while revisions to the QAPP are made, unless authorized by the San Diego River WMA Responsible Copermittees Project Manager.

ELEMENT 5 PROBLEM DEFINITION/BACKGROUND

1.6.11 Problem Statement

The Copermittees are required to conduct sediment quality monitoring in accordance with the requirements of the San Diego Regional Water Quality Control Board (RWQCB) Order No. R9-2013-0001 (Permit), effective June 27, 2013. The Copermittees are required, either individually, in association with multiple Copermittees, or through participation in a water body monitoring coalition to perform sediment quality monitoring to assess compliance with the sediment quality receiving water limits applicable to municipal separate storm sewer system (MS4) discharges to enclosed bays and estuaries. Urban runoff from the MS4 poses a risk to beneficial uses in receiving waterbodies. An understanding of the quality of sediments in relation to MS4 discharges is needed to direct and prioritize management actions.

Provision D.1.e.(2) of the Permit requires the Copermittees to develop a Sediment Monitoring Plan for incorporation into the Water Quality Improvement Plan (WQIP) which satisfies the requirements of the *Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality* (Sediment Control Plan; State Water Quality Control Board [SWRCB] and California Environmental Protection Agency [CA EPA], 2009; see Appendix A). This QAPP supports the Sediment Monitoring Plan by describing the sampling, analysis, and quality assurance procedures that are needed to comply with Permit-required sediment quality monitoring.

1.6.12 Decisions or Outcomes

The primary objective of the sediment monitoring program is to assess compliance with the sediment quality receiving water limits applicable to MS4 discharges to enclosed bays and estuaries of San Diego County. Sediment toxicity, chemistry, and benthic community condition will be assessed using SQOs as described in the Sediment Monitoring Plan. The goals of the SQOs are to determine whether pollutants in sediments are present in quantities that are toxic to benthic organisms and/or will bioaccumulate in marine organisms to levels that may be harmful.

The goal of the Sediment Monitoring Plan and Sediment Monitoring QAPP is to provide the key elements that are required to successfully conduct field sediment sampling, processing, testing, and analysis of the results in accordance with SQO guidelines. Analyses of chemistry, toxicity, and benthic community condition require that samples be collected, preserved, processed, and analyzed using proper field and laboratory equipment, methods, and techniques. The Sediment Monitoring Plan and Sediment Monitoring QAPP describe the collection and analysis of surface sediment samples necessary to provide representative assessments of in-situ conditions for the enclosed bays and estuaries of San Diego County. By adhering to SQO protocols, sediment quality in subtidal marine and estuarine habitats can be assessed as to whether it is protective of aquatic life and human health.

ELEMENT 6 PROJECT/TASK DESCRIPTION

1.6.13 Work Statement and Produced Products

The San Diego County Regional Copermittees (Copermittees) are required to conduct sediment quality monitoring in accordance with the requirements of the *Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality* (Sediment Control Plan; SWRCB and CA EPA, 2009; see Appendix A). The Sediment Control Plan outlines a multiple lines of evidence (MLOE) approach to determine whether pollutants in sediments are present in quantities that are toxic to benthic organisms and/or will bioaccumulate in marine organisms to levels that may be harmful to humans. Sediment monitoring will be conducted at least twice during the Permit cycle except at stations that have consistently been classified as Unimpacted or Likely Unimpacted using the MLOE approach. At the Unimpacted or Likely Unimpacted stations, monitoring may be reduced to a frequency of once during the Permit cycle. The participating agencies propose to conduct one round of sediment sampling each permit term. The second required round of sampling will be satisfied by conducting additional follow up sampling in the vicinity of potentially impacted sites identified in the first round. For the San Diego River Estuary, this requirement is met for the 2013-2018 MS4 Permit term based on sampling and assessments conducted through the participation in the Bight'13 monitoring program and the subsequent follow-up sediment sampling carried out in 2014.

Sediment samples will be analyzed for toxicity, chemistry, and benthic infauna at a designated number of stations (station selection is outlined in ELEMENT 10) within a waterbody. An SQO analysis will be conducted on each station to determine a final station assessment that indicates whether the aquatic life SQO has been met. Depending on the outcome of the SQO assessments at the designated stations located in San Diego County waterbodies, follow-up monitoring may be necessary to meet all of the Permit requirements. Upon completion of the sediment quality monitoring, a Sediment Monitoring Report will be incorporated into the WQIP Annual Report. An additional stressor identification study may be required by the San Diego RWQCB for stations not meeting SQOs.

Provision D.1.e.(1)(a) of the Permit also requires the Copermittees to participate in the Southern California Bight Regional Monitoring Program. Participation in the Bight Program can be used to simultaneously fulfill all or part of the sediment quality monitoring requirement (Provision D.1.e[2]) because sediment monitoring and SQO analyses are incorporated into the Bight Program to regionally assess the sediment quality of Southern California's waterbodies. The Copermittees can also decide to conduct the initial sediment quality monitoring of San Diego County's water bodies independently of the Bight Program. Depending upon the outcome of the initial SQO assessments, the Copermittees may need to perform follow-up monitoring to meet all of the Permit requirements.

1.6.14 Constituents to be Monitored and Measurement Techniques

Chemical and toxicity analyses of all sediment samples collected as part of the SQO assessment must be tested in accordance with United States Environmental Protection Agency (USEPA) or American Society for Testing and Materials (ASTM) protocols. If appropriate protocols do not exist, the SWRCB or San Diego RWQCB may approve the use of other methods. All analytical laboratories must be certified by the California Department of Health Services in accordance with Water Code 13176.

Physical and chemical measurements of sediment were selected to comply with the Sediment Control Plan and to provide data on chemicals of potential concern in bays and estuaries located in San Diego County. The physical and chemical analyses of sediments will include, at a minimum, grain size, percent solids, total organic carbon (TOC), trace metals, organochlorine pesticides, polychlorinated biphenyl (PCBs) congeners, and polynuclear aromatic hydrocarbons (PAHs). Chemical analyses of these constituents are necessary in order to compare to the California Logistic Regression Model (CA LRM) and the Chemical Score Index (CSI) for SQO analyses. Additional physical or chemical analyses may be included in order to aid in the interpretation of the individual lines of evidence (LOEs) (e.g. pyrethroids or ammonia).

Sediment toxicity testing will be performed for each station using a minimum of one short-term survival toxicity test and one sublethal toxicity test. Acceptable short-term sediment survival tests include the *Eohaustorius estuarius* 10-day survival test, the *Leptocheirus plumulosus* 10-day survival test, or the *Rhepoxynius abronius* 10-day survival test. Acceptable sublethal sediment toxicity tests include the the *Mytilus galloprovincialis* sediment-water interface (SWI) 48-hour embryo development test or the *Neanthes arenaceodentata* whole sediment 28-day growth test. The *E. estuarius* short-term survival test and the *M. galloprovincialis* sublethal toxicity test have been the test methods used in previous San Diego County bay and estuary monitoring programs including the Bight program where the SQO analytical tool was used to assess aquatic health.

Benthic community condition samples will be screened by field personnel and then sorted and identified to the lowest possible taxon by qualified taxonomists in accordance with the most recent version of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) taxonomic listing for nomenclature and orthography.

For the purposes of this QAPP, the constituent list for chemical analyses includes only those analytes that are required for compliance with SQO analyses and physical analyses that will aid in the interpretation of the SQO data. Analytical physical and chemistry methods provided in Table 3 are suggested methods that have been used in previous sediment monitoring programs within San Diego County's waterbodies (e.g. Bight), but are not the only acceptable methods. A detailed list of individual analytes is provided in Element 13.

Table 3. Analyte list and Suggested Testing Methods for SQO analyses

Analyte/ Test	Method
Physical Analyses	
Grain size	Plumb 1981 or use of a Horiba LA920 (Laser Particle Analyzer)*
Percent solids	SM 2540B*
TOC	USEPA 9060A*
Chemical Analyses	
Trace Metals	USEPA 6020A (Mercury- 7471B)*
Oganochlorine pesticides	USEPA 8081B*
PCB congeners	USEPA 8082A*
PAHs	USEPA 8270D*
Toxicity	
Short-term amphipod survival using *Eohaustorius estuarius*	USEPA (1994) *Methods for Assessing Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods*, ASTM E1367-03
Sublethal testing using *Mytilus galloprovincialis*	USEPA (1995) *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms;* Anderson et al. (1996) *Assessment of Sediment Toxicity at the Sediment-Water Interface*
Sublethal testing using *Neanthes arenaceodentata*	ASTM E1562 with modifications described in Farrar and Bridges (2011)
Benthic Infauna	
Benthic Community Condition	See Element 13

* may be substituted with equivalent methods

Short-term survival toxicity testing will be performed in accordance with procedures for amphipod testing outlined in *Methods for Assessing Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods* (USEPA, 1994) and ASTM method E1367-03 (ASTM, 2006). Sublethal sediment toxicity testing for *Mytilus galloprovincialis* should follow procedures outlined in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (USEPA, 1995) and *Assessment of Sediment Toxicity at the Sediment-Water Interface* (Anderson et al., 1996), whereas sublethal sediment toxicity testing for *Neanthes arenaceodentata* should follow ASTM method E1562 (ASTM, 2002) with modifications described in Farrar and Bridges (2011) that have been found to contribute manageability and precision to the ASTM procedure. Equivalent toxicity testing methods that meet the requirements of the Sediment Control Plan may be substituted for ones described above.

1.6.15 SQO Analyses

Protocols for assessing sediment chemistry, toxicity, and benthic community conditions for San Diego County waterbodies using California's SQOs are described in Section 3.2 of the Sediment Monitoring Plan.

1.6.16 Project Schedule

The schedule for completing the sediment quality monitoring requirements of the Permit and for submitting the Sediment Monitoring Report is shown in Table 4.

Table 4. Sediment Monitoring Program Schedule

Activity/Deliverable	Dates(s)*
San Diego RWQCB Order No. R9-2013-0001	Adopted May 8, 2013 and effective June 27, 2013
Southern California Bight Regional Monitoring Program	August-September 2013
Follow-up confirmation monitoring	August-September 2014
Final Sediment Monitoring Plan and Sediment Monitoring QAPP incorporated into WQIPs	December 2014
Draft Sediment Monitoring Report	December 2014
Final Sediment Monitoring Report incorporated into Transitional Monitoring and Assessment Program Report	January 31, 2015
Potential Stressor ID Studies	Not required

*Table does not include future permit cycles

The San Diego County Regional Copermittees participated in the 2013 Bight Program and conducted follow-up monitoring in 2014 to satisfy Provisions D.1.e.(1)(b) and D.1.e.(2) of the Permit prior to the development of the Sediment Monitoring Plan. Monitoring was conducted in accordance with *San Diego County Municipal Copermittees Bight 2013 Workplan* (WESTON, 2013) and data were collected using methods consistent with previous Bight surveys and the current SQO guidelines as described in the Sediment Control Plan. Follow-up confirmation monitoring was conducted in 2014 in accordance with the *San Diego County Municipal Copermittees 2014 Sampling and Analysis Plan for Bight '13 Follow-up Investigations* (WESTON, 2014). The Sediment Monitoring Report summarizing results of the 2013 Bight Program and the follow-up monitoring conducted in 2014 was included in the Transitional Monitoring and Assessment Program Report submitted to the San Diego RWQCB on January 31, 2015. Any sediment quality monitoring or stressor identification studies conducted after 2014 will be included as needed in the WQIP Annual Reports.

1.6.17 Constraints

Sediment monitoring must occur in subtidal areas located within a waterbody between the months of June through September. SQOs have been fully developed for only two of California's six enclosed bay habitats: euhaline (salinity = 25 to 32 parts per thousand [ppt]) bays and estuaries south of Point Conception and polyhaline (18 to 25 ppt) central San Francisco Bay. The benthic species assemblage used to calculate the benthic LOE in San Diego bays and estuaries is Habitat C- Southern California Marine Bays, which requires a salinity greater than 27 ppt (Bay et al 2014; Ranasinghe et al 2008). In order to select a sampling station applicable to the SQO assessment using Habitat C for the benthic LOE, it is recommended to verify that a proposed sampling station is both subtidal and has salinity greater than 27 ppt. Salinity measurements should be taken near the sediment-water interface. Sediment samples will be collected with a 0.1 m^2 Van Veen grab sampler or other similar device. Certain types of benthic habitat such as hard clay, cobble, coarse sand, and areas with thick eel grass may be difficult to sample using this type of device. A slight relocation of the target sampling location may be necessary to avoid areas in which obtaining acceptable grab samples is not achievable.

Nesting periods for threatened or endangered bird species inhabiting coastal water bodies may prevent or delay sampling during certain summer months. Species of particular concern include least terns, snowy plovers, California clapper rails, and Belding’s savannah sparrows. Permission from California Fish and Wildlife may be required to enter restricted areas that are known to contain these species. Additionally permission from private land owners may be necessary to gain access to private property and/or private boat launches.

ELEMENT 7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

All quality assurance/quality control (QA/QC) procedures for chemistry and toxicity samples must be employed in accordance with the QAPP for the State of California's Surface Water Ambient Monitoring Program (SWAMP) (SWAMP Quality Assurance Team, 2008). The data quality objectives (DQOs) are summarized by category in Table 5. If sediment quality monitoring is conducted as part of the Bight Program (i.e. SQO analysis as stated in the Sediment Control Plan), the work plans and associated QA/QC documents pertaining to the Bight Program should be followed in conjunction with this QAPP.

Table 5. Summary of Data Quality Objectives

Measurement or Analysis Type	Applicable Data Quality Objective
Chemistry Laboratory Analyses	Accuracy, precision, and completeness
Toxicity Laboratory Analyses	Precision and completeness
Benthic Infauna Analyses	Accuracy and completeness

Acceptance criteria will be based on the implementation of acceptable and recognized QA/QC procedures. Acceptable data must have proper sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols.

Accuracy is a measure of how closely the analytical result or field measurement represents the true quantity found in the sample. Evaluation of the accuracy of laboratory samples will be achieved through the preparation and analysis of either reference materials (e.g. certified or standard reference materials [CRM/SRM]) or laboratory control samples [LCS]) with each analytical batch. For sediment toxicity samples, the accuracy of sediment toxicity tests cannot be determined since a reference material of known toxicity is not available. The accuracy of benthic infaunal sorting will be evaluated via a QA/QC procedure that ensures a 95% sorting efficiency of each sample.

Precision is the measure of agreement among repeated measurements of the same property under identical or substantially similar conditions calculated as either the range or as the standard deviation. The precision of chemistry laboratory measurements will be controlled by comparison of the sample to either a laboratory duplicate or a laboratory matrix spike/matrix spike duplicate (MS/MSD). For toxicity samples, a water only reference toxicant test will be run with every batch of test samples in order to document organism relative sensitivity and test precision. Reference toxicant test results that fall outside of control chart limits (2 standard deviations of the mean) will trigger a review of test procedures and a possible retest of the corresponding sediment samples. A negative control will be run with each test batch for both the short term survival and sublethal toxicity tests.

Completeness is a measure of the percentage of sample results that are collected and analyzed and determined to be valid. A goal of 90% completeness exists for each measurement process.

Completeness will be assessed in all chemistry samples with qualifiers indicating the reasons for any samples that did not meet acceptance criteria. All toxicity tests will be run with toxicity control tests to assess validity of the toxicity test results. Benthic infauna samples that do not meet acceptance criteria will be re-sorted.

“Representative” is a qualitative term that expresses “the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition” (ANSI/ASQC, 1994). Best professional judgement (BPJ) will be used in the field to evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied. Sample selection and use of approved/documented analytical methods will control to the best extent possible that the measurement data represent the conditions at the investigation site.

Quality control samples and data quality objectives for analyzing chemistry and toxicity samples collected as part of the sediment monitoring program must be conducted in accordance with the QAPP for the State of California’s SWAMP (SWAMP Quality Assurance Team, 2008) if SWAMP quality objectives are available. The quality objectives are outlined in Table 6 through Table 8. Depending on the physical or chemical analysis of the sediment samples, the following QA/QC sample types may be required to be included in the analytical run:

- A laboratory blank to determine the likelihood of contamination in the samples.
- A laboratory duplicate sample to estimate the precision of the results through the calculation of the relative percent difference (RPD) between the sample and the duplicate sample.
- A certified or standard reference material to determine the accuracy of the analyses.
- A matrix spike to determine if interference has occurred between the sample matrix and the analysis of the target analyte.
- A surrogate compound to estimate losses of the target analyte during the sample extraction phase and analysis of the sample (for organic measurements only).

SWAMP quality control measurements for toxicity testing of marine sediments are provided in Table 7. It should be noted that these SWAMP measurements currently only apply for the short term 10-day survival test using *Eohaustorius estuariu*s. SWAMP is developing quality guidelines for *Mytilus galloprovincialis.*. For the SQO analysis, quality assurance recommendations for toxicity testing are also provided in the Sediment Quality Assessment Technical Support Manual (Bay et al., 2014).

Table 6. Frequency of Chemistry Analysis for Laboratory Quality Assurance/Quality Control Samples

Analysis Type	Laboratory Blanks	Laboratory Duplicate	SRM or LCS[1]	Matrix Spikes	Matrix Spike Duplicates	Surrogate
Total solids	1 per analytical batch	1 per analytical batch	N/A	N/A	N/A	N/A
Total organic carbon	1 per analytical batch	1 per analytical batch	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A	N/A	N/A
Grain size	N/A	1 per analytical batch	N/A	N/A	N/A	N/A
Trace Metals	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A
Organochlorine Pesticides	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A	1 per 20 samples or 1 per analytical batch	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	Included in all samples and all QC samples
PCB Congeners	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A	1 per 20 samples or 1 per analytical batch	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	Included in all samples and all QC samples
PAHs	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A	1 per 20 samples or 1 per analytical batch	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	Included in all samples and all QC samples

LCS = Laboratory control sample

N/A = not applicable

SRM = standard reference material

[1] When a Standard Reference Material is not available, an LCS will be analyzed.

Table 7. Quality Control Measurements for Sediment Toxicity Testing

QC Control	Frequency of Analysis and Control Limits
Negative Controls Laboratory Control Water	Laboratory Control water consistent with Section 7 of appropriate EPA method/manual must be tested with each analytical batch/ Laboratory control water must meet all test acceptability criteria for the species of interest.
Negative Controls Conductivity/Salinity Control Water	A conductivity or salinity control must be tested when these parameters are above or below the species tolerance/ Follow EPA guidance on interpreting data.
Negative Controls Additional Control Water	Additional method blanks are required whenever manipulations are performed on one or more of the ambient samples within each analytical batch/ There must be no statistical difference between the laboratory control water and each additional control water within an analytical batch.
Negative Controls Sediment Control	Sediment control consistent with Section 7 of the appropriate EPA method/manual must be tested with each analytical batch of sediment toxicity tests/ Sediment control must meet all data acceptability criteria for the species of interest.
Positive Controls Reference Toxicant Tests	Reference toxicant tests must be conducted monthly for species that are raised within a laboratory, or per analytical batch for commercially-supplied or field-collected species/ Last plotted data point (LC50 or EC50) must be within 2 SD of the cumulative mean (n=20). Reference toxicant tests that fall outside of recommended control chart limits are evaluated to determine the validity of associated tests. An out of control reference toxicant test result does not necessarily invalidate associated test results. More frequent and/or concurrent reference toxicant testing may be advantageous if recent problems have been identified in testing.
Sample Duplicate	5% of total project sample count/ Recommended acceptable RPD<20%

[1] SWAMP quality control measurements currently only apply for marine sediment toxicity testing for the 10-day survival *Eohaustorius estuarius* test. SWAMP is in the process of developing guidelines for the *Mytilus galloprovincialis* 48-hr SWI test.

Table 8. Data Quality Objectives for Laboratory Measurements

Group	Parameter	Accuracy	Precision	Completeness
		Sediment Samples		
Laboratory analyses	Total Solids	N/A	Laboratory duplicate RPD < 25%	90%
Laboratory analyses	TOC	Laboratory Blank <RL or <30% of lowest sample; SRM or LCS with 80–120% recovery of true value	Laboratory duplicate RPD < 25%	90%
Laboratory analyses	Grain Size	N/A	Laboratory duplicate RPD < 25%	90%
Laboratory Analyses	Trace Metals	Laboratory Blank< RL for target analyte; SRM or LCS 75-125% recovery	Laboratory duplicate, MSD RPD < 25%; MS/MSD 75-125% recovery	90%
Laboratory Analyses	Organochlorine Pesticides	Laboratory Blank< RL for target analyte; SRM 70-130% recovery if certified, otherwise 50-150% recovery; if using LCS 70-130% recovery	MSD RPD < 25%; MS/MSD 50-150% recovery or based on historical laboratory control limits (average ±3SD); surrogates based on historical lab control limits (50-150% or better)	90%
Laboratory Analyses	PCB Congeners	Laboratory Blank< RL for target analyte; SRM 70-130% recovery if certified, otherwise 50-150% recovery; if using LCS 70-130% recovery	MSD RPD < 25%; MS/MSD 50-150% recovery or based on historical laboratory control limits (average ±3SD); surrogates based on historical lab control limits (50-150% or better)	90%
Laboratory Analyses	PAHs	Laboratory Blank< RL for target analyte; SRM 70-130% recovery if certified, otherwise 50-150% recovery; if using LCS 70-130% recovery	MSD RPD < 25%; MS/MSD 50-150% recovery or based on historical laboratory control limits (average ±3SD); surrogates based on historical lab control limits (50-150% or better)	90%

Table 8. Data Quality Objectives for Laboratory Measurements

Group	Parameter	Accuracy	Precision	Completeness
Toxicity Samples				
Toxcity Testing	Short-term 10-day Amphipod Survival Tests	N/A	Reference toxicity testing; test results within 2 standard deviations of the mean are re-evaluated.	90%
Toxicity Testing	Sublethal Sediment Toxicity Tests	N/A	Reference toxicity testing; test results within 2 standard deviations of the mean are re-evaluated.	90%
Benthic Infauna Samples				
Benthic Infauna	Benthic Infaunal Sorting	95% sorting efficiency	N/A	90%

ELEMENT 8 SPECIAL TRAINING NEEDS/CERTIFICATION

1.6.18 Specialized Training or Certifications

1.6.18.1 Field Sampling

Field personnel will have current and relevant experience in the aspects of standard field monitoring, including use of relevant field equipment such as boats, field instruments, and monitoring equipment. Field personnel will also have been trained and have experience in the collection and handling of samples, and chain-of-custody (COC) procedures. Training will be reviewed in proper field sampling and sample-handling techniques prior to sampling and only those staff with proficiency will be permitted to conduct field work.

1.6.18.2 Analytical Laboratory

All analytical tests including chemistry and toxicity will be conducted by laboratories certified by the California Department of Health Services in accordance with Water Code Section 13176.

1.6.19 Training and Certification Documentation

Personnel are responsible for complying with QA/QC requirements that pertain to their organizational/technical function. Each technical staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and a general knowledge of laboratory operations, test methods, QA/QC procedures, and records management.

1.6.19.1 Field Sampling

Field personnel training will be documented and records kept in the project files at each organization's offices.

1.6.19.2 Analytical Laboratory

Training documents for each subcontracting laboratory will be detailed in the individual QAPPs for each laboratory.

1.6.20 Training Personnel

The Project Manager and/or Field Task Manager will provide training for field personnel in proper field sampling techniques prior to work initiation to ensure consistent and appropriate sampling, sample handling/storage, and COC procedures.

ELEMENT 9 DOCUMENTS AND RECORDS

The San Diego River WMA Responsible Copermittees or their subcontractor(s) will document and track the aspects of the sample collection process, including generating field logs at each site and COC forms for the samples collected. COC forms will accompany samples to the appropriate laboratory for analysis. Each laboratory will document and track the aspects of receipt and storage, analyses, and reporting related to their respective samples.

A database of information collected during the sediment monitoring will be maintained by each San Diego River WMA Responsible Copermittees or their subcontractor(s). The database will include field observations, data sheets, COC records, and analytical results. The original data sheets, statistical worksheets, and reports produced will be accumulated into project-specific files maintained in file cabinets following submittal of the draft report. Data from outside contractors will be kept exactly as received. Monitoring data and analytical results will be uploaded into California Environmental Data Exchange Network (CEDEN).

Persons responsible for maintaining records for this project will be specified by the project manager and will be tasked with overseeing the operations of the project, and maintaining the sample collection, sample transport, COC, field analysis forms, and laboratory data. They will also be responsible for arbitrating any issues relative to records retention and any decisions to discard records.

Copies of this QAPP will be distributed to all parties identified previously in Element 3. Updates to this QAPP will be distributed in like manner, and previous versions will be discarded from the project file. The Project Manager under the direction, supervision, and review of the QA Officer, will be responsible for distributing an updated version of the QAPP.

Copies of the final report, including laboratory results and field records, will be maintained for a minimum of five years after project completion.

GROUP B:
DATA GENERATION AND ACQUISITION

ELEMENT 10 SAMPLE PROCESS DESIGN

1.6.21 Station Selection

The selection of suitable station locations is critical to assessing benthic conditions. Justification for selecting locations for sediment sampling is provided in Section 2.1.1 of the Sediment Monitoring Plan. The Sediment Control Plan does not give guidance as to how many stations should be sampled in each waterbody. The number of sampling stations in the San Diego River Estuary can vary based on the spatial extent of the area likely to be impacted. If the Bight Program is utilized to fulfill the Sediment Quality Monitoring requirement of the Permit, then the number of stations within San Diego River Estuary will be dictated by the Bight Program. If a stressor identification study becomes necessary following the original SQO assessment of the Estuary, then the number of stations will be based upon the drivers of the impacted scores (e.g. algae, physical factors, or chemical factors) and statistical power (i.e., having enough samples to statistically support meaningful findings).

All station locations will be pre-plotted prior to sampling activities. Locations will be identified in the field using a Differential Global Positioning System (DGPS). The system uses U.S. Coast Guard differential correction data, and is accurate within 10 feet (ft). All final station locations will be recorded in the field using positions from the DGPS.

In the event that a pre-plotted sample location is found to be unsuitable for collecting sediment, because of factors such as inaccessibility, the salinity does not meet the SQO criteria, disturbance to wildlife, or safety considerations, the station may be abandoned and an alternate station may be selected. Reasons for abandonment should be recorded on field data sheets.

The San Diego River WMA Responsible Copermittees are responsible for sediment monitoring in the San Diego River Estuary. Although the number of stations selected may vary, three monitoring stations were selected in accordance with the Sediment Monitoring Plan. The selected stations are presented in Table 9.

Table 9. San Diego River Estuary Selected Monitoring Stations*

Site ID	Latitude	Longitude
8129	32.7568	-117.2353
8134	32.7574	-117.2380
8136	32.7579	-117.2274

*Specific station locations and number of stations selected are subject to change based on the spatial extent of the study area, study requirements, and safety and access considerations

Monitoring Season and Frequency

Sediment for SQO programs must be collected between June and September. Physical environments and benthic community composition and abundance within enclosed bays and estuaries are generally most stable during this time of year (Bay et al., 2014).

According to Section VII.D of the Sediment Control Plan, sediment monitoring associated with Phase I stormwater discharges and major discharges shall be conducted at least twice during the Permit cycle except at stations that have consistently been classified as Unimpacted or Likely Unimpacted using the MLOE approach described in Section 3.2 of the Sediment Monitoring Plan. At the Unimpacted or Likely Unimpacted stations, monitoring may be reduced to a frequency of once during the Permit cycle. The San Diego RWQCB may also limit receiving water monitoring to a subset of outfalls to focus where the risk to sediment quality is greatest. The participating agencies propose to conduct one round of sediment sampling each permit term. The second required round of sampling will be satisfied by conducting additional follow up sampling in the vicinity of potentially impacted sites identified in the first round. For the San Diego River Estuary, this requirement is met for the 2013-2018 MS4 Permit term based on sampling and assessments conducted through the participation in the Bight'13 monitoring program and the subsequent follow up sediment sampling carried out in 2014.

ELEMENT 11 SAMPLING METHODS

1.6.22 Sediment Sampling

Information regarding the sampling vessel and site acceptability are provided in Sections 2.1.4 and 2.1.5 of the Sediment Monitoring Plan. Benthic sediments will be collected as surface grabs using an appropriate sampler, such as a stainless steel Van Veen grab sampler. The size of the grab sampler to be used for sediment programs in Southern California should be 0.1 m^2 across the top of the sampler. An appropriate sampler for the collection of benthic sediments will have the following characteristics:

- Constructed of a material that does not introduce contaminants.
- Causes minimal surface sediment disturbance.
- Does not leak or mix during sample retrieval.
- Has a design that enables safe/easy sample verification that samples meet all applicable sampling criteria (e.g., collects sediments to at least 5 centimeters (cm) below the sediment surface, has access doors allowing visual inspection and removal of undisturbed surface sediment).

Sediment grabs will be collected for the following analyses: benthic infauna, chemistry, grain size, and toxicity. A sample will be considered acceptable if the surface of the grab is even, there is minimal surface disturbance, and there is a penetration depth of at least 7 cm. Rejected grabs will be discarded, and the station will be re-sampled. Acceptable sediment grabs to be utilized for chemistry, grain size, and toxicity analyses will have the overlying water carefully drained from the sediment surface prior to removing the sediment to be placed in the appropriate sample containers. Overlying water will not be drained from sediment samples collected for benthic infaunal analysis. Station location and grab event data will be recorded on pre-formatted field data sheets (hard copies or via computer). At a minimum, field data will include station identification, station location, date, time of sample collection, depth of water, depth of penetration of grab in sediment (e.g. 5 cm), sediment composition, sediment odor and color, and sample type (e.g. sediment chemistry). Photographs of each sediment sample may be taken as needed and stored.

The entire contents of one grab sample will be utilized for benthic community analyses with a minimum penetration depth of 7 cm. Samples collected for benthic infaunal analysis will be rinsed through a 1.0-millimeter (mm) mesh screen. The material retained on the screen will be transferred to a labeled glass or plastic sample container. A 7% magnesium sulfate ($MgSO_4$) seawater solution will be added to the sample container to 85-90% of its volume to relax the collected specimens. The sample container will be inverted several times to distribute the relaxant solution. After 30 minutes, add enough sodium borate buffered formaldehyde to top off the sample container and gently invert the container several times to ensure the sample is mixed. This will make a 10% formalin solution.

Sediment samples for chemistry and toxicity testing will be collected from the top 5 cm of a grab sample using a pre-cleaned stainless steel scoop. Sediment within 1 cm of the sides of the grab will be avoided to prevent interaction of any contaminants and the steel sampling device. For chemistry and grain size analysis, equal portions of sediment will be aliquoted from a single grab and placed into the appropriate samples containers. The sediment aliquots will be representative of the entire 5 cm depth of the surface sediment. According to the Sediment Control Plan, the preferred method of collection for SWI toxicity tests is to collect intact cores directly from the sediment sampler by pressing polycarbonate core tubes (7.3-cm inner diameter [ID] and 16 cm in length) into the top 5 cm of sediment. However, homogenizing sediment for SWI testing is also acceptable according to the Sediment Control Plan. This method is more practical to implement in the field and is consistent with previous sediment quality objective methodology (e.g., Bight protocols and previous lagoon monitoring implemented by the Copermittees). A stainless steel scoop will be used to remove aliquots of the top 5 cm of surface sediment from two grab samples and evenly distributed into the appropriate toxicity sample container(s) until the necessary volume is reached.

All sampling equipment will be cleaned prior to sampling. Between sampling locations, grab sampling equipment will be scrubbed with a brush and rinsed with site water. Stainless steel scoops will be rinsed with seawater and rinsed with de-ionized water between stations. Clean gloves will be worn by sampling personnel at each new station.

ELEMENT 12 SAMPLE HANDLING CUSTODY

Sediment samples will be uniquely identified with sample labels in indelible ink or by equivalent method. All sample containers will be identified with the project title, appropriate identification number, date and time of sample collection, and preservation method. All samples will be kept on wet ice or equivalently chilled from the time of sample collection until delivery or transport to the analytical laboratory. All samples will be transferred to the appropriate laboratory and analyses initiated within the method specified holding time (Table). Sample volumes required for each analysis will be provided by the analytical laboratory conducting the analyses.

Table 10. List of Analytes with Container Type, Holding Time, and Preservation Method

Analyte	Recommended Container Type	Required Holding Time	Recommended Preservation
Field Measurements			
Salinity (conductivity & temperature if using a YSI sonde)	*In situ*		
Depth			
Sediment Chemistry			
Total Solids	Glass jar	7 days	Cool to ≤6 °C
Total Organic Carbon	Glass jar	28 days at ≤6 °C; 1 year at ≤- 20°C	Cool to ≤6 °C or freeze to ≤ -20°C
Grain Size	HDPE, Glass jar, or plastic bag	1 year	Wet ice to ≤6 °C in the field, then refrigerate at ≤6 °C
Trace Metals	Glass jar	1 year; samples must be analyzed within 14 days of collection or thawing	Cool to ≤6 °C within 24 hours, then freeze to ≤-20°C
Organochlorine Pesticides	Glass jar	1 year; samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction	Cool to ≤6 °C within 24 hours, then freeze to ≤-20°C
PCB Congeners	Glass jar	None	Cool to ≤6 °C within 24 hours, then freeze to ≤-20°C
PAHs	Glass jar	1 year; samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction	Cool to ≤6 °C within 24 hours, then freeze to ≤-20°C
Sediment Toxicity			
Toxicity Testing	10L Polyethylene bag or 1-L glass jar	1 month	Wet ice then 4°C for transport; 4°C for storage
Benthic Infauna			
Benthic Community Condition	1-L HDPE or 1-L Glass jar – sample volume will vary so may need multiple jars per sample	Formalin: 2-5 days 70% Ethanol: Indefinite-sample jars should be periodically checked for evaporation of ethanol	Initially samples are placed in 10% Buffered Formalin for 2-5 days; samples are then transferred to 70% ethanol

1.6.23 Chain-of-Custody Procedures

Samples will be considered to be in custody if they are (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a container and secured with an official seal such that the sample could not be reached without breaking the seal. The principal documents used to identify samples and to document possession will be COC records, field logbooks, and field tracking forms. COC procedures will be used for samples throughout the collection, transport, and analytical process.

Chain of custody procedures will be initiated during sample collection. A COC record will be provided with each sample or group of samples. Each person who will have custody of the samples will sign the form and ensure the samples will not be left unattended unless properly secured. Documentation of sample handling and custody includes the following:

- Sample identifier.
- Sample collection date and time.
- Any special notations on sample characteristics or analysis.
- Initials of the person collecting the sample.
- Date the sample was sent to the analytical laboratory.
- Shipping company and waybill information.

Completed COC forms will be placed in a water proof (ex. plastic) envelope and kept inside the cooler containing the samples. Once delivered to the analytical laboratory, the COC form will be signed by the person receiving the samples. The condition of the samples will be noted and recorded by the receiver. COC records will be included in the final reports prepared by the analytical laboratories and are considered an integral part of the report.

1.6.24 Sampling Transport, Shipping, and Storage Procedures

Sediment samples collected in the field for chemistry and toxicity analyses will initially be placed on ice and stored in the dark. Prior to shipping or transport, sample containers will be packed inside coolers with ice. COC forms will be filled out, and the original signed COC forms will be inserted in a sealable water proof (ex. plastic) bag and placed inside the coolers. The cooler lids will be securely taped shut and then samples will be delivered or shipped on ice, or otherwise chilled, to the appropriate analytical laboratory for analysis. Sediment designated for benthic infauna analysis will be screened on location by field personnel. The material and organisms retained on the screen will be put into appropriate 1-L containers, treated with magnesium sulfate relaxant, and preserved with formalin (or relaxed and preserved using equivalent methods). Once preserved, benthic infauna samples will be delivered with accompanying COC forms to the laboratory tasked with sorting macroinvertebrates into broad taxonomic groupings. Following sorting, taxonomic samples will be shipped/ delivered to specialized taxonomists who will identify benthic macroinvertebrates to the lowest possible taxon.

ELEMENT 13 ANALYTICAL METHODS

1.6.25 Field Analytical Methods

A YSI water quality data sonde (e.g. YSI 6600 Multiparameter Sonde) or similar device can be utilized to take salinity measurements at each station location. Salinity measurements should be taken approximately six inches above the SWI. At a minimum, it is recommended that salinity measurements should be taken at a spring high and low tide to get an estimate of the salinity range for a proposed station. If feasible, it is recommended that salinity should be monitored throughout an entire spring tidal cycle to ensure it meets the salinity criteria prior to sampling. Water depth should also be measured when visiting the station at a spring low tide or deploying a continuous monitoring device over a spring tidal cycle to ensure the station is subtidal. Operation of field equipment will be conducted as per manufacturer instructions. Calibrations will be performed and recorded to ensure accurate functionality.

1.6.26 Laboratory Analytical Methods

Chemistry Samples
A list of sediment chemical constituents and maxiumum reporting limits (RLs) for analytes that are required for SQO analysis are provided in Table 11. Additional physical parameters including grain size and TOC are also listed. While these physical parameters are not required to calculate the chemistry LOE, they should be analyzed in order to provide additional information to aid in the interpretation of the toxicity and benthic LOEs. Percent solids must be measured to convert concentrations of the chemical parameters from a wet-weight to a dry-weight basis.

Target RLs listed in Table 11 are those that are provided in the Sediment Quality Assessment Technical Support Manual (Bay et al., 2014) for SQO analyses. The maximum RLs provided in Table 11 are based on the CSI classification ranges and are expressed on a dry weight basis. Lower RLs may be achievable depending on available analytical methods. As stated in Element 6, the analytical methods listed in Table 8 are suggested methods that have been used in previous sediment monitoring programs within San Diego County's waterbodies (e.g. Bight), but are not the only acceptable methods. Chemical analyses of all sediment samples collected as part of the SQO assessment must be tested in accordance with USEPA or ASTM protocols. If appropriate protocols do not exist, the SWRCB or San Diego RWQCB may approve the use of other methods.

Table 11. Physical and Chemical Parameters, Suggested Methods, and Maximum Reporting Limits for SQO Analysis

Parameter	Method*	Procedure*	Maximum Reporting Limit (dry weight)
Physical/ Conventional			
Grain Size	Plumb 1981	Wet sieving	1.00 %
Percent Solids	SM 2540B	Gravimetric	0.10 %
Total Organic Carbon (TOC)	USEPA 9060A	Combustion/ oxidation	0.01 %

Table 11. Physical and Chemical Parameters, Suggested Methods, and Maximum Reporting Limits for SQO Analysis

Parameter	Method*	Procedure*	Maximum Reporting Limit (dry weight)
Chemistry			
Trace Metals			
Cadmium (Cd)	USEPA 6020A	ICP/MS	0.09 mg/kg
Copper (Cu)	USEPA 6020A	ICP/MS	52.8 mg/kg
Lead (Pb)	USEPA 6020A	ICP/MS	25.0 mg/kg
Mercury (Hg)	USEPA 7471B	CVAA	0.09 mg/kg
Zinc (Zn)	USEPA 6020A	ICP/MS	60.0 mg/kg
Organochlorine Pesticides			
2,4′-DDD	USEPA 8081B	GC/MS	0.50 µg/kg
2,4′-DDE	USEPA 8081B	GC/MS	0.50 µg/kg
2,4′-DDT	USEPA 8081B	GC/MS	0.50 µg/kg
4,4′-DDD	USEPA 8081B	GC/MS	0.50 µg/kg
4,4′-DDE	USEPA 8081B	GC/MS	0.50 µg/kg
4,4′-DDT	USEPA 8081B	GC/MS	0.50 µg/kg
Chlordane-alpha	USEPA 8081B	GC/MS	0.50 µg/kg
Chlordane-gamma	USEPA 8081B	GC/MS	0.54 µg/kg
Dieldrin	USEPA 8081B	GC/MS	2.5 µg/kg
trans-Nonachlor	USEPA 8081B	GC/MS	4.6 µg/kg
PCB Congeners			
2,4'-Dichlorobiphenyl (8)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',5-Trichlorobiphenyl (18)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,4,4'-Trichlorobiphenyl (28)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,5'-Tetrachlorobiphenyl (44)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',5,5'-Tetrachlorobiphenyl (52)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,3',4,4'-Tetrachlorobiphenyl (66)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',4,5,5'-Pentachlorobiphenyl (101)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,3,3',4,4'-Pentachlorobiphenyl (105)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,3',4,4',5-Pentachlorobiphenyl (118)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,3',4,4'-Hexachlorobiphenyl (128)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,4,4',5'-Hexachlorobiphenyl (138)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',4,4',5,5'-Hexachlorobiphenyl (153)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,3',4,4',5-Heptachlorobiphenyl (170)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,4,4',5,5'-Heptachlorobiphenyl (180)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,4',5,5',6-Heptachlorobiphenyl (187)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,3',4,4',5,6-Octachlorobiphenyl (195)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (206)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
Decachlorobiphenyl (209)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
Low Molecular Weight PAHs			
Acenaphthene	USEPA 8270D	GC/MS SIM	20 µg/kg
Anthracene	USEPA 8270D	GC/MS SIM	20 µg/kg
Phenanthrene	USEPA 8270D	GC/MS SIM	20 µg/kg

Table 11. Physical and Chemical Parameters, Suggested Methods, and Maximum Reporting Limits for SQO Analysis

Parameter	Method*	Procedure*	Maximum Reporting Limit (dry weight)
Biphenyl	USEPA 8270D	GC/MS SIM	20 µg/kg
Naphthalene	USEPA 8270D	GC/MS SIM	20 µg/kg
2,6-Dimethylnaphthalene	USEPA 8270D	GC/MS SIM	20 µg/kg
Fluorene	USEPA 8270D	GC/MS SIM	20 µg/kg
1-Methylnaphthalene	USEPA 8270D	GC/MS SIM	20 µg/kg
2-Methylnaphthalene	USEPA 8270D	GC/MS SIM	20 µg/kg
1-Methylphenanthrene	USEPA 8270D	GC/MS SIM	20 µg/kg
High Molecular Weight PAHs			
Benzo(a)anthracene	USEPA 8270D	GC/MS SIM	80 µg/kg
Benzo(a)pyrene	USEPA 8270D	GC/MS SIM	80 µg/kg
Benzo(e)pyrene	USEPA 8270D	GC/MS SIM	80 µg/kg
Chrysene	USEPA 8270D	GC/MS SIM	80 µg/kg
Dibenzo(a,h)anthracene	USEPA 8270D	GC/MS SIM	80 µg/kg
Fluoranthene	USEPA 8270D	GC/MS SIM	80 µg/kg
Perylene	USEPA 8270D	GC/MS SIM	80 µg/kg
Pyrene	USEPA 8270D	GC/MS SIM	80 µg/kg

DDD Dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethylene
DDT dichlorodiphenyltrichloroethane
mg/kg milligrams per kilogram
µg/kg micrograms per kilogram* Other equivalent methods or procedures may be used

Toxicity Samples

To evaluate the benthic condition of the San Diego River Estuary, sediment toxicity testing will be conducted in accordance with ASTM and USEPA methods. Toxicity testing involves a short-term survival test, a sublethal endpoint test, and an assessment of sediment toxicity. For each test type, more than one specific test is acceptable. The appropriate species tested for a sample will depend on the characteristics of the sample such as grain size, salinity, and suspected toxic constituents, if any. When historical data are available for a sample location, it is recommended that the same species be used in order to make comparisons and to conduct trend analysis. In addition, when testing is conducted as part of a regional monitoring program such as the Bight program, the species selection will be dictated by the program.

Short-Term Survival Testing

SQO analysis requires that at least one short-term survival test be conducted. There are three acceptable short-term survival tests, each of which is a 10-day test exposing amphipods to whole sediment. The three acceptable test organisms are *Eohaustorius estuarius*, *Leptocheirus plumulosus*, and *Rhepoxynius abronius*. The *E. estuarius* short-term survival test has been the 10-day test method used in previous San Diego County enclosed bay and estuary monitoring programs, including the Bight Program, where the SQO analytical tool was used to assess aquatic health. These amphipod bioassays will be conducted in accordance with procedures outlined in *Methods for Assessing Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods* (USEPA, 1994) and ASTM method E1367-03 (ASTM, 2006) or equivalent methods that satisfy the requirements of the Sediment Control Plan. Test conditions are summarized in Table 12. If sediment monitoring is conducted as part of the Bight Program, then procedures and test conditions should be in accordance with Bight Workplans.

A water-only reference toxicity test should be conducted concurrently with the whole sediment amphipod test to assess the relative sensitivity of test organisms used in the evaluation of project sediments. Amphipod reference toxicant tests are typically conducted using cadmium. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing. If ammonia is selected as the reference toxicant, pore water ammonia will be measured between sample receipt and test set-up, and again at test initiation. If the un-ionized pore water ammonia concentration in the test initiation sample is 0.8 mg/L or greater, then the ammonia reference toxicant test will be extended from 4 days to 10 days for better comparison to 10-day test sample results.

Table 12. Summary of Conditions for 10-Day Whole Sediment Amphipod Bioassay

Test Conditions 10-Day Whole Sediment Bioassay				
	Test Species	***E. estuarius***	***L. plumulosus***	***R. abronius***
	Test Procedures	USEPA (1994); ASTM E1367-03 (2006)		
	Test Type/Duration	Static - Acute Whole Sediment/10 days		
	Sample Storage Conditions	4 °C, dark, minimal head space		
	Age/Size Class	3-5 mm	2-4 mm; immature	3-5 mm
	Grain Size Tolerance	0.6-100% sand	0-100% sand	10-100% sand
Recommended Water Quality Parameters	Temperature	15 ± 1 °C	25 ± 1 °C	15 ± 1 °C
	Salinity	20 ± 2 ppt	20 ± 2 ppt	28 ± 2 ppt
	Dissolved Oxygen	Maintaining 90% saturation		
	Total Ammonia	< 60 mg/L	< 60 mg/L	< 30 mg/L
	Test Chamber	1 L glass		
	Exposure Volume	2 cm sediment, 800 mL seawater		
	Replicates/Sample	5		
	No. of Organisms/Replicate	20		
	Photoperiod	Continuous light		
	Feeding	None		
	Water Renewal	None		
	Aeration	Constant gentle aeration		
	Acceptability Criteria	Mean control survival $\geq$ 90%; $\geq$80% survival in each replicate		

mg/L milligram per liter

1.6.26.1

Sublethal Testing

The second type of testing required for SQO analysis is a sublethal test. Either a 48-hour development test exposing embryos of the bivalve *Mytilus galloprovincialis* to the sediment-water interface may be conducted or a 28-day survival and growth test exposing the polychaete worm *Neanthes arenaceodentata* to whole sediment. Test condition summaries for the bivalve and polychaete tests are presented in Table 13 and Table 14, respectively. The *M.*

galloprovincialis sediment-water interface test has been the sublethal test method used in previous San Diego County enclosed bay and estuary monitoring programs, including the Bight Program, where the SQO analytical tool was used to assess aquatic health.

1.6.26.1.1 *Mytilus galloprovincialis* Sediment-Water Interface Development Sublethal Test

Sediment-water interface bioassays are performed to estimate the potential toxicity of contaminants fluxing from test sediments into the overlying water. The sediments will be tested in a 48-hour sediment-water interface test using the bivalve *M. galloprovincialis* in accordance with procedures outlined in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (USEPA, 1995) and Assessment of Sediment Toxicity at the Sediment-Water Interface (Anderson et al., 1996). If sediment monitoring is conducted as part of the Bight Program, then procedures and test conditions should be in accordance with Bight Workplans. Sediment-water interface bioassays will be tested on intact cores collected in the field or on homogenized sediment samples as described in Section 2.1.6 of the Sediment Monitoring Plan.

A water-only reference toxicity test should be conducted concurrently with the sediment-water interface bivalve test to assess the relative sensitivity of test organisms used in the evaluation of the project sediments. Bivalve reference toxicant tests are typically conducted using copper. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing. If ammonia is selected as the reference toxicant, pore water ammonia will be measured between sample receipt and test set-up, and again at test initiation. If the un-ionized pore water ammonia concentration in the test initiation sample is 0.8 mg/L or greater, then the ammonia reference toxicant test will be extended from 4 days to 10 days for better comparison to 10-day test sample results.

Table 13. Test Conditions for the 48-Hour *M. galloprovincialis* Sediment-Water Interface Bioassay

Test Conditions 10-Day Whole Sediment Bioassay		
Test Species		***M. galloprovincialis***
Test Procedures		USEPA (1995), Anderson et al. (1996)
Test Type/Duration		Static - Acute sediment-water interface/48 hours
Sample Storage Conditions		4 °C, dark, minimal head space
Age/Size Class		< 4 hour old larvae
Recommended Water Quality Parameters	Temperature	15 ± 1 °C
	Salinity	32 ± 2 ppt
	Dissolved Oxygen	Maintaining 90% saturation
	Total Ammonia	< 4 mg/L
Test Chamber		Polycarbonate core tube 7.3-cm inner diameter, 16 cm high
Exposure Volume		5 cm sediment, 300 mL water
Replicates/Sample		4
No. of Organisms/Replicate		Approximately 250 larvae
Photoperiod		16 hours light: 8 hours dark

Test Conditions 10-Day Whole Sediment Bioassay	
Feeding	None
Water Renewal	None
Aeration	Constant gentle aeration
Acceptability Criteria	Mean control normal-alive $\geq$ 80%

1.6.26.1.2 *Neanthes arenaceodentata* Whole Sediment Survival and Growth Sublethal Test

The *N. arenaceodentata* test will be conducted in accordance with ASTM method E1562 (ASTM, 2002) with modifications described in Farrar and Bridges (2011) that have been found to contribute manageability and precision to the ASTM procedure. If sediment monitoring is conducted as part of the Bight Program, then procedures and test conditions should be in accordance with Bight Workplans. A water-only reference toxicity test should be conducted concurrently with the whole sediment polychaete test to assess the relative sensitivity of test organisms used in the evaluation of the project sediments. Polychaete reference toxicant tests are typically conducted using cadmium. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing. If ammonia is selected as the reference toxicant, pore water ammonia will be measured between sample receipt and test set-up, and again at test initiation. If the un-ionized pore water ammonia concentration in the test initiation sample is 0.8 mg/L or greater, then the ammonia reference toxicant test will be extended from 4 days to 10 days for better comparison to 10-day test sample results.

Table 14. Test Conditions for the 28-Day Whole Sediment *N. arenaceodentata* Bioassay

Test Conditions 10-Day Whole Sediment Bioassay		
	Test Species	***N. arenaceodentata***
	Test Procedures	ASTM E1562 (2002), Farrar and Bridges (2011)
	Test Type/Duration	Static - Acute Whole Sediment/28 days
	Sample Storage Conditions	4 °C, dark, minimal head space
	Age/Size Class	≤ 7 days post-emergence
	Grain Size Tolerance	5-100% sand
Recommended Water Quality Parameters	Temperature	20 ± 1 °C
	Salinity	30 ± 2 ppt
	Dissolved Oxygen	Maintaining 90% saturation
	Total Ammonia	< 20 mg/L
	Test Chamber	300 mL glass
	Exposure Volume	2 cm sediment, 125 mL seawater
	Replicates/Sample	10
	No. of Organisms/Replicate	1
	Photoperiod	12 hours light: 12 hours dark
	Feeding	Twice per week
	Water Renewal	Weekly
	Aeration	Constant gentle aeration
	Acceptability Criteria	Mean control survival ≥ 80%; positive growth in controls

Benthic Infauna Samples

The benthic infaunal samples will be transported from the field to the laboratory and stored in a formalin solution for a minimum of 48 hours and no longer than 5 days. The samples will then be transferred from formalin to 70% ethanol for laboratory processing. Alternative specimen preservation methods may be used if equivalent. The organisms will initially be sorted using a dissecting microscope into five major phyletic groups: polychaetes, crustaceans, molluscs, echinoderms, and miscellaneous minor phyla. While sorting, technicians will keep a count for quality control purposes. After initial sorting, samples will be distributed to qualified taxonomists who will identify each organism to species or to the lowest possible taxon. Taxonomists will use the most recent version of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) taxonomic listing for nomenclature and orthography. If sediment monitoring is conducted as part of the Bight Program, then procedures should be in accordance with Bight Workplans.

ELEMENT 14 QUALITY CONTROL

1.6.27 QA/QC Field Procedures

Field measurements for salinity will be made using a water quality probe, such as a YSI data sonde, that has been calibrated according to manufacturer specifications. Operation of field equipment will be conducted as per manufacturer instructions. Calibrations will be performed and recorded to ensure accurate functionality. Proper storage and maintenance procedures will be followed.

QA/QC for sampling processes begins with proper collection of the samples to minimize the possibility of contamination. Sediment samples will be collected in appropriate containers, kept on wet ice or otherwise chilled during the sampling event, and placed into coolers along with completed COC for transfer to the analytical laboratory. Field crews will ensure that sampling containers are being filled properly and the requirement to avoid contamination of samples at all times is met. The field data log sheets will include empirical observations of the site and water quality characteristics. Field duplicates will be collected at a minimum of 5% of total project sample count. A minimum of one equipment blank will be collected during the monitoring event. The equipment blank will be analyzed for the same target SQO analytes specified for the sediment samples (excluding grain size and percent solid analyses).

1.6.28 QA/QC Laboratory Analyses

Chemistry Analyses

The chemistry analysis of the samples will be performed under the guidelines of the analytical laboratories respective standard operationg procedures (SOPs) and QAPPs as well as meet the DQOs and quality objectives set forth in this QAPP. This includes analyzing the appropriate QC laboratory controls for each analysis in accordance with SWAMP criteria such as laboratory blanks and duplicates, MS/MSDs, certified or standard reference materials, and surrogates (see Element 7 for frequency of analysis and DQOs for QC laboratory controls).

Toxicity Analyses

A water-only reference toxicity test will be conducted concurrently with each batch of sediment tests to establish the sensitivity of the test organisms used in the evaluation of the sediments and to evaluate the potential influence of ammonia toxicity on the test organisms. Typically, amphipod and polychaete reference toxicant tests are conducted using cadmium and bivalve reference toxicant tests are typically conducted using copper. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing. The LC_{50} and/or EC_{50} values of the reference toxicant test will be compared to historical laboratory data for each respective test species. The results of these reference toxicant tests will be used in combination with the control mortality to assess the health of the test organisms.

Benthic Infauna Analyses

A QA/QC procedure will be performed on each of the sorted samples to ensure a 95% sorting efficiency. This procedure is the same one followed in the Bight programs. A 10% aliquot of a sample will be re-sorted by a senior technician trained in the QA/QC procedure. The number of organisms found in the aliquot will be divided by 10% and added to the total number found in the sample. The original total will be divided by the new total to calculate the percent sorting efficiency. When the sorting efficiency of the sample is below 95%, the remainder of the sample (90%) will be re-sorted.

ELEMENT 15 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

1.6.29 Field Sampling

Prior to conducting field sampling, field technicians will be responsible for preparing sampling kits that include field logs, COC forms, sample labels, sampling containers, decontamination equipment and tools. Field measurement equipment should be checked for operation in accordance with the manufacturer's specifications. Equipment should be inspected prior to use and when returned from use for damage.

1.6.30 Analytical Laboratories

All analytical laboratories including chemistry, toxicity, and benthic infaunal will maintain their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the method. Each laboratory's QAPP will specify equipment and system evaluations.

ELEMENT 16 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

The equipment and instruments used at each analytical laboratory will be operated and calibrated according to manufacturer recommendations as well as by criteria defined in each analytical laboratory's SOPs. Operation and calibration will be performed by properly trained personnel. Documentation of routine and special calibration information will be recorded in appropriate logbooks and reference files. If a critical measurement is found to be out of compliance during analysis, the results of that analysis will not be reported, corrective action will be taken and documented, and the analysis will be repeated.

1.6.31 Field Equipment

Water quality instruments used for salinity measurements will be calibrated per manufacturer's specifications prior to each monitoring event. Complete records of calibration will be maintained for each field instrument that requires periodic calibration.

1.6.32 Analytical Laboratories

All analytical labortatories including chemistry, toxicity, and benthic infaunal will calibrate their instrumentation at a frequency that ensures the validity of the results. Each laboratory's calibration procedures must follow EPA guidelines and the recommendations of the instrument manufacturer. Each laboratory's QAPP should provide detailed information on calibration procedures.

ELEMENT 17 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

It is the duty of each person who is responsible for equipment ordering to inspect equipment and materials for quality and report any equipment or materials that do not meet acceptance criteria to the Project Manager, Laboratory Manager, and/or QA Officer, as appropriate. Upon receipt of materials or equipment, a designated employee must receive and sign for the materials. The items will then be reviewed to ensure the shipment is complete, prior to delivery to the proper storage location. Chemicals must be dated upon receipt. Supplies will be stored appropriately and discarded on their expiration date. The equipment and supplies purchased for use in field sampling activities will be inspected for damage as they are received. Confirmation that sample bottles are laboratory-certified clean will be made when received.

Critical Supplies and Consumables

Chemistry Sample Bottles – Chemistry sample bottles will be provided by the analytical laboratory. They will be shipped from the laboratory and stored appropriately by the field sampling team prior to use in the field. Confirmation that sample bottles are laboratory-certified clean will be made when received from the analytical laboratories. Preservatives may be required for the analysis of certain analyte groups and the laboratory supplied bottles should already contain any required preservatives.

Toxicity Sample Containers – Clean, food-grade, heavy duty 0.004 gauge polyethylene bags capable of holding up to 20-L, or clean glass jars with Teflon-lined lids should be used as the sample container for sediment toxicity samples. If bags are used, samples should be double bagged, twisted at the top with excess air removed, and cable tied to ensure sample integrity.

Benthic Infauna Jars– Clean, 1-L HDPE or glass sample jars should be used as containers for benthic infauna samples following sediment processing in the field. Additionally, magnesium sulfate and 10% formalin solutions that are used for processing benthic infauna samples will need to be on hand during sampling events and should be provided by San Diego River WMA Responsible Copermittees or their subcontractor(s).

ELEMENT 18 NON-DIRECT MEASUREMENTS

Data will be reviewed against DQOs in Section 7 prior to SQO analysis. Only data meeting the DQOs will be used in the SQO analysis.

ELEMENT 19 DATA MANAGEMENT

Data will be maintained as described in Element 9. The original data sheets and reports produced will be accumulated into project-specific files that are kept by either the San Diego River WMA Responsible Copermittees or Contractor Project Manager.

The San Diego River WMA Responsible Copermittees or Contractor Project Manager will document and track the aspects of the sample collection process, including generating field logs at each site and COC forms for the samples collected. COC forms will accompany samples to the appropriate laboratories for analysis. Each analytical laboratory will document and track the aspects of sample receipt and storage, analyses, and reporting. Each analytical laboratory's results will be stored in a database system at their office and will be provided to the San Diego River WMA Responsible Copermittees or Contractor Project Manager both electronically and by hard copy. Further details of each laboratory's data management protocols can be found in each laboratory's respective QAPP.

Field logs and analytical data will be entered into or transferred to the San Diego River WMA Responsible Copermittees or Contractor's database. After the data is added to the database, the Contractor Project QA Officer will validate the data by checking for errors and ensure the data is complete. The database will be updated with finalized data. The results of the laboratory QC analyses will be reported with the final data. Any QC samples that fail to meet the specified QC criteria in the methodology or the DQOs described in Element 7 will be identified, and the corresponding data will be appropriately qualified in the final report. All QA/QC records will be kept on file for review by regulatory agency personnel. Once data are finalized, all monitoring data and analytical results will be formatted and uploaded into CEDEN. All records should be maintained for at least five years.

GROUP C:
ASSESSMENT AND OVERSIGHT

ELEMENT 20 ASSESSMENTS AND RESPONSE ACTIONS

1.6.33 Corrective Actions

The following sections identify the responsibilities of key project members and corrective actions to be taken if issues arise during field sampling or laboratory analyses that may result in noncompliance with protocols established in the Sediment Monitoring Plan.

1.6.34 Field Sampling

The initial responsibility for monitoring the quality of field measurements lies with the field personnel. The Field Task Manager is responsible for verifying that QC procedures are followed. This requires that the Field Task Manager assess the accuracy of the field methods as well as the ability to meet QA objectives and make a value judgment regarding the impact a procedure has on field objectives and subsequent data quality. If a problem occurs that might jeopardize the integrity of the project, hinder a QA objective, or impact data quality, the Field Task Manager will immediately (within 24 hours) notify the San Diego River WMA Responsible Copermittees or Contractor Project Manager. Corrective action measures are then decided upon and implemented. The Field Task Manager documents the situation, the field objective affected, the corrective action taken, and the results of that action. Copies of the documentation are provided to the San Diego River WMA Responsible Copermittees or Contractor Project Manager and the QA Officer.

1.6.35 Laboratory

The need for corrective action comes from several sources, including equipment malfunction, failure of internal QA/QC checks or to follow-up on performance or system audit findings, and noncompliance with QA requirements. All laboratory personnel are responsible for documenting and correcting problems that might affect quality. When measurement equipment or analytical methods fail QA/QC requirements, the problem(s) will be brought immediately to the attention of the Laboratory Manager and QA Officer. Corrective measures will depend entirely on the type of analysis, the extent of the error, and whether or not the error is determinant. The corrective action is determined by either the Laboratory Manager, technicians, the San Diego River WMA Responsible Copermittees or Contractor Project Manager, the QA Officer, or by all of them in conference, if necessary, but final approval is the responsibility of the San Diego River WMA Responsible Copermittees or Contractor QA Officer and/or Project Manager.

If failure is due to equipment malfunction, the equipment will not be used until repaired. Precision and accuracy will be reassessed, and the analysis will be rerun. Attempts will be made to reanalyze the affected parts of the analysis so that in the end, the product is not affected by failure of QC requirements. When a result in a performance audit is unacceptable, the laboratory will identify the problem(s) and implement corrective actions immediately. A step-by-step analysis and investigation to determine the cause of the problem will take place as part of the corrective action program. If the problem cannot be controlled, the laboratory will analyze the impact on data. If the data is affected, the problem will be documented and the San Diego River WMA Responsible Copermittees or Contractor QA Officer and/or Project Manager will be notified. When a system audit reveals an unacceptable performance, work will be suspended until corrective action has been implemented and performance has been proven acceptable. If the problem is instrumental or specific only to preparation of a sample batch, samples are reprocessed after the instrument is repaired and recalibrated. In the event that a QC measure is out-of-control and the data are to be reported, qualifiers are reported together with sample results.

ELEMENT 21 PROJECT REPORTS

The Project Manager is responsible for preparation and submittal of all project deliverables. Each analytical laboratory's QA Officer is responsible for the preparation of all data packages and laboratory reports originating from their laboratory. Provision D.1.e.(2)(c) of the Permit requires incorporation of a Sediment Monitoring Report into the WQIP Annual Report. The Sediment Monitoring Report will contain an evaluation, interpretation, and tabulation of monitoring data, including an assessment of whether receiving water limits outlined in the Permit were attained; a sample location map; and a statement of certification that monitoring data and results have been uploaded into CEDEN.

Based on the conclusions of the Sediment Monitoring Report, a human health risk assessment may be necessary in order to determine whether human health objectives have been obtained at each sample location. Provision A.2.a.(3)(b)(ii) states that "pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health." The potential risk assessments must consider any relevant information, such as guidelines set forth in the CA EPA's Office of Environmental Health Hazard Assessment (OEHHA) fish consumption policies, CA EPA's Department of Toxic Substances Control (DTSC) risk assessment, and the USEPA human health risk assessment policies.

The San Diego River WMA Responsible Copermittees included the 2012-2014 Sediment Monitoring Report with the Transitional Monitoring and Assessment Report submitted to the San Diego RWQCB on January 31, 2015. The Sediment Monitoring Report includes the results from the 2013 Bight Program and follow-up monitoring conducted in the San Diego River Estuary in 2014 to satisfy Provisions D.1.e.(1)(b) and D.1.e.(2) of the Permit. Any sediment quality monitoring or stressor identification studies conducted after 2014 will be included in the WQIP Annual Reports.

The schedule for completing the sediment quality monitoring requirements of the Permit and for submitting the Sediment Monitoring Report(s) is shown in Table 15.

Table 15. Sediment Monitoring Report Schedule

Activity/Deliverable	Dates(s)*
San Diego RWQCB Order No. R9-2013-0001	Adopted May 8, 2013 and effective June 27, 2013
Southern California Bight Regional Monitoring Program	August-September 2013
Follow-up confirmation monitoring	August-September 2014
Final Sediment Monitoring Plan and Sediment Monitoring QAPP incorporated into WQIPs	December 2014
Draft Sediment Monitoring Report	December 2014
Final Sediment Monitoring Report incorporated into Transitional Monitoring and Assessment Report	January 31, 2015
Potential Stressor ID Studies	TBD

*Table does not include future permit cycles

GROUP D:
DATA VALIDATION AND USABILITY

ELEMENT 22 DATA REVIEW, VERIFICATION, AND VALIDATION

Data reduction, verification, validation, and reporting are ongoing processes, which involve the field technicians, laboratory technicians, Laboratory Managers, and QA personnel. Data generated by the sediment monitoring activities including field sampling and laboratory analyses will be reviewed against the DQOs presented in Element 7 and the QA/QC practices cited in this QAPP. This includes field logbooks, COC forms, and all data related to laboratory analytical procedures (e.g., sample preparation logs, instrument logs, etc.). Data entry of field sampling data will be reviewed to check for accuracy and completeness. Analytical laboratory electronic data deliverables and hard copy reports will be reviewed to ensure that the proper QC elements are included (e.g., blanks, lab duplicates, etc.), all sample analyses are correct, holding times were met, and data failing to meet QC criteria are properly qualified. Data that does not meet the DQOs will be evaluated to determine the impact of the failure on the data quality. If sufficient evidence is found to support the use of the data, the data will be qualified, and entered into the database.

ELEMENT 23 VERIFICATION AND VALIDATION METHODS

After each sampling event, the field data sheets will be removed from the field logbooks, and the sheets will be checked for completeness and accuracy by the QA Officer or Project Manager. The appropriate field sheets must be present. If there are any questions, clarification from the Field Task Manager will be obtained as soon as possible.

In the laboratory, sample preparation activities will be documented in bound laboratory notebooks or on bench sheets. Data validation includes dated and signed entries by technicians on the data sheets and logbooks used for the samples, the use of sample tracking and numbering systems to track the progress of samples through the laboratory, and the use of QC criteria to reject or accept specific data. The laboratory generating the data will have the prime responsibility for the accuracy and completeness of the data. Each laboratory will review the data to ensure that the following information is correct and complete: sample description information, analysis information, results, and documentation of the data. Further data validation is performed by the Laboratory Manager. Validation is accomplished through routine audits of the data collection and flow procedures and by monitoring of QC sample results. In the data review process, the data will be compared to information such as the sample's history, sample preparation, and QC sample data to evaluate the validity of the results. Corrective action will be minimized through the development and implementation of routine internal system controls. Analysts are provided with specific criteria that must be met for each procedure, operation, or measurement system.

ELEMENT 24 RECONCILIATION WITH USER REQUIREMENTS

The QA personnel will review data after each survey to determine if DQOs have been met. If data do not meet project specifications, the QA personnel will review errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors, and they will suggest corrective action. It is expected that the problem would be correctible through personnel re-training, technique revision, or supplies/equipment replacement. If not, the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the QA personnel will recommend appropriate modifications. Any revisions would need approval by the San Diego River WMA Responsible Copermittees or Contractor Project Manager.

ELEMENT 25 REFERENCES

Anderson, B.S., Hunt, J.W., Hester, M., Phillips, B.M. 1996. Assessment of sediment toxicity at the sediment-water interface. In: G.K. Ostrander (ed.) *Techniques in Aquatic Toxicology*. Lewis Publishers, Ann Arbor, MI.

ASTM (American Society for Testing and Materials). 2002. E1562 Standard Guide for Conducting Acute, Chronic, and Life-Cycle Aquatic Toxicity Tests with Polychaetous Annelids. *Annual Book of Standards, Water and Environmental Technology, Vol. 11.05*, West Conshohocken, PA.

ASTM (American Society for Testing and Materials). 2006. E1367-03 Standard Guide for Conducting 10-Day Static Sediment Toxicity Tests With Marine and Estuarine Amphipods. *Annual Book of Standards, Water and Environmental Technology, Vol. 11.05*, West Conshohocken, PA.

Bay, S.M., Greenstein, D.J., Ranasinghe, J.A., Diehl, D.W., Fetscher, A.E. 2014. *Sediment Quality Assessment Technical Support Manual*. Southern California Coastal Water Research Project. Costa Mesa, CA. January 2014.

Farrar, J.D., Bridges, T.S. 2011. 28-Day Chronic Sublethal Test Method for Evaluating Whole Sediments Using an Early Life Stage of the Marine Polychaete *Neanthes arenaceodentata*. ERDC TN-DOER-R14. U.S. Army Corps of Engineers, Vicksburg, MS.

SDRWQCB (San Diego Regional Water Quality Control Board). 2013. Order No. R9-2013-0001. NPDES No. CAS0109266. 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. June 27, 2013.

SWAMP (Surface Water Ambient Monitoring Program) Quality Assurance Team. 2008. The State of California's Surface Water Ambient Monitoring Program Quality Assurance Program Plan. September 1, 2008.

SWRCB (State Water Resources Control Board) – CA EPA (California Environmental Protection Agency). 2009. *Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality*. August 25, 2009.

USEPA (United States Environmental Protection Agency). 1994. *Methods for Assessing Toxicity of Sediment-Associated Contaminants With Estuarine and Marine Amphipods*. EPA/600/R-94/025. EPA Office of Research and Development, Narragansett, Rhode Island. June 1994.

USEPA (United States Environmental Protection Agency). 1995. *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms*. EPA/600/R-95/136. EPA Office of Research and Development.

WESTON (Weston Solutions, Inc.). 2013. *San Diego County Municipal Copermittees Bight 2013 Workplan*. Prepared for the County of San Diego Municipal Copermittees. July 25, 2013.

WESTON (Weston Solutions, Inc.). 2014. *San Diego County Municipal Copermittees 2014 Sampling and Analysis Plan for Bight '13 Follow-up Investigations*. Prepared for the County of San Diego Municipal Copermittees. May 2014.

CALIFORNIA

Water Boards

STATE WATER RESOURCES CONTROL BOARD

REGIONAL WATER QUALITY CONTROL BOARDS

WATER QUALITY CONTROL PLAN
FOR ENCLOSED BAYS AND ESTUARIES
- PART 1 SEDIMENT QUALITY

Effective August 25, 2009

STATE WATER RESOURCES CONTROL BOARD

California Environmental Protection Agency

History of Plan
Adopted by the State Water Resources Control Board on September 16, 2008
Approved by the Office of Administrative Law on January 5, 2009
Approved by the U. S. Environmental Protection Agency on August 25, 2009

Prepared by
Chris Beegan, Ocean Unit, Division of Water Quality

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 2008-0070

ADOPTION OF A WATER QUALITY CONTROL PLAN FOR
ENCLOSED BAYS AND ESTUARIES – PART 1 SEDIMENT QUALITY

WHEREAS:

1. California Water Code section 13393 requires the State Water Resources Control Board (State Water Board) to develop sediment quality objectives for toxic pollutants for California's enclosed bays and estuaries.

2. In 1991, the State Water Board adopted a workplan for the development of sediment quality objectives for California's enclosed bays and estuaries (1991 Workplan).

3. Due to funding constraints, the State Water Board did not implement the 1991 Workplan; consequently, litigation by environmental interests against the State Water Board ensued.

4. In August 2001, the Sacramento County Superior Court ruled against the state and ordered the State Water Board to initiate development of sediment quality objectives. On May 21, 2003, the State Water Board adopted a revised workplan.

5. Based upon the scope of work in the revised workplan, staff developed narrative sediment quality objectives to protect benthic communities, which utilize an approach based upon multiple lines of evidence.

6. Narrative sediment quality objectives have also been developed to protect human health from exposure to contaminants in fish tissue.

7. Staff also developed an implementation program for the narrative sediment quality objectives based upon input from the Scientific Steering Committee, Sediment Quality Advisory Committee, and staff of the State Water Board and the Regional Water Quality Control Boards (Regional Water Boards), and staff from other state and federal agencies. The work that has been completed, to date, is Phase 1 of the sediment quality objectives program.

8. The State Water Board recognizes this effort is an iterative process. Staff additionally have initiated a second phase of the sediment quality objectives program (Phase 2), which includes extensive sediment sampling in the Delta; further development of the estuarine chemistry, sediment toxicity, and benthic community indicators; and completion of a more prescriptive framework to address human health and exposure to contaminants in fish tissue. The tools, indicators, and framework developed under Phase 2 will be adopted into the draft plan in 2010. Phase 3 is proposed as the development, within available resources, of a

framework to protect fish and/or wildlife from the effects of pollutants in sediment. During Phases 2 and 3, staff would continue to evaluate the tools developed during the initial phase and the implementation language. As the Water Boards experience grows, the draft plan would be updated and amended as necessary to more effectively interpret and implement the narrative objectives.

9. In the process of developing SQOs, the State Water Board has identified the need to address statewide consistency in the regulation of dredging activities under the water quality certification program. While this issue is outside the scope of this plan, the State Water Board will consider initiating policy development in the future to address regulation of dredging activities under the water quality certification program.

10. The State Water Board's Clean Water Act section 303(d) listing policy was adopted prior to the development of SQOs and without the benefit of the scientific evidence supporting their development. The State Water Board recognizes the need to ensure that the listing policy and this plan are consistent. The State Water Board will, therefore, consider amending the 303(d) listing policy in the future to ensure consistency with this plan.

11. Staff has responded to significant verbal and written comments received from the public and made minor revisions to the draft plan in response to the comments.

12. In adopting this draft plan, the State Water Board has considered the requirements in Water Code section 13393. In particular, the sediment quality objectives are based on scientific information, including chemical monitoring, bioassays, and established modeling procedures; and the objectives provide adequate protection for the most sensitive aquatic organisms. In addition, sediment quality objectives for the protection of human health from contaminants in fish tissue are based on a health risk assessment.

13. As required by Water Code section 13393, the State Water Board has followed the procedures for adoption of water quality control plans in Water Code sections 13240 through 13247, in adopting this draft plan. In addition to the procedural requirements, the State Water Board has considered the substantive requirements in Water Code sections 13241 and 13242. The State Water Board has considered the past, present, and probable future beneficial uses of estuarine and bay waters that can be impacted by toxic pollutants in sediments; environmental characteristics of these waters; water quality conditions that can reasonably be achieved through the control of all factors affecting sediment quality; and economic considerations. Adoption of this draft plan is unlikely to affect housing needs or the development or use of recycled water. Further, the State Water Board has developed an implementation program to achieve the sediment quality objectives, which describes actions to be taken to achieve the objectives and monitoring to determine compliance with the objectives. Time schedules to achieve the objectives will be developed on a case-by-case basis by the appropriate Regional Water Board.

14. This draft plan is consistent with the state and federal antidegradation policies (State Water Board Resolution No. 68-16 and 40 C.F.R. Section 131.12, respectively). No lowering of water quality is anticipated to result from adoption of the draft plan. The draft plan contains scientifically-defensible sediment quality objectives for bays and estuaries, which can be consistently applied statewide to assess sediment quality, regulate waste discharges that can impact sediment quality, and provide the basis for appropriate remediation activities, where necessary. Adoption of the draft plan should result in improved sediment quality.

15. The Resources Agency has approved the State and Regional Water Boards' planning process as a "certified regulatory program" that adequately satisfies the California Environmental Quality Act (CEQA) requirements for preparing environmental documents. State Water Board staff has prepared a "substitute environmental document" for this project that contains the required environmental documentation under the State Water Board's CEQA regulations. (California Code of Regulations, title 23, section 3777.) The substitute environmental documents include the "Draft Staff Report – Water Quality Control Plan for Enclosed Bays and Estuaries, Part 1. Sediment Quality," the environmental checklist, the comments and responses to comments, the plan itself, and this resolution. The project is the adoption of sediment quality objectives and an implementation program, as Part 1 of the Water Quality Control Plan for Enclosed Bays and Estuaries.

16. CEQA scoping hearings were conducted on October 23, 2006 in San Diego, California, on November 8, 2006 in Oakland, California, and on November 28, 2006 in Rancho Cordova, California.

17. On September 26, 2007, staff circulated the draft plan – Part 1 Sediment Quality for public comment.

18. On November 19, 2007, the State Water Board conducted a public hearing on the draft plan and supporting Draft Staff Report and Substitute Environmental Document. Written comments were received through November 30, 2007.

19. The State Water Board adopted the Plan on February 19, 2008, and submitted it to the Office of Administrative Law (OAL) on February 29, 2008. Review by OAL revealed that the statutorily-required newspaper notification of the November 2007 hearing had not occurred. The State Water Board has, therefore, noticed and conducted a new public hearing for the draft plan on September 16, 2008.

20. In preparing the substitute environmental documents, the State Water Board has considered the requirements of Public Resources Code section 21159 and California Code of Regulations, title 14, section 15187, and intends these documents to serve as a Tier 1 environmental review. The State Water Board has considered the reasonably foreseeable consequences of adoption of the draft plan; however, project level impacts may need to be considered in any subsequent environmental analysis performed by lead agencies, pursuant to Public Resources Code section 21159.1.

21. Consistent with CEQA, the substitute environmental documents do not engage in speculation or conjecture but, rather, analyze the reasonably foreseeable environmental impacts related to methods of compliance with the draft plan, reasonably foreseeable mitigation measures to reduce those impacts, and reasonably feasible alternatives means of compliance that would avoid or reduce the identified impacts.

22. The draft plan could have a potentially significant adverse effect on the environment. However, there are feasible alternatives or feasible mitigation measures that, if employed, would reduce the potentially significant adverse impacts identified in the substitute environmental documents to less than significant levels. These alternatives or mitigation measures are within the responsibility and jurisdiction of other public agencies. When the sediment quality objectives are implemented on a project-specific basis, the agencies responsible for the project can and should incorporate the alternatives or mitigation measures into any subsequent project or project approvals.

23. From a program-level perspective, incorporation of the mitigation measures described in the substitute environmental documents will foreseeably reduce impacts to less than significant levels.

24. The substitute environmental documents for this draft plan identify broad mitigation approaches that should be considered at the project level.

25. Pursuant to Health and Safety Code section 57400, the draft Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality has undergone external peer review through an interagency agreement with the University of California.

26. This draft plan must be submitted for review and approval to the State Office of Administrative Law (OAL) and the United States Environmental Protection Agency (USEPA). The draft plan will become effective upon approval by OAL and USEPA.

27. If, during the OAL approval process, OAL determines that minor, non-substantive modifications to the language of the draft plan are needed for clarity or consistency, the Executive Director or designee may make such changes consistent with the State Water Board's intent in adopting this draft plan, and shall inform the State Water Board of any such changes.

THEREFORE BE IT RESOLVED THAT:

The State Water Board:

1. Approves and adopts the CEQA substitute environmental documentation, including all findings contained in the documentation, which was prepared in accordance with Public Resources Code section 21159 and California Code of

Regulations, Title 14, section 15187, and directs the Executive Director or designee to sign the environmental checklist;

2. After considering the entire record, including oral testimony at the public hearing, hereby adopts the proposed Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality;

3. Directs staff to submit the administrative record to OAL for review and approval; and

4. If, during the OAL approval process, OAL determines that minor, non-substantive modifications to the language of the draft plan are needed for clarity or consistency, directs the Executive Director or designee to make such changes and inform the State Water Board of any such changes.

5. Directs staff to initiate appropriate proceedings to amend the section 303(d) listing policy by February 2009.

CERTIFICATION

The undersigned Acting Clerk to the Board does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on September 16, 2008.

AYE: Chair Tam M. Doduc
Arthur G. Baggett, Jr.
Charles R. Hoppin
Frances Spivy-Weber

NAY: None

ABSENT: Vice Chair Gary Wolff, P.E., Ph.D

ABSTAIN: None

Jeanine Townsend

Jeanine Townsend
Clerk to the Board

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

ATTACHMENTS

I. INTENT AND SUMMARY

A. INTENT OF PART 1 OF THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES (PART 1)

It is the goal of the State Water Resources Control Board (State Water Board) to comply with the legislative directive in Water Code §13393 to adopt sediment quality objectives (SQOs). Part 1 integrates chemical and biological measures to determine if the sediment dependent biota are protected or degraded as a result of exposure to toxic pollutants* in sediment and to protect human health. Part 1 is not intended to address low dissolved oxygen, pathogens or nutrients including ammonia. Part 1 represents the first phase of the State Water Board's SQO development effort and focuses primarily on the protection of benthic* communities in enclosed bays* and estuaries*. The State Water Board has committed in the second phase to the refinement of benthic community protection indicators for estuarine waters and the development of an improved approach to address sediment quality related human health risk associated with consumption of fish tissue.

B. SUMMARY OF PART 1

Part 1 includes**:**

1. Narrative SQOs for the protection of aquatic life and human health;
2. Identification of the beneficial uses that these objectives are intended to protect;
3. A program of implementation that contains:
    a. Specific indicators, tools and implementation provisions to determine if the sediment quality at a station or multiple stations meets the narrative objectives;
    b. A description of appropriate monitoring programs; and
    c. A sequential series of actions that shall be initiated when a sediment quality objective is not met including stressor identification and evaluation of appropriate targets.
4. A glossary that defines all terms denoted by an asterisk

II. USE AND APPLICABILITY OF SQOS

A. AMBIENT SEDIMENT QUALITY

The SQOs and supporting tools shall be utilized to assess ambient sediment quality.

B. RELATIONSHIP TO OTHER NARRATIVE OBJECTIVES

1. Except as provided in 2 below, Part 1 supersedes all applicable narrative water quality objectives and related implementation provisions in water quality control plans (basin plans) to the extent that the objectives and provisions are applied to protect bay or estuarine benthic communities from toxic pollutants in sediments.
2. The supersession provision in 1. above does not apply to existing sediment cleanup activities where a site assessment was completed and submitted to the Regional Water Board by February 19, 2008.

C. APPLICABLE WATERS

Part 1 applies to enclosed bays[1] and estuaries[2] only. Part 1 does not apply to ocean waters* including Monterey Bay and Santa Monica Bay, or inland surface waters*.

D. APPLICABLE SEDIMENTS

Part 1 applies to subtidal surficial sediments* that have been deposited or emplaced seaward of the intertidal zone. Part 1 does not apply to:

1. Sediments characterized by less than five percent of fines or substrates composed of gravels, cobbles, or consolidated rock.
2. Sediment as the physical pollutant that causes adverse biological response or community degradation related to burial, deposition, or sedimentation.

E. APPLICABLE DISCHARGES

Part 1 is applicable in its entirety to point source* discharges. Nonpoint sources* of toxic pollutants are subject to Sections II, III, IV, V, and VI of Part 1.

III. BENEFICIAL USES

Beneficial uses protected by Part 1 and corresponding target receptors are identified in Table 1.

Table 1. Beneficial Uses and Target Receptors

Beneficial Uses	Target Receptors
Estuarine Habitat	Benthic Community
Marine Habitat	Benthic Community
Commercial and Sport Fishing	Human Health
Aquaculture	Human Health
Shellfish Harvesting	Human Health

[1] ENCLOSED BAYS are indentations along the coast which enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. This definition includes, but is not limited to: Humboldt Bay, Bodega Harbor, Tomales Bay, Drakes Estero, San Francisco Bay, Morro Bay, Los Angeles Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay.

[2] ESTUARIES AND COASTAL LAGOONS are waters at the mouths of streams that serve as mixing zones for fresh and ocean waters during a major portion of the year. Mouths of streams that are temporarily separated from the ocean by sandbars shall be considered as estuaries. Estuarine waters will generally be considered to extend from a bay or the open ocean to the upstream limit of tidal action but may be considered to extend seaward if significant mixing of fresh and salt water occurs in the open coastal waters. The waters described by this definition include, but are not limited to, the Sacramento-San Joaquin Delta as defined by Section 12220 of CWC, Suisun Bay, Carquinez Strait downstream to Carquinez Bridge, and appropriate areas of the Smith, Klamath, Mad, Eel, Noyo, and Russian Rivers.

IV. SEDIMENT QUALITY OBJECTIVES

A. AQUATIC LIFE – BENTHIC COMMUNITY PROTECTION

Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California. This narrative objective shall be implemented using the integration of multiple lines of evidence (MLOE) as described in Section V of Part 1.

B. HUMAN HEALTH

Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health. This narrative objective shall be implemented as described in Section VI of Part 1.

V. BENTHIC COMMUNITY PROTECTION

A. MLOE APPROACH TO INTERPRET THE NARRATIVE OBJECTIVE

The methods and procedures described below shall be used to interpret the Narrative Objective described in Section IV.A. These tools are intended to assess the condition of benthic communities relative to potential for exposure to toxic pollutants in sediments. Exposure to toxic pollutants at harmful levels will result in some combination of a degraded benthic community, presence of toxicity, and elevated concentrations of pollutants in sediment. The assessment of sediment quality shall consist of the measurement and integration of three lines of evidence (LOE). The LOE are:

- ***Sediment Toxicity***—Sediment toxicity is a measure of the response of invertebrates exposed to surficial sediments under controlled laboratory conditions. The sediment toxicity LOE is used to assess both pollutant related biological effects and exposure. Sediment toxicity tests are of short durations and may not duplicate exposure conditions in natural systems. This LOE provides a measure of exposure to all pollutants present, including non-traditional or unmeasured chemicals.
- ***Benthic Community Condition***—Benthic community condition is a measure of the species composition, abundance and diversity of the sediment-dwelling invertebrates inhabiting surficial sediments*. The benthic community LOE is used to assess impacts to the primary receptors targeted for protection under Section IV.A. Benthic community composition is a measure of the biological effects of both natural and anthropogenic stressors.
- ***Sediment Chemistry***—Sediment chemistry is the measurement of the concentration of chemicals of concern* in surficial sediments. The chemistry LOE is used to assess the potential risk to benthic organisms from toxic pollutants in surficial sediments. The sediment chemistry LOE is intended only to evaluate overall exposure risk from chemical pollutants. This LOE does not establish causality associated with specific chemicals.

B. LIMITATIONS

None of the individual LOE is sufficiently reliable when used alone to assess sediment quality impacts due to toxic pollutants. Within a given site, the LOEs applied to assess exposure as described in Section V.A. may underestimate or overestimate the risk to benthic communities and do not indicate causality of specific chemicals. The LOEs applied to assess biological effects can respond to stresses associated with natural or physical factors, such as sediment grain size, physical disturbance, or organic enrichment.

Each LOE produces specific information that, when integrated with the other LOEs, provides a more confident assessment of sediment quality relative to the narrative objective. When the exposure and effects tools are integrated, the approach can quantify protection through effects measures and also provide predictive capability through the exposure assessment.

C. WATER BODIES

1. The tools described in the Sections V.D. through V.I. are applicable to Euhaline* Bays and Coastal Lagoons* south of Point Conception and Polyhaline* San Francisco Bay that includes the Central and South Bay Areas defined in general by waters south and west of the San Rafael Bridge and north of the Dumbarton Bridge.
2. For all other bays and estuaries where LOE measurement tools are unavailable, station assessment will follow the procedure described in Section V.J.

D. FIELD PROCEDURES

1. All samples shall be collected using a grab sampler.
2. Benthic samples shall be screened through:
   a. A 0.5 millimeter (mm)-mesh screen in San Francisco Bay and the Sacramento-San Joaquin Delta;
   b. A 1.0 mm-mesh screen in all other locations.
3. Surface sediment from within the upper 5 cm shall be collected for chemistry and toxicity analyses.
4. The entire contents of the grab sample, with a minimum penetration depth of 5 cm, shall be collected for benthic community analysis.
5. Bulk sediment chemical analysis will include at a minimum the pollutants identified in Attachment A.

E. LABORATORY TESTING

All samples will be tested in accordance with U.S. Environmental Protection Agency (USEPA) or American Society for Testing and Materials (ASTM) methodologies where such methods exist. Where no EPA or ASTM methods exist, the State Water Board or Regional Water Quality Control Boards (Regional Water Boards) (collectively Water Boards) shall approve the use of other methods. Analytical tests shall be conducted by laboratories certified by the California Department of Health Services in accordance with Water Code Section 13176.

F. SEDIMENT TOXICITY

1. Short Term Survival Tests—A minimum of one short-term survival test shall be performed on sediment collected from each station. Acceptable test organisms and methods are summarized in Table 2.

Table 2. Acceptable Short Term Survival Sediment Toxicity Test Methods

Test Organism	Exposure Type	Duration	Endpoint*
Eohaustorius estuarius	Whole Sediment	10 days	Survival
Leptocheirus plumulosus	Whole Sediment	10 days	Survival
Rhepoxynius abronius	Whole Sediment	10 days	Survival

2. Sublethal Tests—A minimum of one sublethal test shall be performed on sediment collected from each station. Acceptable test organisms and methods are summarized in Table 3.

Table 3. Acceptable Sublethal Sediment Toxicity Test Methods

Test Organism	Exposure Type	Duration	Endpoint
Neanthes arenaceodentata	Whole Sediment	28 days	Growth
Mytilus galloprovincialis	Sediment-water Interface	48 hour	Embryo Development

3. Assessment of Sediment Toxicity—Each sediment toxicity test result shall be compared and categorized according to responses in Table 4. The response categories are:
   a. Nontoxic—Response not substantially different from that expected in sediments that are uncontaminated and have optimum characteristics for the test species (e.g., control sediments).
   b. Low toxicity—A response that is of relatively low magnitude; the response may not be greater than test variability.
   c. Moderate toxicity—High confidence that a statistically significant toxic effect is present.
   d. High toxicity—High confidence that a toxic effect is present and the magnitude of response includes the strongest effects observed for the test.

Table 4. Sediment Toxicity Categorization Values

Test Species/ Endpoint	Statistical Significance	Nontoxic (Percent)	Low Toxicity (Percent of Control)	Moderate Toxicity (Percent of Control)	High Toxicity (Percent of Control)
Eohaustorius Survival	Significant	90 to 100	82 to 89	59 to 81	< 59
Eohaustorius Survival	Not Significant	82 to 100	59 to 81		<59
Leptocheirus Survival	Significant	90 to 100	78 to 89	56 to 77	<56
Leptocheirus Survival	Not Significant	78 to 100	56 to 77		<56
Rhepoxynius Survival	Significant	90 to 100	83 to 89	70 to 82	< 70
Rhepoxynius Survival	Not Significant	83 to 100	70 to 82		< 70
Neanthes Growth	Significant	90 to 100*	68 to 90	46 to 67	<46
Neanthes Growth	Not Significant	68 to 100	46 to 67		<46
Mytilus Normal	Significant	80 to 100	77 to 79	42 to 76	< 42
Mytilus Normal	Not Significant	77 to 79	42 to 76		< 42

* Expressed as a percentage of the control.

4. Integration of Sediment Toxicity Categories—The average of all test response categories shall determine the final toxicity LOE category. If the average falls midway between categories it shall be rounded up to the next higher response category.

G. BENTHIC COMMUNITY CONDITION

1. General Requirements.
   a. All benthic invertebrates in the screened sample shall be identified to the lowest possible taxon and counted.
   b. Taxonomic nomenclature shall follow current conventions established by local monitoring programs and professional organizations (e.g., master species list).
2. Benthic Indices—The benthic condition shall be assessed using the following methods:
   a. Benthic Response Index (BRI), which was originally developed for the southern California mainland shelf and extended into California's bays and estuaries. The BRI is the abundance-weighted average pollution* tolerance score of organisms occurring in a sample.
   b. Index of Biotic Integrity (IBI), which was developed for freshwater streams and adapted for California's bays and estuaries. The IBI identifies community measures that have values outside a reference range.
   c. Relative Benthic Index (RBI), which was developed for embayments in California's Bay Protection and Toxic Cleanup Program. The RBI is the weighted sum of: (a) several community parameters (total number of species, number of crustacean species, number of crustacean individuals, and number of mollusc species), and abundances of (b) three positive, and (c) two negative indicator species.
   d. River Invertebrate Prediction and Classification System (RIVPACS), which was originally developed for British freshwater streams and adapted for California's bays and estuaries. The approach compares the assemblage at a site with an expected species composition determined by a multivariate predictive model that is based on species relationships to habitat gradients.
3. Assessment of Benthic Community Condition—Each benthic index result shall be categorized according to disturbance as described in Table 5. The disturbance categories are:
   a. Reference—A community composition equivalent to a least affected or unaffected site.
   b. Low disturbance— A community that shows some indication of stress, but could be within measurement error of unaffected condition.
   c. Moderate disturbance—Confident that the community shows evidence of physical, chemical, natural, or anthropogenic stress.
   d. High disturbance—The magnitude of stress is high.
4. Integration of Benthic Community Categories—The median of all benthic index response categories shall determine the benthic condition LOE category. If the median falls between categories it shall be rounded up to the next higher effect category.

Table 5. Benthic Index Categorization Values

Index	Reference	Low Disturbance	Moderate Disturbance	High Disturbance
Southern California Marine Bays				
BRI	< 39.96	39.96 to 49.14	49.15 to 73.26	> 73.26
IBI	0	1	2	3 or 4
RBI	> 0.27	0.17 to 0.27	0.09 to 0.16	< 0.09
RIVPACS	> 0.90 to < 1.10	0.75 to 0.90 or 1.10 to 1.25	0.33 to 0.74 or > 1.25	< 0.33
Polyhaline Central San Francisco Bay				
BRI	< 22.28	22.28 to 33.37	33.38 to 82.08	> 82.08
IBI	0 or 1	2	3	4
RBI	> 0.43	0.30 to 0.43	0.20 to 0.29	< 0.20
RIVPACS	> 0.68 to < 1.32	0.33 to 0.68 or 1.32 to 1.67	0.16 to 0.32 or > 1.67	< 0.16

H. SEDIMENT CHEMISTRY

1. All samples shall be tested for the analytes identified in Attachment A—This list represents the minimum analytes required to assess exposure. In water bodies where other toxic pollutants are believed to pose risk to benthic communities, those toxic pollutants shall be included in the analysis. Inclusion of additional analytes cannot be used in the exposure assessment described below. However, the data can be used to conduct more effective stressor identification studies as described in Section VII. F.
2. Sediment Chemistry Guidelines—The sediment chemistry exposure shall be assessed using the following two methods:
   a. Chemical Score Index (CSI), that uses a series of empirical thresholds to predict the benthic community disturbance category (score) associated with the concentration of various chemicals (Table 6). The CSI is the weighted sum of the individual scores (Equation 1).

      Equation 1. $CSI = \Sigma(w_i \times cat_i)/\Sigma w$

      Where: cat_i = predicted benthic disturbance category for chemical I;
      w_i = weight factor for chemical I;
      Σw = sum of all weights.

   b. California Logistic Regression Model (CA LRM), that uses logistic regression models to predict the probability of sediment toxicity associated with the concentration of various chemicals (Table 7 and Equation 2). The CA LRM exposure value is the maximum probability of toxicity from the individual models (P_{max})

      Equation 2. $\boldsymbol{p} = e^{B0+B1\,(x)} / (1 + e^{B0+B1\,(x)})$

      Where: $\boldsymbol{p}$ = probability of observing a toxic effect;
      B0 = intercept parameter;
      B1 = slope parameter; and
      x = concentration the chemical.

Table 6. Category Score Concentration Ranges and Weighting Factors for the CSI

Chemical	Units	Weight	Score (Disturbance Category)			
			1 Reference	2 Low	3 Moderate	4 High
Copper	mg/kg	100	≤52.8	> 52.8 to 96.5	> 96.5 to 406	> 406
Lead	mg/kg	88	≤ 26.4	> 26.4 to 60.8	> 60.8 to 154	> 154
Mercury	mg/kg	30	≤ 0.09	> 0.09 to 0.45	> 0.45 to 2.18	> 2.18
Zinc	mg/kg	98	≤ 112	> 112 to 200	> 200 to 629	> 629
PAHs, total high MW	µg/kg	16	≤ 312	> 312 to 1325	> 1325 to 9320	>9320
PAHs, total low MW	µg/kg	5	≤ 85.4	> 85.4 to 312	> 312 to 2471	> 2471
Chlordane, alpha-	µg/kg	55	≤ 0.50	> 0.50 to 1.23	> 1.23 to 11.1	>11.1
Chlordane, gamma-	µg/kg	58	≤ 0.54	> 0.54 to 1.45	> 1.45 to 14.5	> 14.5
DDDs, total	µg/kg	46	≤ 0.50	> 0.50 to 2.69	> 2.69 to 117	> 117
DDEs, total	µg/kg	31	≤ 0.50	> 0.50 to 4.15	> 4.15 to 154	> 154
DDTs, total	µg/kg	16	≤ 0.50	> 0.50 to 1.52	> 1.52 to 89.3	> 89.3
PCBs, total	µg/kg	55	≤11.9	> 11.9 to 24.7	> 24.7 to 288	> 288

Table 7. CA LRM Regression Parameters

Chemical	Units	B0	B1
Cadmium	mg/kg	0.29	3.18
Copper	mg/kg	-5.59	2.59
Lead	mg/kg	-4.72	2.84
Mercury	mg/kg	-0.06	2.68
Zinc	mg/kg	-5.13	2.42
PAHs, total high MW	µg/kg	-8.19	2.00
PAHs, total low MW	µg/kg	-6.81	1.88
Chlordane, alpha	µg/kg	-3.41	4.46
Dieldrin	µg/kg	-1.83	2.59
Trans nonachlor	µg/kg	-4.26	5.31
PCBs, total	µg/kg	-4.41	1.48
p,p' DDT	µg/kg	-3.55	3.26

3. Assessment of Sediment Chemistry Exposure—Each sediment chemistry guideline result shall be categorized according to exposure as described in Table 8. The exposure categories are:
   a. Minimal exposure—Sediment-associated contamination* may be present, but exposure is unlikely to result in effects.
   b. Low exposure—Small increase in pollutant exposure that may be associated with increased effects, but magnitude or frequency of occurrence of biological impacts is low.
   c. Moderate exposure—Clear evidence of sediment pollutant exposure that is likely to result in biological effects; an intermediate category.
   d. High exposure—Pollutant exposure highly likely to result in possibly severe biological effects; generally present in a small percentage of the samples.

Table 8. Sediment Chemistry Guideline Categorization Values

Guideline	Minimal Exposure	Low Exposure	Moderate Exposure	High Exposure
CSI	< 1.69	1.69 to 2.33	2.34 to 2.99	>2.99
CA LRM	< 0.33	0.33 to 0.49	0.50 to 0.66	> 0.66

4. Integration of Sediment Chemistry Categories—The average of all chemistry exposure categories shall determine the final sediment chemistry LOE category. If the average falls midway between categories it shall be rounded up to the next higher exposure category.

I. INTERPRETATION AND INTEGRATION OF MLOE

Assessment as to whether the aquatic life sediment quality objective has been attained at a station is accomplished by the interpretation and integration of MLOE. The categories assigned to the three LOE, sediment toxicity, benthic community condition and sediment chemistry are evaluated to determine the station level assessment. The assessment category represented by each of the possible MLOE combinations reflects the presence and severity of two characteristics of the sample: severity of biological effects, and potential for chemically-mediated effects.

1. Severity of Biological Effects—The severity of biological effects present at a site shall be determined by the integration of the toxicity LOE and benthic condition LOE categories using the decision matrix presented in Table 9.
2. Potential for Chemically-Mediated Effects—The potential for effects to be chemically-mediated shall be determined by the integration of the toxicity LOE and chemistry LOE categories using the decision matrix presented in Table 10.

Table 9. Severity of Biological Effects Matrix

		Toxicity LOE Category			
		Nontoxic	Low Toxicity	Moderate Toxicity	High Toxicity
Benthic Condition LOE Category	Reference	Unaffected	Unaffected	Unaffected	Low Effect
	Low Disturbance	Unaffected	Low Effect	Low Effect	Low Effect
	Moderate Disturbance	Moderate Effect	Moderate Effect	Moderate Effect	Moderate Effect
	High Disturbance	Moderate Effect	High Effect	High Effect	High Effect

Table 10. Potential for Chemically Mediated Effects Matrix

		Toxicity LOE Category			
		Nontoxic	Low Toxicity	Moderate Toxicity	High Toxicity
Sediment Chemistry LOE Category	Minimal Exposure	Minimal Potential	Minimal Potential	Low Potential	Moderate Potential
	Low Exposure	Minimal Potential	Low Potential	Moderate Potential	Moderate Potential
	Moderate Exposure	Low Potential	Moderate Potential	Moderate Potential	Moderate Potential
	High Exposure	Moderate Potential	Moderate Potential	High Potential	High Potential

3. Station Level Assessment—The station level assessment shall be determined using the decision matrix presented in Table 11. This assessment combines the intermediate classifications for severity of biological effect and potential for chemically-mediated effect to result in six categories of impact at the station level:
   a. Unimpacted—Confident that sediment contamination is not causing significant adverse impacts to aquatic life living in the sediment at the site.
   b. Likely Unimpacted—Sediment contamination at the site is not expected to cause adverse impacts to aquatic life, but some disagreement among the LOE reduces certainty in classifying the site as unimpacted.
   c. Possibly Impacted—Sediment contamination at the site may be causing adverse impacts to aquatic life, but these impacts are either small or uncertain because of disagreement among LOE.
   d. Likely Impacted—Evidence for a contaminant-related impact to aquatic life at the site is persuasive, even if there is some disagreement among LOE.
   e. Clearly Impacted—Sediment contamination at the site is causing clear and severe adverse impacts to aquatic life.
   f. Inconclusive—Disagreement among the LOE suggests that either the data are suspect or that additional information is needed before a classification can be made.

Table 11. Station Assessment Matrix

		Severity of Effect			
		Unaffected	Low Effect	Moderate Effect	High Effect
Potential For Chemically-Mediated Effects	Minimal Potential	Unimpacted	Likely Unimpacted	Likely Unimpacted	Inconclusive
	Low Potential	Unimpacted	Likely Unimpacted	Possibly Impacted	Possibly Impacted
	Moderate Potential	Likely Unimpacted	Possibly Impacted or Inconclusive[1]	Likely Impacted	Likely Impacted
	High Potential	Inconclusive	Likely Impacted	Clearly Impacted	Clearly Impacted

[1]Inconclusive category when chemistry is classified as minimal exposure, benthic response is classified as reference, and toxicity response is classified as high.

The station assessment resulting from each possible combination of the three LOEs is shown in Attachment B. As an alternative to Tables 9, 10 and 11, each LOE category can be applied to Attachment B to determine the overall condition of the station. The results will be the same regardless of the tables used.

4. Relationship to the Aquatic Life – Benthic Community Protection Narrative Objective.

   a. The categories designated as **Unimpacted** and **Likely Unimpacted** shall be considered as achieving the protective condition at the station. All other categories shall be considered as degraded except as provided in b. below.

   b. The Water Board shall designate the category **Possibly Impacted** as meeting the protective condition if the studies identified in Section VII.F demonstrate that the combination of effects and exposure measures are not responding to toxic pollutants in sediments and that other factors are causing these responses within a specific reach segment or waterbody. In this situation, the Water Board will consider only the Categories **Likely Impacted** and **Clearly Impacted** as degraded when making a determination on receiving water limits and impaired water bodies described in Section VII.

J. MLOE Approach to Interpret the Narrative Objective in Other Bays and Estuaries

Station assessments for waterbodies identified in Section V.C.2. will be conducted using the same conceptual approach and similar tools to those described in Sections V.D-H. Each LOE will be evaluated by measuring a set of readily available indicators in accordance with Tables 12 and 13.

1. Station assessment shall be consistent with the following key principles of the assessment approach described in Sections V.D. through V.I:

   a. Results for a single LOE shall not be used as the basis for an assessment.

   b. Evidence of both elevated chemical exposure and biological effects must be present to indicate pollutant-associated impacts.

   c. The categorization of each LOE shall be based on numeric values or a statistical comparison.

2. Lines of Evidence and Measurement Tools—Sediment chemistry, toxicity, and benthic community condition shall be measured at each station. Table 12 lists the required tools for evaluation of each LOE. Each measurement shall be conducted using standardized methods (e.g., EPA or ASTM guidance) where available.

3. Categorization of LOEs—Determination of the presence of an LOE effect (i.e., biologically significant chemical exposure, toxicity, or benthic community disturbance) shall be based on a comparison to a numeric response value or a statistical comparison to reference stations. The numeric values or statistical comparisons (e.g., confidence interval) used to classify a LOE as Effected shall be comparable to those specified in Sections V.F-H. to indicate High Chemical Exposure, High Toxicity, or High Disturbance. Reference stations shall be located in an area expected to be uninfluenced by the discharge or pollutants of concern in the assessment area and shall be representative of other habitat characteristics of the assessment area (e.g., salinity, grain size). Comparison to reference shall be accomplished by compiling data for appropriate regional reference sites and determining the reference envelope using statistical methods (e.g., tolerance interval).

Table 12. Tools for Use in Evaluation of LOEs

LOE	Tools	Metrics
Chemistry	Bulk sediment chemistry to include existing list (Attachment A) plus other chemicals of concern	CA LRM P_{max} Concentration on a dry weight basis
Sediment Toxicity	10-Day amphipod survival using a species tolerant of the sample salinity and grain size characteristics. e.g., ***Hyalella azteca*** or ***Eohaustorius estuarius***	Percent of control survival
Benthic Community Condition	Invertebrate species identification and abundance	Species richness* Presence of sensitive indicator taxa Dominance by tolerant indicator taxa Presence of diverse functional and feeding groups Total abundance

Table 13. Numeric Values and Comparison Methods for LOE Categorization

Metric	Threshold value or Comparison
CA LRM	Pmax > 0.66
Chemical Concentration	Greater than reference range or interval
Percent of Control Survival	***E. estuarius***: < 59 ***H. azteca***: < 62 or SWAMP criterion
Species Richness	Less than reference range or interval
Abundance of Sensitive Indicator Taxa	Less than reference range or interval
Abundance of Tolerant Indicator Taxa	Greater than reference range or interval
Total Abundance	Outside of reference range or interval

4. Station Level Assessment—The station level assessment shall be determined using the decision matrix presented in Table 14. This assessment combines the classifications for each LOE to result in two categories of impact at the station level:
   a. Unimpacted—No conclusive evidence of both high pollutant exposure and high biological effects present at the site. Evidence of chemical exposure and biological effects may be within natural variability or measurement error.
   b. Impacted—Confident that sediment contamination present at the site is causing adverse direct impacts to aquatic life.

Table 14. Station Assessment Matrix for Other Bays and Estuaries

Chemistry LOE Category	Toxicity LOE Category	Benthic Condition LOE Category	Station Assessment
No effect	No effect	No effect	Unimpacted
No effect	No effect	Effect	Unimpacted
No effect	Effect	No effect	Unimpacted
No effect	Effect	Effect	Impacted
Effect	No effect	No effect	Unimpacted
Effect	No effect	Effect	Impacted
Effect	Effect	No effect	Impacted
Effect	Effect	Effect	Impacted

5. Relationship to the Aquatic Life – Benthic Community Protection Narrative Objective—The category designated as **Unimpacted** shall be considered as achieving the protective condition at the station.

VI. HUMAN HEALTH

The narrative human health objective in Section IV. B. of this Part 1 shall be implemented on a case-by-case basis, based upon a human health risk assessment. In conducting a risk assessment, the Water Boards shall consider any applicable and relevant information, including California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, Cal/EPA's Department of Toxic Substances Control (DTSC) Risk Assessment, and USEPA Human Health Risk Assessment policies.

VII. PROGRAM OF IMPLEMENTATION

Implementation of Part 1 shall be conducted in accordance with the following provisions and consistent with the process shown in Figures 1 and 2.

A. DREDGE MATERIALS

1. Part 1 shall not apply to dredge material suitability determinations.
2. The Water Boards shall not approve a dredging project that involves the dredging of sediment that exceeds the objectives in Part 1, unless the Water Boards determine that:
   a. The polluted sediment is removed in a manner that prevents or minimizes water quality degradation.
   b. The polluted sediment is not deposited in a location that may cause significant adverse effects to aquatic life, fish, shellfish, or wildlife or may harm the beneficial uses of the receiving waters, or does not create maximum benefit to the people of the State.
   c. The activity will not cause significant adverse impacts upon a federal sanctuary, recreational area, or other waters of significant national importance.

B. NPDES RECEIVING WATER AND EFFLUENT LIMITS

1. If a Water Board determines that discharge of a toxic pollutant to bay or estuarine waters has the reasonable potential to cause or contribute to an exceedance of the SQOs, the Water Board shall apply the objectives as receiving water limits.
2. The Permittee shall be in violation of such limits if it is demonstrated that the discharge is causing or contributing to the SQO exceedance as defined in Section VII.C.
3. Receiving water monitoring required by an NPDES permit may be satisfied by a Permitee's participation in a regional SQO monitoring program described in Section VII.E.
4. The sediment chemistry guidelines shall not be translated into or applied as effluent limits. Effluent limits established to protect or restore sediment quality shall be developed only after:
   a. A clear relationship has been established linking the discharge to the degradation,

b. The pollutants causing or contributing to the degradation have been identified, and

c. Appropriate loading studies have been completed to estimate the reductions in pollutant loading that will restore sediment quality.

These actions are described further in Sections VII.F and VII.G. Nothing in this section shall limit a Water Board's authority to develop and implement waste* load allocations* for Total Maximum Daily Loads. However, it is recommended that the Water Boards develop TMDL allocations using the methodology described herein, wherever possible.

C. EXCEEDANCE OF RECEIVING WATER LIMIT

Exceedance of a receiving water limit is demonstrated when:

1. Using a binomial distribution*, the total number of stations designated as not meeting the protective condition as defined in Sections V.I.4. or V.J.4. supports rejection of the null hypothesis* as presented in Table 15. The stations included in this analysis will be those located in the vicinity of the discharge and identified in the permit, and
2. It is demonstrated that the discharge is causing or contributing to the SQO exceedance, following the completion of the stressor identification studies described in Section VII.F.
3. If studies by the Permittee demonstrate that other sources may also be contributing to the degradation of sediment quality, the Regional Water Board shall, as appropriate, require the other sources to initiate studies to assess the extent to which these sources are a contributing factor.

Table 15. Minimum Number of Measured Exceedances Needed to Exceed the Direct Effects SQO as a Receiving Water Limit

Sample Size	List If the Number of Exceedances Equals or Is Greater Than
2 – 24	2*
25 – 36	3
37 – 47	4
48 – 59	5
60 – 71	6
72 – 82	7
83 – 94	8
95 – 106	9
107 – 117	10
118 – 129	11

Note: Null Hypothesis: Actual exceedance proportion $\leq$ 3 percent. Alternate Hypothesis: Actual exceedance proportion > 18 percent. The minimum effect size* is 15 percent.

*Application of the binomial test requires a minimum sample size of 16. The number of exceedances required using the binomial test at a sample size of 16 is extended to smaller sample sizes.

Exceedance will require the Permittee to perform additional studies as described in Sections VII.F and VII.G.

D. RECEIVING WATER LIMITS MONITORING FREQUENCY

1. Phase I Stormwater Discharges and Major Discharges—Sediment Monitoring shall not be required less frequently than twice per permit cycle. For Stations that are consistently classified as unimpacted or likely unimpacted the frequency may be reduced to once per permit cycle. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase I Stormwater Permitees.
2. Phase II Stormwater and Minor Discharges—Sediment Monitoring shall not be required more often then twice per permit cycle or less then once per permit cycle. For stations that are consistently classified as unimpacted or likely unimpacted, the number of stations monitored may be reduced at the discretion of the Water Board. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase II Stormwater Permitees.
3. Other Regulated Discharges and Waivers—The frequency of the monitoring for receiving water limits for other regulated discharges and waivers will be determined by the Water Board.

E. SEDIMENT MONITORING

1. Objective—Bedded sediments in bays contain an accumulation of pollutants from a wide variety of past and present sources discharged either directly into the bay or indirectly into waters draining into the bay. Embayments also represent highly disturbed or altered habitats as a result of dredging and physical disturbance caused by construction and maintenance of harbor works, boat and ship traffic, and development of adjacent lands. Due to the multitude of stressors and the complexity of the environment, a well-designed monitoring program is necessary to ensure that the data collected adequately characterizes the condition of sediment in these water bodies.
2. Permitted Discharges—Monitoring may be performed by individual Permitees to assess compliance with receiving water limits, or through participation in a regional or water body monitoring coalition as described under VII.E.3, or both as determined by the Water Board.
3. Monitoring Coalitions—To achieve maximum efficiency and economy of resources, the State Water Board encourages the regulated community in coordination with the Regional Water Boards to establish water body-monitoring coalitions. Monitoring coalitions enable the sharing of technical resources, trained personnel, and associated costs and create an integrated sediment-monitoring program within each major water body. Focusing resources on regional issues and developing a broader understanding of pollutants effects in these water bodies enables the development of more rapid and efficient response strategies and facilitates better management of sediment quality.
    a. If a regional monitoring coalition is established, the coalition shall be responsible for sediment quality assessment within the designated water body and for ensuring that appropriate studies are completed in a timely manner.
    b. The Water Board shall provide oversight to ensure that coalition participants are proactive and responsive to potential sediment quality related issues as they arise during monitoring and assessment.
    c. Each regional monitoring coalition shall prepare a workplan that describes the monitoring, a map of the stations, participants and a schedule that shall be submitted to the Water Board for approval.

4. Methods—Sediments collected from each station shall be tested or assessed using the methods and metrics described in Section V.

5. Design.

   a. The design of sediment monitoring programs, whether site-specific or region wide, shall be based upon a conceptual model. A conceptual model is useful for identifying the physical and chemical factors that control the fate and transport of pollutants and receptors that could be exposed to pollutants in the sediment. The conceptual model serves as the basis for assessing the appropriateness of a study design. The detail and complexity of the conceptual model is dependent upon the scope and scale of the monitoring program. A conceptual model shall consider:

      – Points of discharge into the segment of the waterbody or region of interest
      – Tidal flow and/or direction of predominant currents
      – Historic and or legacy conditions in the vicinity
      – Nearby land and marine uses or actions
      – Beneficial uses
      – Potential receptors of concern
      – Changes in grain size salinity water depth and organic matter
      – Other sources or discharges in the immediate vicinity.

   b. Sediment monitoring programs shall be designed to ensure that the aggregate stations are spatially representative of the sediment within the water body.

   c. The design shall take into consideration existing data and information of appropriate quality.

   d. Stratified random design shall be used where resources permit to assess conditions throughout a water body.

   3. Identification of appropriate strata shall consider characteristics of the water body including sediment transport, hydrodynamics, depth, salinity, land uses, inputs (both natural and anthropogenic) and other factors that could affect the physical, chemical, or biological condition of the sediment.

   f. Targeted designs shall be applied to those Permitees that are required to meet receiving water limits as described in Section VII. B.

6. Index Period—All stations shall be sampled between the months of June through September to be consistent with the benthic community condition index period.

7. Regional Monitoring Schedule and Frequency.

   a. Regional sediment quality monitoring will occur at a minimum of once every three years.

   b. Sediments identified as exceeding the narrative objective will be evaluated more frequently.

8. Evaluating Waters for placement on the Section 303(d) list —In California, water segments are placed on the section 303(d) list for sediment toxicity based either on toxicity alone or toxicity that is associated with a pollutant. The listing criteria are contained in the State Water Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (2004)(Listing Policy). Part 1 adds an additional listing criterion that applies only to listings for exceedances of the narrative sediment quality objective for aquatic life protection in Section IV.A. The criterion under Part 1 is described in subsection a. below and the relationship

between the sediment toxicity listing criteria under the Listing Policy and the criterion under Part 1 is described in subsections b. and c., below.

1. Water segments shall be placed on the section 303(d) list for exceedance of the narrative sediment quality objective for aquatic life protection in Section IV.A. of Part 1 only if the number of stations designated as not achieving the protective condition as defined in Sections V.I. and V.J. supports rejection of the null hypothesis, as provided in Table 3.1 of the State Water Board's Listing Policy.
2. Water segments that exhibit sediment toxicity but that are not listed for an exceedance of the narrative sediment quality objective for aquatic life protection in Section IV.A. shall continue to be listed in accordance with Section 3.6 of the Listing Policy.
3. If a water segment is listed under Section 3.6 of the Listing Policy and the Regional Water Board later determines that the applicable water quality standard that is impaired consists of the sediment quality objective in Section IV.A. of Part 1 and a bay or estuarine habitat beneficial use, the Regional Water Board shall reevaluate the listing in accordance with Sections V.I and V.J. If the Regional Water Board reevaluates the listing and determines that the water segment does not meet the criteria in subsection a. above, the Regional Water Board shall delist the water segment.

F. STRESSOR IDENTIFICATION

If sediments fail to meet the narrative SQOs in accordance with Sections V. and VI. the Water Boards shall direct the regional monitoring coalitions or Permittees to conduct stressor identification.

The Water Boards shall assign the highest priority for stressor identification to those segments or reaches with the highest percentage of sites designated as Clearly Impacted and Likely Impacted.

Where segments or reaches contain Possibly Impacted but no Clearly or Likely Impacted sites, confirmation monitoring shall be conducted prior to initiating stressor identification.

The stressor identification approach consists of development and implementation of a work plan to seek confirmation and characterization of pollutant-related impacts, pollutant identification and source identification. The workplan shall be submitted to the Water Board for approval. Stressor identification consists of the following studies:

1. Confirmation and Characterization of Pollutant Related Impacts—Exceedance of the direct effects SQO at a site indicates that pollutants in the sediment are the likely cause but does not identify the specific pollutant responsible. The MLOE assessment establishes a linkage to sediment pollutants; however, the lack of confounding factors (e.g., physical disturbance, non-pollutant constituents) must be confirmed. There are two generic stressors that are not related to toxic pollutants that may cause the narrative to be exceeded:

   a. Physical Alteration—Examples of physical stressors include reduced salinity, impacts from dredging, very fine or coarse grain size, and prop wash from passing ships. These types of stressors may produce a non-reference condition* in the benthic community that is similar to that caused by pollutants. If impacts to a site are purely due to physical disturbance, the LOE characteristics will likely show a degraded benthic community with little or no toxicity and low chemical concentrations.

b. Other Pollutant Related Stressors—These constituents, which include elevated total organic carbon, ammonia, nutrients and pathogens, may have sources similar to chemical pollutants. Chemical and microbiological analysis will be necessary to determine if these constituents are present. The LOE characteristics for this type of stressor would likely be a degraded benthic community with possibly an indication of toxicity, and low chemical concentrations.

To further assess a site that is impacted by toxic pollutants, there are several lines of investigation that may be pursued, depending on site-specific conditions. These studies may be considered and evaluated in the work plan for the confirmation effort:

a. Evaluate the spatial extent of the Area of Concern. This information can be used to evaluate the potential risk associated with the sediment, distinguish areas of known physical disturbance or pollution and evaluate the proximity to anthropogenic source gradient from such inputs as outfalls, storm drains, and industrial and agricultural activities.

b. Body burden data may be examined from animals exposed to the site's sediment to indicate if pollutants are being accumulated and to what degree.

c. Chemical specific mechanistic benchmarks* may be applied to interpret sediment chemistry concentrations.

d. Chemistry and biology data from the site should be examined to determine if there is a correlation between the two LOE.

e. Alternate biological effects data may be pursued, such as bioaccumulation* experiments and pore water toxicity or chemical analysis.

f. Other investigations that may commonly be performed as part of a Phase 1 Toxicity Identification Evaluation* (TIE).

If there is compelling evidence that the SQO exceedances contributing to a receiving water limit exceedance are not due to toxic pollutants, then the assessment area shall be designated as having achieved the receiving water limit.

2. Pollutant Identification—Methods to help determine cause may be statistical, biological, chemical or a combination. Pollutant identification studies should be structured to address site-specific conditions, and may be based upon the following:

   a. Statistical methods—Correlations between individual chemicals and biological endpoints (toxicity and benthic community).

   b. Gradient analysis—Comparisons are made between different samples taken at various distances from a chemical hotspot to examine patterns in chemical concentrations and biological responses. The concentrations of causative agents should decrease as biological effects decrease.

   c. Additional Toxicity Identification Evaluation efforts—A toxicological method for determining the cause of impairments is the use of toxicity identification evaluations (TIE). Sediment samples are manipulated chemically or physically to remove classes of chemicals or render them biologically unavailable. Following the manipulations, biological tests are performed to determine if toxicity has been removed. TIEs should be conducted at a limited number of stations, preferably those with strong biological or toxicological effects.

   d. Bioavailability*—Chemical pollutants may be present in the sediment but not biologically available to cause toxicity or degradation of the benthic community. There are several measures of bioavailability that can be made. Chemical and toxicological measurements can be made on pore water to determine the availability of sediment pollutants. Metal compounds may be naturally bound up in the sediment and rendered unavailable by the presence of sulfides. Measurement of acid volatile sulfides and simultaneously extracted metals analysis can be conducted to determine if sufficient sulfides are present to bind the observed metals. Similarly, organic compounds can be tightly bound to sediments. Measurements of sediment organic carbon and other binding phases can be conducted to determine the bioavailable fraction of organic compounds. Solid phase microextraction (SPME) or laboratory desorption experiments can also be used to identify which organics are bioavailable to benthic organisms.

e. Verification—After specific chemicals are identified as likely causes of impairment, analysis should be performed to verify the results. Sediments can be spiked with the suspected chemicals to verify that they are indeed toxic at the concentrations observed in the field. Alternately, animals can be transplanted to suspected sites for ***in situ*** toxicity and bioaccumulation testing.

When stressor Identification yields inconclusive results for sites classified as Possibly Impacted, the Water Board shall require the Permittee or regional monitoring coalition to perform a one-time augmentation to that study or, alternatively, the Water Board may suspend further stressor identification studies pending the results of future routine SQO monitoring.

3. Sources Identification and Management Actions.

   a. Determine if the sources are ongoing or legacy sources.

   b. Determine the number and nature of ongoing sources.

   c. If a single discharger is found to be responsible for discharging the stressor pollutant at a loading rate that is significant, the Regional Water Board shall require the discharger to take all necessary and appropriate steps to address exceedance of the SQO, including but not limited to reducing the pollutant loading into the sediment.

   d. When multiple sources are present in the water body that discharge the stressor pollutant at a loading rate that is significant, the Regional Water Board shall require the sources to take all necessary and appropriate steps to address exceedance of the SQO. If appropriate, the Regional Water Board may adopt a TMDL to ensure attainment of the sediment standard.

G. CLEANUP AND ABATEMENT

Cleanup and abatement actions covered by Water Code section 13304 for sediments that exceed the objectives in Chapter IV shall comply with Resolution No. 92-49 (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304), Cal. Code Regs., tit. 23, §§2907, 2911.

H. DEVELOPMENT OF SITE-SPECIFIC SEDIMENT MANAGEMENT GUIDELINES

The Regional Water Boards may develop site-specific sediment management guidelines where appropriate, for example, where toxic stressors have been identified and controllable sources of these stressors exist or remedial goals are desired.

Development of site-specific sediment management guidelines is the process to estimate the level of the stressor pollutant that will meet the narrative sediment quality objective. The guideline can serve as the basis for cleanup goals or revision of effluent limits described in B. 4

above, depending upon the situation or sources. All guidelines when applied for cleanup, must comply with 92-49.

Guideline development should only be initiated after the stressor has been identified. The goal is to establish a relationship between the organism's exposure and the biological effect. Once this relationship is established, a pollutant specific guideline may be designated that corresponds with minimum biological effects. The following approaches can be applied to establish these relationships:

1. Correspondence with sediment chemistry. An effective guideline can best be derived based upon the site-specific, or reach- specific relationship between the stressor pollutant exposure and biological response. Therefore the correspondence between the bulk sediment stressor concentration and biological effects should be examined.
2. Correspondence with bioavailable pollutant concentration. The concentration of the bioavailable fraction of the stressor pollutants is likely to show a less variable relationship to biological effects that bulk sediment chemistry. Interstitial water analysis, SPME, desorption experiments, selective extractions, or mechanistic models may indicate the bioavailable pollutant concentration. The correspondence between the bioavailable stressor concentration and biological effects should be examined.
3. Correspondence with tissue residue. The concentration of the stressor accumulated by a target organism may provide a measure of the stressor dose for some chemicals (e.g., those that are not rapidly metabolized). The tissue residue threshold concentration associated with unacceptable biological effects can be combined with a bioaccumulation factor or model to estimate the loading or sediment concentration guideline.
4. Literature review. If site-specific analyses are ambiguous or unable to determine a guideline, then the results of similar development efforts for other areas should be reviewed. Scientifically credible values from other studies can be combined with mechanistic or empirical models of bioavailability, toxic potency, and organism sensitivity to estimate guidelines for the area of interest.
5. The chemistry LOE of Section V.H.2, including the threshold values (e.g. CSI and CALRM), shall not be used for setting cleanup levels or numeric values for technical TMDLs.

VIII. GLOSSARY

BENTHIC: Living on or in bottom of the ocean, bays, and estuaries, or in the streambed.

BINOMIAL DISTRIBUTION: Mathematical distribution that describes the probabilities associated with the possible number of times particular outcomes will occur in series of observations (i.e., samples). Each observation may have only one of two possible results (e.g., standard exceeded or standard not exceeded).

BIOACCUMULATION: A process in which an organism's body burden of a pollutant exceeds that in its surrounding environment as a result of chemical uptake through all routes of chemical exposure; dietary and dermal absorption and transport across the respiratory surface.

BIOAVAILABILITY: The fraction of a pollutant that an organism is exposed to that is available for uptake through biological membranes (gut, gills).

CHEMICALS OF CONCERN (COCS): Pollutants that occur in environmental media at levels that pose a risk to ecological receptors or human health.

CONTAMINATION: An impairment of the quality of the waters of the State by waste to a degree that creates a hazard to the public health through poisoning or through the spread of disease. “Contamination” includes any equivalent effect resulting from the disposal of waste whether or not waters of the State are affected (CWC section 13050(k)).

EFFECT SIZE: The maximum magnitude of exceedance frequency that is tolerated.

ENCLOSED BAYS: Indentations along the coast that enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. This definition includes, but is not limited to: Humboldt Bay, Bodega Harbor, Tomales Bay, Drakes Estero, San Francisco Bay, Morro Bay, Los Angeles Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay.

ENDPOINT: A measured response of a receptor to a stressor. An endpoint can be measured in a toxicity test or in a field survey.

ESTUARIES AND COASTAL LAGOONS: Waters at the mouths of streams that serve as mixing zones* for fresh and ocean waters during a major portion of the year. Mouths of streams that are temporarily separated from the ocean by sandbars shall be considered as estuaries. Estuarine waters will generally be considered to extend from a bay or the open ocean to the upstream limit of tidal action but may be considered to extend seaward if significant mixing of fresh and salt water occurs in the open coastal waters. The waters described by this definition include, but are not limited to, the Sacramento-San Joaquin Delta as defined by Section 12220 of the California Water Code, Suisun Bay, Carquinez Strait downstream to Carquinez Bridge, and appropriate areas of the Smith, Klamath, Mad, Eel, Noyo, and Russian Rivers.

EUHALINE: Waters ranging in salinity from 25–32 practical salinity units (psu).

INLAND SURFACE WATERS: All surface waters of the State that do not include the ocean, enclosed bays, or estuaries.

LOAD ALLOCATION (LA): The portion of a receiving water's total maximum daily load that is allocated to one of its nonpoint sources of pollution or to natural background sources.

MECHANISTIC BENCHMARKS: Chemical guidelines developed based upon theoretical processes governing bioavailability and the relationship to biological effects.

MIXING ZONE: A limited zone within a receiving water that is allocated for mixing with a wastewater discharge where water quality criteria can be exceeded without causing adverse effects to the overall water body.

NONPOINT SOURCES: Sources that do not meet the definition of a point source as defined below.

NULL HYPOTHESIS: A statement used in statistical testing that has been put forward either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved.

OCEAN WATERS: Territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. Discharges to ocean waters are regulated in accordance with the State Water Board’s California Ocean Plan.

POINT SOURCE: Any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

POLLUTANT: Defined in section 502(6) of the CWA as "dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water."

POLLUTION: Defined in section 502(19) of the CWA as the "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water." ***Pollution*** is also defined in CWC section 13050(1) as an alternation of the quality of the waters of the State by waste to a degree that unreasonably affects either the waters for beneficial uses or the facilities that serve these beneficial uses.

POLYHALINE: Waters ranging in salinity from 18–25 psu.

REFERENCE CONDITION: The characteristics of water body segments least impaired by human activities. As such, reference conditions can be used to describe attainable biological or habitat conditions for water body segments with common watershed/catchment characteristics within defined geographical regions.

SPECIES RICHNESS: The number of species in a sample.

SURFICIAL SEDIMENTS: Those sediments representing recent depositional materials and containing the majority of the benthic invertebrate community.

STATISTICAL SIGNIFICANCE: When it can be demonstrated that the probability of obtaining a difference by chance only is relatively low.

TOXICITY IDENTIFICATION EVALUATION (TIE): Techniques used to identify the unexplained cause(s) of toxic events. TIE involves selectively removing classes of chemicals through a series of sample manipulations, effectively reducing complex mixtures of chemicals in natural waters to simple components for analysis. Following each manipulation the toxicity of the sample is assessed to see whether the toxicant class removed was responsible for the toxicity.

WASTE: As used in this document, waste includes a discharger's total discharge, of whatever origin, i.e., gross, not net, discharge.

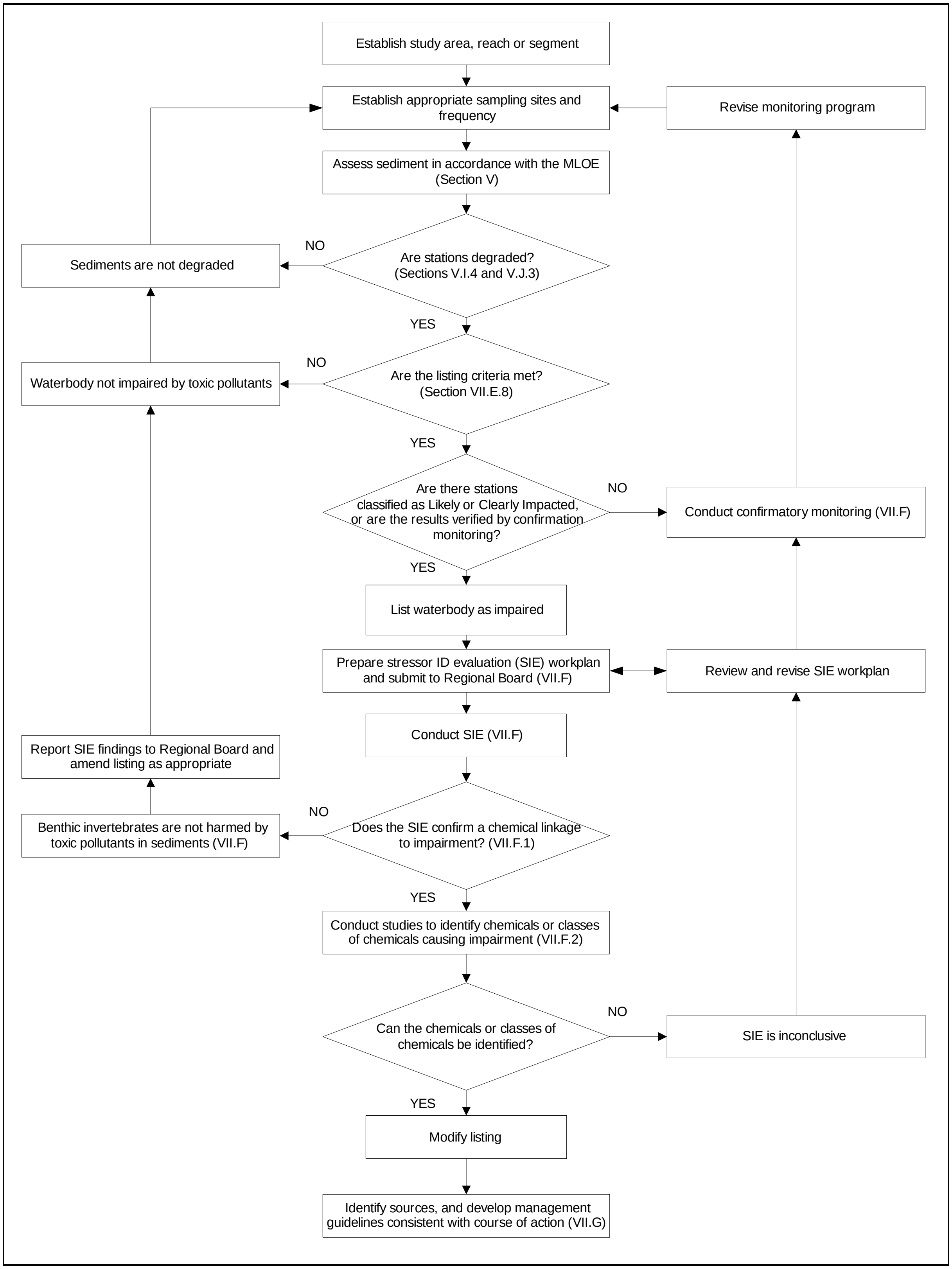


Figure 1. Waterbody Assessment Process

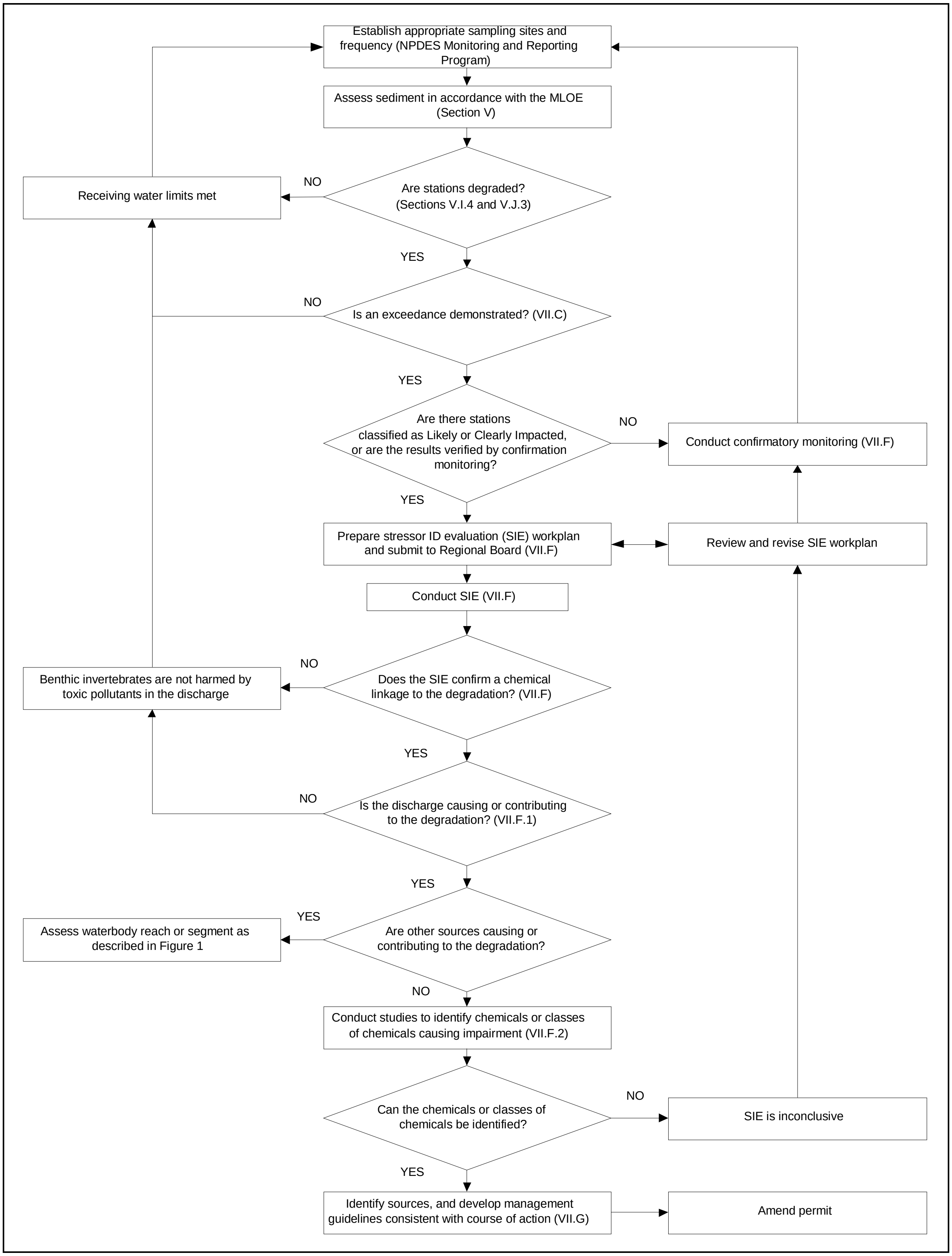


Figure 2. Point Source Assessment Process

Attachment A. List of chemical analytes needed to characterize sediment contamination exposure and effect.

Chemical Name	Chemical Group	Chemical Name	Chemical Group
Total Organic Carbon	General	Alpha Chlordane	Pesticide
Percent Fines	General	Gamma Chlordane	Pesticide
		Trans Nonachlor	Pesticide
Cadmium	Metal	Dieldrin	Pesticide
Copper	Metal	o,p’-DDE	Pesticide
Lead	Metal	o,p’-DDD	Pesticide
Mercury	Metal	o,p’-DDT	Pesticide
Zinc	Metal	p,p’-DDD	Pesticide
		p,p’-DDE	Pesticide
		p,p’-DDT	Pesticide
Acenaphthene	PAH	2,4'-Dichlorobiphenyl	PCB congener
Anthracene	PAH	2,2',5-Trichlorobiphenyl	PCB congener
Biphenyl	PAH	2,4,4'-Trichlorobiphenyl	PCB congener
Naphthalene	PAH	2,2',3,5'-Tetrachlorobiphenyl	PCB congener
2,6-dimethylnaphthalene	PAH	2,2',5,5'-Tetrachlorobiphenyl	PCB congener
Fuorene	PAH	2,3',4,4'-Tetrachlorobiphenyl	PCB congener
1-methylnaphthalene	PAH	2,2',4,5,5'-Pentachlorobiphenyl	PCB congener
2-methylnaphthalene	PAH	2,3,3',4,4'-Pentachlorobiphenyl	PCB congener
1-methylphenanthrene	PAH	2,3',4,4',5-Pentachlorobiphenyl	PCB congener
Phenanthrene	PAH	2,2',3,3',4,4'-Hexachlorobiphenyl	PCB congener
Benzo(a)anthracene	PAH	2,2',3,4,4',5'-Hexachlorobiphenyl	PCB congener
Benzo(a)pyrene	PAH	2,2',4,4',5,5'-Hexachlorobiphenyl	PCB congener
Benzo(e)pyrene	PAH	2,2',3,3',4,4',5-Heptachlorobiphenyl	PCB congener
Chrysene	PAH	2,2',3,4,4',5,5'-Heptachlorobiphenyl	PCB congener
Dibenz(a,h)anthracene	PAH	2,2',3,4',5,5',6-Heptachlorobiphenyl	PCB congener
Fluoranthene	PAH	2,2',3,3',4,4',5,6-Octachlorobiphenyl	PCB congener
Perylene	PAH	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	PCB congener
Pyrene	PAH	Decachlorobiphenyl	PCB congener

Attachment B. Station assessment category resulting from each possible MLOE combination

LOE Category Combination	Sediment Chemistry Exposure	Benthic Community Condition	Sediment Toxicity	Station Assessment
1	Minimal	Reference	Nontoxic	Unimpacted
2	Minimal	Reference	Low	Unimpacted
3	Minimal	Reference	Moderate	Unimpacted
4	Minimal	Reference	High	Inconclusive
5	Minimal	Low	Nontoxic	Unimpacted
6	Minimal	Low	Low	Likely unimpacted
7	Minimal	Low	Moderate	Likely unimpacted
8	Minimal	Low	High	Possibly impacted
9	Minimal	Moderate	Nontoxic	Likely unimpacted
10	Minimal	Moderate	Low	Likely unimpacted
11	Minimal	Moderate	Moderate	Possibly impacted
12	Minimal	Moderate	High	Likely impacted
13	Minimal	High	Nontoxic	Likely unimpacted
14	Minimal	High	Low	Inconclusive
15	Minimal	High	Moderate	Possibly impacted
16	Minimal	High	High	Likely impacted
17	Low	Reference	Nontoxic	Unimpacted
18	Low	Reference	Low	Unimpacted
19	Low	Reference	Moderate	Likely unimpacted
20	Low	Reference	High	Possibly impacted
21	Low	Low	Nontoxic	Unimpacted
22	Low	Low	Low	Likely unimpacted
23	Low	Low	Moderate	Possibly impacted
24	Low	Low	High	Possibly impacted
25	Low	Moderate	Nontoxic	Likely unimpacted
26	Low	Moderate	Low	Possibly impacted
27	Low	Moderate	Moderate	Likely impacted
28	Low	Moderate	High	Likely impacted
29	Low	High	Nontoxic	Likely unimpacted
30	Low	High	Low	Possibly impacted
31	Low	High	Moderate	Likely impacted
32	Low	High	High	Likely impacted
33	Moderate	Reference	Nontoxic	Unimpacted
34	Moderate	Reference	Low	Likely unimpacted
35	Moderate	Reference	Moderate	Likely unimpacted
36	Moderate	Reference	High	Possibly impacted
37	Moderate	Low	Nontoxic	Unimpacted
38	Moderate	Low	Low	Possibly impacted
39	Moderate	Low	Moderate	Possibly impacted
40	Moderate	Low	High	Possibly impacted
41	Moderate	Moderate	Nontoxic	Possibly impacted
42	Moderate	Moderate	Low	Likely impacted
43	Moderate	Moderate	Moderate	Likely impacted
44	Moderate	Moderate	High	Likely impacted

LOE Category Combination	Sediment Chemistry Exposure	Benthic Community Condition	Sediment Toxicity	Station Assessment
45	Moderate	High	Nontoxic	Possibly impacted
46	Moderate	High	Low	Likely impacted
47	Moderate	High	Moderate	Likely impacted
48	Moderate	High	High	Likely impacted
49	High	Reference	Nontoxic	Likely unimpacted
50	High	Reference	Low	Likely unimpacted
51	High	Reference	Moderate	Inconclusive
52	High	Reference	High	Likely impacted
53	High	Low	Nontoxic	Likely unimpacted
54	High	Low	Low	Possibly impacted
55	High	Low	Moderate	Likely impacted
56	High	Low	High	Likely impacted
57	High	Moderate	Nontoxic	Likely impacted
58	High	Moderate	Low	Likely impacted
59	High	Moderate	Moderate	Clearly impacted
60	High	Moderate	High	Clearly impacted
61	High	High	Nontoxic	Likely impacted
62	High	High	Low	Likely impacted
63	High	High	Moderate	Clearly impacted
64	High	High	High	Clearly impacted

CALIFORNIA

Water Boards

STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Office of Public Affairs: (916) 341-5254
Office of Legislative Affairs: (916) 341-5251
Office of the Ombudsman (916) 341-5254

P.O. Box 100, Sacramento, CA 95812-0100
www.waterboards.ca.gov

Water Quality information: (916) 341-5455
Water Rights information: (916) 341-5300
Financial Assistance information: (916) 341-5700

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS

NORTH COAST REGION (1)
www.waterboards.ca.gov/northcoast
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403
E-mail: info1@waterboards.ca.gov
(707) 576-2220 TEL • (707) 523-0135 FAX

SAN FRANCISCO BAY REGION (2)
www.waterboards.ca.gov/sanfranciscobay
1515 Clay Street, Suite 1400
Oakland, CA 94612
E-mail: info2@waterboards.ca.gov
(510) 622-2300 TEL • (510) 622-2460 FAX

CENTRAL COAST REGION (3)
www.waterboards.ca.gov/centralcoast
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401
E-mail: info3@waterboards.ca.gov
(805) 549-3147 TEL • (805) 543-0397 FAX

LOS ANGELES REGION (4)
www.waterboards.ca.gov/losangeles
320 W. 4th Street, Suite 200
Los Angeles, CA 90013
E-mail: info4@waterboards.ca.gov
(213) 576-6600 TEL • (213) 576-6640 FAX

CENTRAL VALLEY REGION (5)
www.waterboards.ca.gov/centralvalley
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670
E-mail: info5@waterboards.ca.gov
(916) 464-3291 TEL • (916) 464-4645 FAX

Fresno branch office
1685 E Street, Suite 200
Fresno, CA 93706
(559) 445-5116 TEL • (559) 445-5910 FAX

Redding branch office
415 Knollcrest Drive
Redding, CA 96002
(530) 224-4845 TEL • (530) 224-4857 FAX

LAHONTAN REGION (6)
www.waterboards.ca.gov/lahontan
2501 Lake Tahoe Blvd.
South Lake Tahoe, CA 96150
E-mail: info6@waterboards.ca.gov
(530) 542-5400 TEL • (530) 544-2271 FAX

Victorville branch office
14440 Civic Drive, Suite 200
Victorville, CA 92392
(760) 241-6583 TEL • (760) 241-7308 FAX

COLORADO RIVER BASIN REGION (7)
www.waterboards.ca.gov/coloradoriver
73-720 Fred Waring Dr., Suite 100
Palm Desert, CA 92260
E-mail: info7@waterboards.ca.gov
(760) 346-7491 TEL • (760) 341-6820 FAX

SANTA ANA REGION (8)
www.waterboards.ca.gov/santaana
3737 Main Street, Suite 500
Riverside, CA 92501-3339
E-mail: info8@waterboards.ca.gov
(951) 782-4130 TEL • (951) 781-6288 FAX

SAN DIEGO REGION (9)
www.waterboards.ca.gov/sandiego
9174 Sky Park Court, Suite 100
San Diego, CA 92123
E-mail: info9@waterboards.ca.gov
(858) 467-2952 TEL • (858) 571-6972 FAX

State Water Resources Control Board (Headquarters)
1001 I Street, Sacramento, CA 95814

State of California
Arnold Schwarzenegger, Governor

California Environmental Protection Agency
Linda S. Adams, Secretary

State Water Resources Control Board
Charles R. Hoppin, Chair

ATTACHMENT 4A-3: SAN DIEGO RIVER WATERSHED BACTERIA TMDL MONITORING PLAN

SAN DIEGO RIVER WATERSHED

BACTERIA TMDL MONITORING PLAN

Prepared For:
San Diego River Watershed
Participating Agencies

Prepared By:
AMEC Environment and Infrastructure, Inc.
9177 Sky Park Court
San Diego, California 92123
January 2015

This page intentionally left blank

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

ACRONYMS AND ABBREVIATIONS

Abbreviation/ Acronym	Meaning
303(d) List	Clean Water Act (CWA) Section 303(d) List of Water Quality Limited Segments
AMEC	AMEC Environment & Infrastructure, Inc.
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)*
Basin Plan	San Diego Region Basin Plan
BPA	Basin Plan Amendment
CEDEN	California Environmental Data Exchange Network
CFU	Colony Forming Units
CLRP	Comprehensive Load Reduction Plan
COC	Chain of Custody
CWA	Clean Water Act
DEH	Department of Environmental Health
EDD	Electronic Data Deliverable
FIB	Fecal Indicator Bacteria
HA	Hydrologic Area
HSA	Hydrologic Sub-Area
LA	Load Allocation
LARWQCB	Los Angeles Regional Water Quality Control Board
mL	Milliliter
mm	millimeter
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer System
NA	Not Applicable
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
*.pdf	Portable Document Format
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
REC-1	Water Contact Recreation
SDRWQCB	San Diego Regional Water Quality Control Board
State Board	State Water Resources Control Board
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WLA	Waste Load Allocation

PROJECT DESCRIPTION

1.1 INTRODUCTION

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). Subsequently, the Bacteria TMDL has been incorporated into to the 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 (SDRWQCB, 2013) (MS4 Permit). In the MS4 Permit, Bacteria TMDL is included as “Attachment E: Specific Provisions for Total Maximum Daily Loads 6. Revised Total Maximum Daily Loads for Indicator Bacteria, Project I –Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek)” Provision 6 of MS4 Permit Attachment E 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). The Phase I MS4s (hereafter called the Responsible Parties) have developed this Monitoring Plan for the San Diego River Watershed to meet the requirements of the MS4 Permit.

The ultimate goal of the Bacteria TMDL is to achieve the necessary pollutant load reductions to restore and protect the designated beneficial use of water contact recreation (REC-1). Beneficial uses within the San Diego River Watershed, as designated by the State Water Resources Control Board’s (State Board) San Diego Region Basin Plan (Basin Plan) for surface waters, are provided in Table 1-1 (SDRWQCB, 2011c).

Table 1-1. Beneficial Uses for the 303(d) Listed Waterbodies

Hydrologic Unit	Waterbody Type	Beneficial Use																
		IND	NAV	REC 1	REC 2	COMM	BIOL	EST	WILD	RARE	MAR	AQUA	MIGR	SPWN	WARM	SHELL	MUN	AGR
Coastal Waters																		
Mouth of San Diego River	Pacific Ocean Shoreline			•	•	•		•	•	•	•		•	•		•		
Inland Surface Waters																		
Lower San Diego River (lower 6 miles)	River	•		•	•		•		•	•					•		+	•
Forester Creek (lower 1 mile)	River	•		•	•				•						•		o	

Notes:
Source: SDRWQCB, 2011c
- • Existing Beneficial Use
- O Potential Beneficial Use
- \+ Exempted from Use

1.2 PURPOSE

This Monitoring Plan is designed to fulfill the compliance monitoring requirements of the MS4 Permit. The San Diego River Bacteria TMDL Monitoring Program will collect data to evaluate the approved TMDL pollutants. A list of the applicable pollutants for the San Diego River Watershed is provided in Table 1-2. The goals of the San Diego River Bacteria TMDL Monitoring Program include the following:

- Characterize the current conditions of receiving waters in terms of approved TMDL pollutants
- Assess progress toward meeting the Bacteria TMDL numeric targets

1.3 WATERSHED BACKGROUND

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%), 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), which is the HA addressed by the San Diego River Comprehensive Load Reduction Plan (CLRP), is the westernmost portion of the San Diego River Watershed. 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%).

The Bacteria TMDL is based on the 2002 303(d) List, which indicated that the greatest cause of waterbody impairments in the San Diego Region was elevated bacteria levels (United States Environmental Protection Agency [USEPA], 2003). Table 1-2 presents the targeted segments identified in the Bacteria TMDL. These segments include the lower one mile of Forester Creek, the lower six miles of the Lower San Diego River, and the Pacific Ocean Shoreline at Dog Beach.

Table 1-2. Waterbodies and Pollutants Listed in the Bacteria TMDL for SDR WMA

Waterbody	TMDL Pollutants
Pacific Ocean Shoreline, Dog Beach at San Diego River Mouth (HSA 907.11)	Total coliform, Fecal coliform, *Enterococcus*
Lower San Diego River[(a)] (HSA 907.11)	Fecal coliform, *Enterococcus*
Forester Creek[(b)] (HSA 907.12)	Fecal coliform, *Enterococcus*

Notes:
(a) Lower Six Miles
(b) Lower One Mile Only

1.4 RESPONSIBLE PARTIES

Attachment E of the MS4 Permit identifies the Responsible Parties for the San Diego River Watershed. The Responsible Parties are working on implementation of the monitoring programs for their watershed. The Responsible Parties, excluding owners and operators of small MS4s, are:

- County of San Diego
- City of El Cajon
- City of Santee
- City of San Diego
- City of La Mesa

1.5 BACTERIA TMDL RECEIVING WATER LIMITATIONS

The receiving water limitations (RWLs) are a combination of numeric targets for bacteria density and allowable exceedance frequencies. The MS4 Permit clarifies the final RWLs (in most probable number [MPN]) for total coliform, fecal coliform, and *Enterococcus* as numeric targets. For dry weather days, the 30-day geometric mean RWLs must be achieved with a 0 percent exceedance frequency. The single-sample maximum RWLs are required to be achieved during wet weather, with an allowable exceedance frequency of 22 percent.

Table 1-3 provides the final numeric and exceedance targets for the San Diego River Watershed per the Bacteria TMDL. Monitoring data collected under the San Diego River Watershed Bacteria TMDL Monitoring Program will be used to evaluate progress and attainment of TMDL numeric targets.

Table 1-3. Final Numeric Targets in Bacteria TMDL

Parameter	Dry Weather[a]		Wet Weather[b]	
	Numeric Target (MPN/100mL)[c]	Allowable Exceedance[c]	Numeric Target (MPN/100mL)[d]	Allowable Exceedance[e]
Enterococcus	33[g]/35[f]	0%	61[g]/104[f]	22%
Fecal Coliform	200	0%	400	22%
Total Coliform[f]	1,000	0%	10,000	22%

Notes:
mL – milliliter
Source: SDRWQCB, 2011a

(a) Dry weather days defined as days with less than 0.1 inch of rainfall observed in the previous 72 hours

(b) Wet weather days defined as days with rainfall events of 0.1 inches or greater and the following 72 hours.

(c) Dry weather numeric objectives based on the 30-day geometric mean water quality objectives in the California Ocean Plan (SWQCB, 2009) as well as the Basin Plan (SDRWQCB, 2011c) and the MS4 Permit (SDRWQCB, 2013). Compliance with the dry weather TMDLs in the receiving water is based on the frequency that the dry weather days in any given year exceed the dry weather numeric objective. The TMDL set a zero percent (0%) allowable exceedance frequency of the Final REC-1 Dry Weather Numeric Targets.

(d) Wet weather numeric objectives based on the single sample maximum water quality objectives in the California Ocean Plan (SWQCB, 2009) as well as the Basin Plan (SDRWQCB, 2011c) and the MS4 Permit (SDRWQCB, 2013). Compliance with the wet weather TMDLs in the receiving water is based on the frequency that the wet weather days in any given year exceed the wet weather numeric objective, but 30-day geometric mean must also be met.

(e) The wet weather allowable exceedance frequency is set at 22%. In the calculation of the wet weather TMDLs, the San Diego Regional Board chose to apply the 22% allowable exceedance frequency as determined for Leo Carillo Beach in Los Angeles County (LARWQCB, 2010a,b). At the time the wet weather watershed model was developed, the 22% exceedance frequency from Los Angeles County was the only reference beach exceedance frequency available.

(f) Marine beach Numeric Target. Applies only to Pacific Shoreline site, FM-010.

(g) Freshwater Designated Beach Numeric Target. Applies to sites SDR-MLS, SDR-CDE, SDR-FC1, SDR-FC2.

1.6 EXISTING, INTERIM, AND FINAL EXCEEDANCES FREQUENCIES

Interim and final RWLs used to determine progress toward achieving compliance milestones are presented in Table 1-4. These numbers were calculated using the “existing” exceedance frequencies which were derived from dry weather FIB data collected at the historical AB411 monitoring site (FM-010) between 2004 and 2010. The interim reduction is a 50 percent reduction of an existing exceedance frequency; a final exceedance frequency is the final numeric goal for a given FIB species.

Table 1-4. San Diego River Watershed TMDL Compliance Reduction Milestones

Classification	Segment	Analyte	"Existing" Exceedance Frequency	Interim Milestone 50% Reduction	Final 100% Reduction
Dry Weather	San Diego River Watershed	Enterococcus[a]	3.0%[a]	1.5%[a]	0%
		Fecal coliform[a]	0%[a]	0%[a]	0%
		Total coliform[a,d]	0.56%[a]	0.28%[a]	0%
Wet Weather	Pacific Ocean Shoreline	Enterococcus	76%[b]	51%[c]	22%
		Fecal coliform	70%[b]	43%[c]	22%
		Total coliform	63%[b]	46%[c]	22%
	San Diego River	Enterococcus	79%[b]	49%[c]	22%
		Fecal coliform	70%[b]	43%[c]	22%
		Total coliform[d]	63%[b]	46%[c]	22%
	Forrester Creek	Enterococcus	79%[b]	49%[c]	22%
		Fecal coliform	70%[b]	43%[c]	22%
		Total coliform[d]	63%[b]	46%[c]	22%

Notes:

a. Interim exceedance frequencies were provided by the County of San Diego and were calculated on a watershed-wide basis from the DEH AB411 data collected at site FM-010 (Dog Beach) between 2004 and 2010.

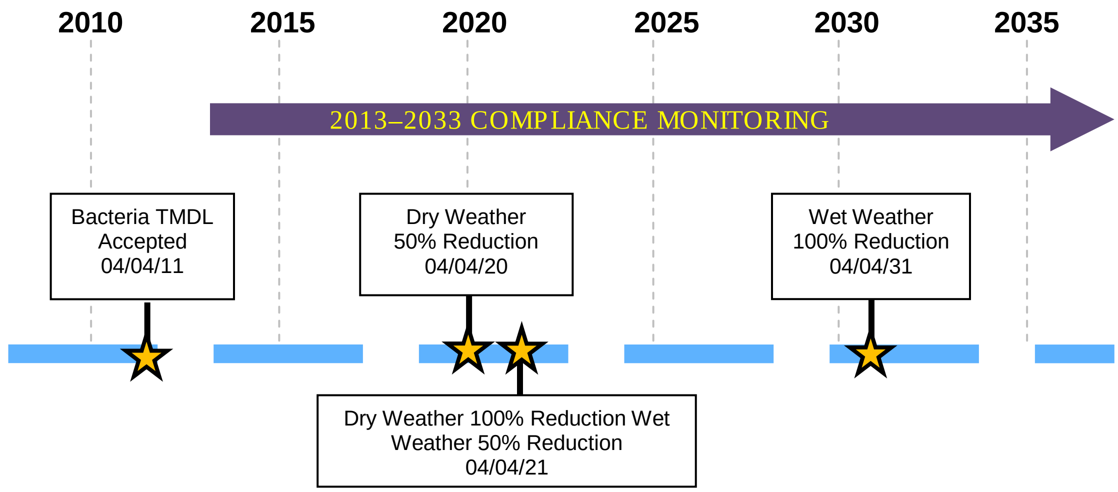
b. Per the Bacteria TMDL (page A-56). See Appendix H

c. Per the MS4 Permit (Attachment E Table 6.5). See Appendix H.

d. Not applicable for creeks per the MS4 Permit

1.7 IMPLEMENTATION SCHEDULE

The effective date of the Bacteria TMDL is April 4, 2011 (SDRWQCB, 2011a). The TMDL provides a compliance timeline outlining the interim reduction milestones over the 20-year compliance period. Figure 1-1 provides an overall timeline for the San Diego River Bacteria TMDL Monitoring Program. Compliance Monitoring is scheduled to begin 50 days after the adoption of the MS4 Permit (June 27, 2013).



Legend:
CLRP – Comprehensive Load Reduction Plan

Figure 1-1. San Diego River Monitoring Program Timeline

MONITORING APPROACH

This section describes the purpose, scope, and types of sampling conducted. Additional details of the sampling and analytical methodology and data quality objectives are described in the Quality Assurance Project Plan (QAPP) (County of San Diego, 2015).

1.8 MONITORING

Monitoring is designed to meet the receiving water monitoring requirements of the recently adopted MS4 Permit (SDRWQCB, 2013). The monitoring, including wet and dry weather sampling, will be conducted at locations listed in Table 2-1. The data generated will be used to address the following questions:

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

Table 2-1. Scope of the Monitoring Program

Months	Number of Monitoring Locations	Event Type	Grab Samples Per Site Per Event	Event Frequency
Apr. 1 to Oct. 31	5	Dry	1	Weekly (5 events per month)
Nov. 1 to Mar. 31	5	Dry	1	At least Monthly
Oct. 1 to Apr. 30	5	Wet	1	At least once within the first 24 hours of the end of the storm event during the rainy season (Oct. 1 through Apr. 30).

Notes:
[a] Not including QA Samples

1.8.1 Monitoring Locations

According to Provision 6.d.(1)(a) of Attachment E of the MS4 Permit, for beaches addressed by the TMDL, monitoring locations should consist of, at a minimum, the same locations used to collect data required pursuant to Order Nos. R9-2007-0001 and R9-2009-0002, and beach monitoring for Health and Safety Code section 115880.3. Therefore, the location historically sampled under the AB411 beach monitoring program (SDRWQCB, 2011a), FM-010, has been selected for the current monitoring program. Data collected at FM-010 between years 2004 and 2010 have been used in the calculation of the “existing” exceedance frequencies from which the interim and final exceedance frequencies for the Bacteria TMDL have been derived. Even if the AB 411 location is changed by the State Water Resources Control Board, Participating Agencies request that compliance with the Bacteria TMDL be assessed at the current AB411 location (FM-010), as these are the data used to develop the 303(d) listing and to develop the baseline of exceedance frequency.

According to Provision 6.d.(2)(a) of Attachment E of the MS4 Permit, for creeks addressed by the TMDL, monitoring locations should consist of, at a minimum, a location at or near the mouth of the creek and one or more locations upstream of the mouth. Therefore, two sites have been selected for monitoring in this manner along the lower 6 miles of the San Diego River, and two along the lower one mile of Forester Creek. Table 2-2 provides the location names and coordinates. Figure 2-1 presents a map of the locations within the San Diego River Watershed.

Table 2-2. Monitoring Locations

Site ID	Site Name	Site Type	Site Descirption	Latitude	Longitude
FM-010	Dog Beach at San Diego River Mouth	Pacific Ocean Shoreline	Historical AB411 Location[a]	32.75631	-117.25318
SDR-MLS	San Diego River MLS at Lower San Diego River	River	San Diego River Mass Loading Station	32.76515	-117.16863
SDR-CDE	Lower San Diego River at Camino Del Este	River	San Diego River at Camino Del Este	32.77255	-117.14456
SDR-FC1	Lower Forester Creek	River	Forrester Creek at the mouth	32.83986	-117.00395
SDR-FC2	Forester Creek at Prospect Avenue	River	Forrester Creek upstream site	32.83130	-116.98572

[a] Historical AB411 location is approximately 25 meters downcoast of river outlet

Figure 2-1. Monitoring Locations

1.8.2 Constituents

Fecal indicator bacteria (FIB) are the target constituents as indicated by the TMDL. For beach samples, grab samples will be collected in a manner consistent with the AB411 program. Samples collected at freshwater sites will be analyzed for fecal coliform and *Enterococcus*; beach water samples will be analyzed for fecal coliform, *Enterococcus* and total Coliform. All samples will be analyzed for FIB in accordance with Surface Water Ambient Monitoring Program (SWAMP) requirements provided in the QAPP (County of San Diego, 2015). Table 2-3 presents the constituents and reporting limits.

Table 2-3. Water Sample Analyses for Bacteria TMDL Monitoring

Parameter	Project Reporting Limit[(a)]
Enterococcus	1 CFU/100mL
Fecal Coliform	2 CFU/100mL
Total Coliform[(b)]	2 CFU/100mL

Notes

CFU – Colony Forming Units

(a) The target reporting limits are consistent with methodology of the Assembly Bill 411 program to facilitate overlap with that program. However, reporting limits may increase depending on dilution in countable range.

(b) Applies to beach samples only.

1.8.3 Dry Weather Monitoring

Dry weather monitoring will be conducted from April through October as described in Table 2-1. Samples will be collected at the monitoring locations listed in Table 2-2 on dry weather days, after an antecedent dry period of 72 hours with less than 0.1 inches of rainfall. During each dry weather monitoring event, field observations will be recorded and a grab water sample will be collected at each location. The methodology for field observations and sample collection/transport is described in the QAPP (County of San Diego, 2015).

1.8.4 Wet Weather Monitoring

Wet weather monitoring will be conducted at the locations listed in Table 2-2 during at least one storm event during the wet season, (October 1, to April 30). Storms resulting in greater than 0.1 inches of precipitation will be targeted for sampling. During each wet weather monitoring event, a grab water sample will be collected within 24 hours of the end of precipitation using the same sample collection technique as during a dry weather monitoring event, taking additional safety precautions as needed. Field observations are not required but will be recorded, if feasible. The methodology for field observations and sample collection/transport is described in the QAPP (County of San Diego, 2015).

1.8.5 Storm Selection Criteria

The following criteria will be used to determine if mobilization will occur for an impending storm event:

- Storms must be forecast to produce at least 0.10 inch (2.54 millimeters [mm]) of rain.
- Storm events must be preceded by at least 72 hours of dry conditions (<0.10 inch of precipitation).

DATA MANAGEMENT AND REPORTING PROCEDURES

This section describes the management of field and analytical data and reporting procedures for the San Diego River Bacteria TMDL Monitoring Program.

1.9 DATA MANAGEMENT

Field Data Records and Analytical Data Reports will be sent to and kept by the Project Manager. Data will be submitted in a standardized California Environmental Data Exchange Network (CEDEN)-compatible format to the County of San Diego.

Specific data review, storage and maintenance procedures for field and laboratory data are described in the QAPP (County of San Diego, 2015).

Follow-up monitoring may be conducted based on indicator bacteria results obtained at the compliance monitoring locations. Detailed follow-up investigations are not required until the first interim milestone is reached; however, Copermittees may choose to voluntarily conduct follow-ups to identify and abate sources, where there is a preponderance of evidence to support the action.

1.10 ASSESSMENT AND REPORTING PROCEDURES

Compliance Monitoring Reports will be prepared annually to be included in the Transitional Monitoring and Assessment Program Reports or WQIP Annual Reports as appropriate. The annual reports will summarize the collected data and provide the results of analysis and assessments of dry and wet weather data collected herein as described in Provisions 6.d.(1)(c) and 6.d.(2)(c) of Attachment E to the MS4 Permit. This will include assessments of whether the interim and final WQBELs for the Pacific Ocean Shoreline at San Diego River mouth at Dog Beach, Forrester Creek (lower 1 mile) and San Diego River (lower 6 miles) as listed in Table 6.0 in Attachment E of the MS4 Permit have been achieved. The following assessments will be conducted and results presented in the reports:

1. Exceedance frequencies for dry weather data:

   Thirty-day geometric means for dry weather samples will be calculated and used to determine dry weather exceedance frequencies by dividing the number of geometric means that exceed receiving water limitations by the total number of geometric means for the dry season.

2. Exceedance frequencies for wet weather data:

   Single sample maximum exceedance frequencies will be calculated for wet weather data by dividing the number of wet weather days that exceed the single sample maximum receiving water limitations by the total number of wet weather days during the rainy season.

Dry weather data will be used in addition to wet weather data to calculate the wet weather 30-day geometric means. The exceedance frequency of the wet weather 30-day geometric means will be calculated by dividing the number of geometric means that exceed the geometric mean receiving water limitations by the total number of geometric means calculated from samples collected during the wet season.

In calculating exceedance frequencies for wet weather data, the following assumptions will be made:

a) If only one sample is collected for a storm event, the bacteria density for every wet weather day associated with that storm event will be assumed to equal the results from the one sample collected;

b) If more than one sample is collected for a storm event, but not on a daily basis, the bacteria density for all wet weather days of the storm event not sampled will be assumed to equal the highest bacteria density result reported from the samples collected;

c) For the storm events not sampled, the bacteria density for every wet weather day of those storm events will be assumed to equal the average of the highest bacteria densities reported from each storm event sampled;

For assessing and determining compliance with the concentration-based effluent limitations under Provision 6.b.(2)(b)(i) of Attachment E of the MS4 Permit, dry and wet weather discharge bacteria densities may be calculated based on a flow-weighted average across all major MS4 outfalls along a water body segment or within a jurisdiction if samples are collected within a similar time period.

The resulting data will also be submitted to the California Environmental Data Exchange Network (CEDEN).

REFERENCES

Assembly Bill 411, Chapter 765. October 1997. An Act to Amend Sections 115880, 115885, and 115915 of the Health and Safety Code, Relating to Public Beaches. Sacramento, California

California Regional Water Quality Control Board, Los Angeles Region (LARWQCB). July 2010a. Los Angeles River Watershed Bacteria Total Maximum Daily Load. Los Angeles, California.

California Regional Water Quality Control Board, Los Angeles Region (LARWQCB). July 2010b. Attachment A to Resolution No. R10-007. Amendment to the Water Quality Control Plan – Los Angeles Region to Incorporate a Total Maximum Daily Load for Indicator Bacteria in the Los Angeles River Watershed. Los Angeles, California.

California Regional Water Quality Control Board, San Diego Region (SDRWQCB).January 2007. Order No. R9-2007-0001. NPDES No. CAS0108758. Waste Discharge Requirements For Discharges Of Urban Runoff From The Municipal Separate Storm Sewer Systems (MS4s) Draining The Watersheds Of The County Of San Diego, The Incorporated Cities Of San Diego County, The San Diego Unified Port District, And The San Diego County Regional Airport Authority. San Diego, California.

California Regional Water Quality Control Board, San Diego Region (SDRWQCB). Effective April 2011(a). 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 for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (including Tecolote Creek). San Diego, California.

California Regional Water Quality Control Board, San Diego Region (SDRWQCB). Effective April 2011(b). Effective April 2011. Attachment A to Resolution No. R9-2010-0001. Amendment to 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). San Diego, California.

California Regional Water Quality Control Board, San Diego Region (SDRWQCB). April 2011(c). Water Quality Control Plan for the San Diego Basin (9). San Diego, California.

California Regional Water Quality Control Board, San Diego Region (SDRWQCB). Adopted May 2013. Order No. R9-2013-0001. NPDES No. CAS0109266. 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. San Diego, California.

California State Water Resource Control Board (SWRCB), 2009. California Ocean Plan, Water Quality Control Plan for Ocean Waters of California. Adopted September 15, 2009. Effective March 10, 2010.

County of San Diego. 2015. Quality Assurance Project Plan for the San Diego River Watershed Bacteria TMDL Monitoring Program. Available from the County of San Diego Department of Public Works Watershed Protection Program upon request.

Geosyntec Consultants. 2012. Comprehensive Load Reduction Plan for San Diego River Watershed. San Diego, California.

SanGIS, 2009. SanGIS/San Diego Association of Governments (SANDAG) GIS Data Warehouse. http://www.sangis.org/Download_GIS_Data.htm. Accessed on May 7, 2012.

United States Environmental Protection Agency (USEPA). July 2003. Final 2002 Integrated Report (Clean Water Act [CWA] Section 303(d) List / 305(b) Report). Washington, D.C.

ATTACHMENT 4A-4: SAN DIEGO RIVER WATERSHED TOXICITY IDENTIFICATION EVALUATION/ TOXICITY REDUCTION EVALUATION WORK PLAN

Toxicity Identification Evaluation / Toxicity Reduction Evaluation Implementation Draft Work Plan

Prepared for:

San Diego County Regional Copermittees

Prepared by:

Weston Solutions, Inc.
5817 Dryden Place, Suite 101
Carlsbad, California 92008

January 16, 2015

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

2007 Permit	RWQCB Order No. R9-2007-0001
2013 Permit	RWQCB Order No. R9-2013-0001
BMP	best management practice
BSA	bovine serum albumin
CLRP	Comprehensive Load Reduction Plan
Copermittees	San Diego Regional Copermittees
EDTA	ethylenediaminetetraacetic acid
IWC	instream waste concentration
JRMP	Jurisdictional Runoff Management Plan
LC_{50}	median lethal concentration
LID	low impact development
MAP	Monitoring and Assessment Plan
MEP	maximum extent practicable
MS4	multiple separate storm sewer system
NOEC	no observed effect concentration
NPDES	National Pollutant Discharge Elimination System
PBO	piperonyl butoxide
QA/QC	quality assurance/quality control
RWQCB	Regional Water Quality Control Board
SMC	Stormwater Monitoring Coalition
SPE	solid phase extraction
STS	sodium thiosulfate
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TIE	toxicity identification evaluation
TMDL	Total Maximum Daily Load
TRE	toxicity reduction evaluation
TST	Test of Significant Toxicity
USEPA	United States Environmental Protection Agency
WMA	Watershed Management Area
WQIP	Water Quality Improvement Plan
WURMP	Watershed Urban Runoff Management Program

UNITS OF MEASURE

ppt	parts per thousand
%	percent
<	less than
>	greater than

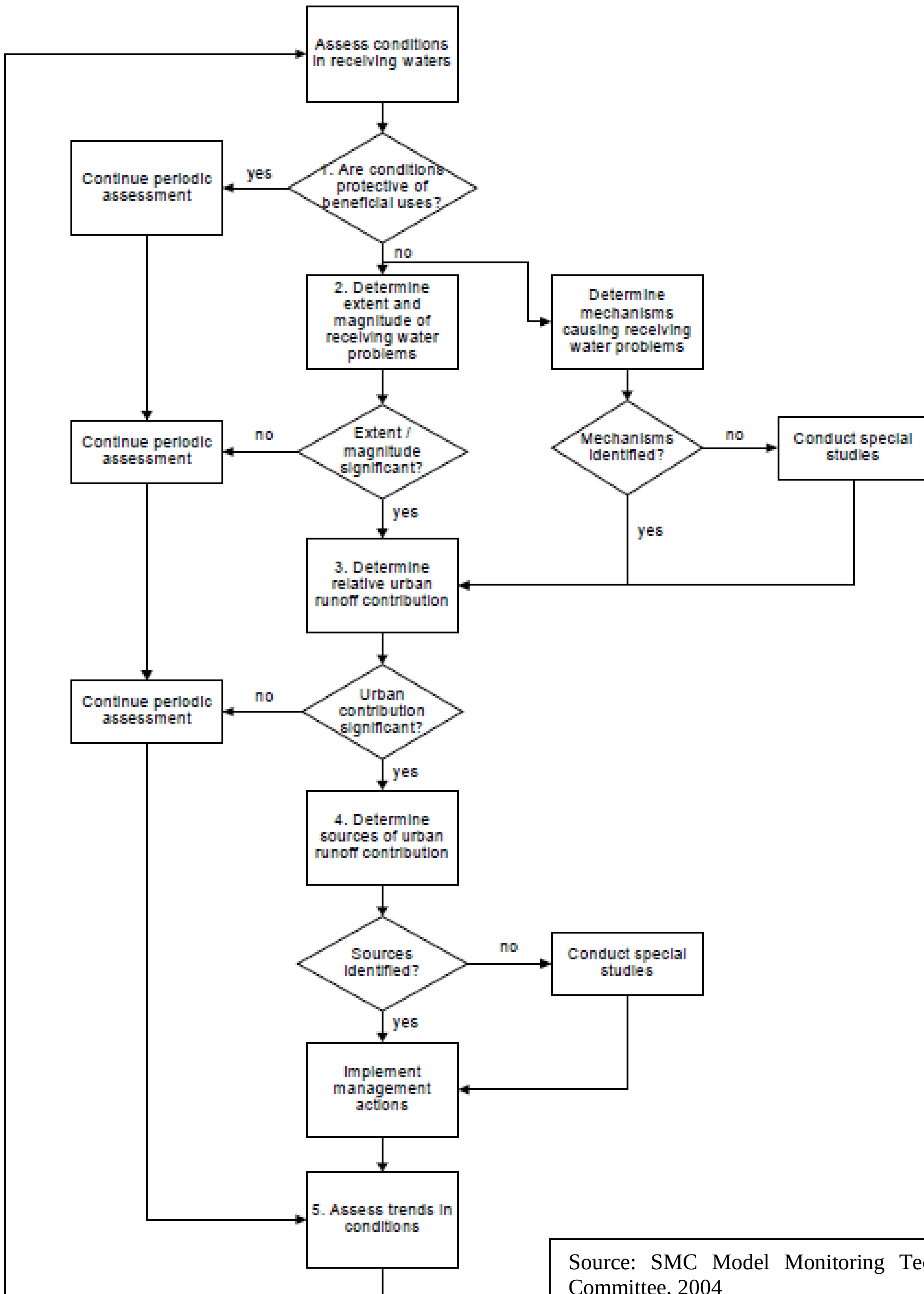
1.0 INTRODUCTION

In May of 2013, San Diego Regional Water Quality Control Board (RWQCB) Order No. R9-2013-0001 (2013 Permit) was adopted. Provision B of the 2013 Permit requires Copermittees in each Watershed Management Area (WMA) to develop a Water Quality Improvement Plan (WQIP) which, per Provision B.4, incorporates a Monitoring and Assessment Program (MAP). Also, per Provision D.1.c.(4)(f), "*If chronic toxicity is detected in receiving waters, the Copermittees must discuss the need for conducting a TIE/TRE in the assessments required under Provision D.4.a.(2), and develop a plan for implementing the TIE/TRE to be incorporated in the Water Quality Improvement Plan*."

A toxicity identification evaluation (TIE) is defined by the 2013 Permit as "*A set of procedures for identifying the specific chemical(s) responsible for toxicity. These procedures are performed in three phases (characterization, identification, and confirmation) using aquatic organism toxicity tests*." A toxicity reduction evaluation (TRE) is defined as "*A study conducted in a step-wise process designed to identify the causative agents of effluent or ambient toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in toxicity. The first steps of the TRE consist of the collection of data relevant to the toxicity, including additional toxicity testing, and an evaluation of facility operations and maintenance practices and best management practices. A TIE may be required as part of the TRE, if appropriate*."

This Work Plan outlines the process used to identify chronic toxicity in receiving waters, as well as guidance to prioritize the need to implement a TIE/TRE based on the magnitude and persistence of chronic toxicity. The Work Plan refers to the appropriate references for detailed sampling and analytical/toxicity test methods specific to the TIE/TRE treatment process. An example of a potential TRE decision process for receiving water samples (Stormwater Monitoring Coalition (SMC) Model Monitoring Technical Committee, 2004) is presented in Figure 1-1. The process should be modified on location-specific and pollutant-specific basis, and a detailed work plan should be developed for the implementation of a pollutant reduction program once the specific pollutant(s) causing toxicity exceedances are identified.

This Work Plan focuses primarily on the implementation of the TIE/TRE process, recognizing the limitations of utilizing TRE guidance developed for point source discharges. Receiving water stations potentially capture pollutants from many sources with runoff flows and contaminant concentrations likely more variable than those from point source discharges. However, with modifications to the TRE guidance developed for point source discharges, a TRE may be conducted to attempt to identify sources of toxicity, propose mitigation measures for these sources, and conduct follow-up studies to confirm toxicity reduction. Any activities that result in consistently reducing toxicity to an acceptable level may be considered TRE activities (USEPA 2001).



Source: SMC Model Monitoring Technical Committee, 2004

Figure 1-1. Example Receiving Water Monitoring and TIE/TRE Decision Framework

2.0 RECEIVING WATER TOXICITY TESTING

Receiving water monitoring is conducted by the San Diego Regional Copemittees (Copermittees) in accordance with Provision D of the 2013 Permit and chronic toxicity is one of the parameters evaluated in both wet and dry weather receiving water samples. Under the long-term monitoring requirements of the 2013 Permit, chronic toxicity tests are conducted in accordance with Provision D.1.c.(4)(e) as summarized in Table 2-1. Toxicity is evaluated using the Test of Significant Toxicity (TST) as outlined in the *National Pollutant Discharge Elimination System Test of Significant Toxicity Implementation Document* (USEPA, 2010). The TST approach assigns a Pass or Fail result based on whether the organism response observed at the chronic instream waste concentration (IWC) of 100 percent (%) receiving water is significantly different from that in the control treatment. When chronic toxicity is observed in receiving water samples (i.e., the sample receives a "Fail" based on the TST), implementation of a TIE/TRE process following the phased approach described in subsequent sections will be considered, as appropriate.

Table 2-1. Transitional and Long-Term Receiving Water Toxicity Tests

Organism	Endpoint	Toxicity Threshold	USEPA Protocol
Monitoring in accordance with Order No. R9-2013-0001, Salinity < 1 ppt			
Ceriodaphnia dubia	Chronic survival and reproduction	Pass/Fail	EPA-821-R-02-013
Selenastrum capricornutum	Chronic growth		
Pimephales promelas	Chronic survival and growth		
Monitoring in accordance with Order No. R9-2013-0001, Salinity $\geq$ 1 ppt			
Strongylocentrotus purpuratus	Chronic development	Pass/Fail	EPA-600-R-95-136

3.0 TIE/TRE PROCESS

3.1 Information and Data Acquisition

Prior to initiating the TIE/TRE process, an evaluation of sampling and toxicity testing procedures should be conducted to assess whether toxicity may have been introduced during these procedures or errors may have been made. This may include a review of the following:

- Sampling equipment decontamination procedures
- Field and laboratory logs
- Laboratory reports

If all test acceptability criteria are met and no errors are identified, Copermittees will consider implementing the TIE/TRE process. Conducting a TIE is often the first step to identifying the toxicant.

3.2 TIE Testing

TIEs may be conducted in accordance with USEPA guidance for characterizing, identifying, and confirming toxicity (USEPA 1991, 1992, 1993a, and 1993bPriority may be given to stations exhibiting significant and persistent toxicity that has not previously been characterized and where analytical results indicate that a specific toxicant may be causing or contributing to toxicity. The sample may be evaluated for TIE suitability using the following assessments:

- Presence of Persistent Toxicity: toxicity is considered persistent if more than 50% of samples (generally during a monitoring year) collected at a station receive a "Fail" based on the test of significant toxicity (TST) .
- Magnitude of Toxicity: based on past experience, a 50% response rate(i.e. 50% of test organisms respond in a 100% receiving water sample) can provide a reasonable opportunity for a successful TIE.
- Previous Characterization: TIEs are generally prioritized for receiving water stations where previous TIEs have not characterized the pollutant(s) causing toxicity. However, TIE/TRE procedures should not be ruled out for previously characterized stations since contributor(s) to toxicity may change over time.

The TIE approach is divided into three phases, as described in USEPA (1991) and summarized as follows:

- Phase I – characterizes the physical/chemical nature of the constituent(s) which cause or contribute to toxicity. Such characteristics as solubility, volatility and filterability are determined without specifically identifying the toxicants.
- Phase II – utilizes methods to specifically identify toxicants.
- Phase III – utilizes methods to confirm the suspected toxicants.

Phase I (characterization) manipulations of receiving water samples generally include those presented in Table 3-1.

Table 3-1. Phase I TIE Receiving Water Sample Manipulations

Physical and Chemical Manipulations on Receiving Water Samples	Purpose of Test
Baseline	Confirms toxicity is still present in the sample at time of TIE testing
Filtration	Detects particulates or particulate-bound toxicants
Aeration	Detects volatile, oxidizable, sublatable, or spargeable compounds
Ethylenediaminetetraacetic acid (EDTA) addition	Detects cationic metals (e.g., cadmium)
Sodium thiosulfate (STS) addition	Detects oxidative compounds (e.g., chlorine)
Solid phase extraction (SPE) over C18 column (may be followed by methanol elution)	Detects non-polar organics and some surfactants (methanol elution adds toxicity back to sample)
Piperonyl butoxide (PBO) addition	Detects organophosphate pesticides and pyrethroids

Carboxyl esterase addition*	Hydrolyzes pyrethroids
Bovine serum albumin (BSA) addition	Protein BSA is used as a control for the carboxyl esterase
Temperature reduction	Increases toxicity of pyrethroid pesticides
pH adjustment	Detects pH-dependent toxicants (e.g., ammonia and sulfides)
* Carboxylesterase addition has been used in recent studies to help identify pyrethroid-associated toxicity (Wheelock et al., 2004; Weston and Amweg, 2007). However, this treatment is experimental in nature and should be used along with other pyrethroid-targeted TIE treatments (e.g., PBO addition).	

Adjustments may be made to these TIE protocols if specific contaminants are suspected to be contributing to toxicity. For example, total dissolved solids (TDS) controls and/or mock effluents to mimic TDS concentrations observed in samples are often added to the treatments listed in Table 3-1 if ionic imbalance or elevated TDS are suspected. Toxicity due to ionic imbalance occurs when ion concentrations are not within the tolerance range of the selected test organism; utilizing *S. purpuratus* for toxicity tests conducted for samples with salinity > 1 ppt may help to alleviate this common issue, especially during dry weather.

Phase II and III TIEs may be necessary, depending whether the Phase I determination of toxicant class is sufficient for identifying pollutants for outfall monitoring and/or identifying source control measures. If necessary, Phase II and III procedures may include toxicant removal and add-back, serial additions, and/or toxicant spiking experiments in accordance with USEPA 1993a and 1993b.

It should be noted that, due to intermittent toxicity and/or toxicity resulting from multiple toxicants, TIEs are not always conclusive. In such cases, conducting toxicity tests with additional organisms (SMC Model Monitoring Technical Committee, 2004) and/or serially identifying toxicants (USEPA, 2001) may help characterize observed toxicity. When a receiving water sample exhibits persistent toxicity of a high magnitude, as is generally the case when TIEs are conducted, TIEs are typically successful (USEPA, 2001).

3.3 Toxicity Source Evaluation

Once any toxicants have been identified during the TIE process, Copermittees must discuss the need for conducting a TRE. The following sections provide an outline for developing specific monitoring elements intended to focus the effort in locating the source(s) of the pollutant(s).

If urban runoff is suspected as a significant source of the pollutant(s) characterized by a TIE to be a contributor to toxicity at a receiving water station, source identification procedures may need to be considered. An evaluation of chemistry and bioassessment data for the receiving water station and chemistry data for upstream outfalls may help to confirm whether urban runoff is a significant source of the pollutant(s) causing toxicity and may justify further source identification procedures.

More comprehensive source identification procedures, if warranted, may include compiling descriptions of all potential sources to the receiving water station, determining actual sources and their relative magnitudes, and quantitatively estimating loads from these sources. A model for a source identification investigation study is outlined in the *Model Monitoring Program for Municipal Separate Storm Sewer Systems in Southern California* (SMC Model Monitoring Technical Committee, 2004) and more detailed source identification study methodology is outlined in USEPA (1993c) and by Pitt (2004). The general approach may include a combination of the components presented in Figure 3-1.

Desktop Assessment

- Delineate tributary drainage area and MS4 infrastructure draining to receiving water, as well as responsible agencies to be involved in TRE and investigations.
- Identify upstream land uses and watershed activities which may represent contributing sources of pollutant(s) causing toxicity.
- Compile and evaluate existing data for upstream MS4 from MS4 inventory.
- Leverage observation and monitoring data from other programs such as for example:
  - *Industrial Permit*
  - *Construction Permit*
  - *IC/ID Program*

Initial Field Assessment

- Implement initial upstream MS4 investigations, sampling for pollutant(s) identifed in TIE to be causing toxicity. Prioritize investigations based on MS4 inventory and other factors.
- Types of Investigations to conisder may include::
  - Visual/Observation
  - Upstream MS4 Transect Surveys
  - Land Use or Activity Based Source Investigations
  - Special Studies

Watershed Planning

- Review existing water quality plans and programs (i.e. WQIPs, CLRPs, TMDL implementation plans, WURMPs, JRMPs) for pollutant sources, watershed priorities, and existing institutional activities and BMPs implemented locally. Cross-reference effectiveness to reducing pollutant(s) causing observed toxicity.
- Identify local water quality criteria and habitat health criteria to establish triggers for source investigations.
- Develop source investigation report and work plan based on existing guidance.

Figure 3-1. The Toxicity Source Evaluation Approach

Source identification efforts may coordinate with monitoring and assessment activities necessary for compliance with the following Provisions:

- Provision A.4.a.(2) – If it is determined that discharges from the MS4 are causing or contributing to a new exceedance of an applicable water quality standard not addressed by the WQIP, update the WQIP with the water quality improvement strategies implemented or to be implemented, the implementation schedule, and the monitoring and assessment program updates intended to track progress toward achieving compliance.

- Provision B.2.d – identify and prioritize known and suspected sources of stormwater and non-stormwater pollutants from MS4 outfalls that contribute to the highest priority water quality conditions, as identified in the WQIP.
- Provision B.3 – identify water quality improvement goals and strategies to address the highest priority water quality conditions, as identified in the WQIP.
- Provision D.2.b – perform dry weather MS4 outfall monitoring to identify non-storm water flows and illicit discharges within its jurisdiction and to prioritize these discharges for investigation and elimination.
- Provision D.2.c – perform wet weather MS4 outfall monitoring to identify pollutants in storm water discharges from the MS4, guide pollutant source identification efforts, and determine compliance with applicable Total Maximum Daily Loads (TMDLs).
- Provision D.3 – conduct special studies related to the highest priority water quality conditions. Provision D.3.c specifies that special studies related to pollutant and/or stressor source identification should include a compilation of known information on the pollutant and/or stressor, an identification of data gaps intended to be filled by the studies, and a monitoring plan which includes, among other required elements, a prioritization of sources of the pollutant and/or stressor.
- Provision E.2 – implement a program to detect and eliminate illegal discharges and improper disposal into the MS4.

If no source can be identified as a major contributor to receiving water toxicity, more intensive follow-up studies may be required.

3.4 Toxicity Control Evaluation

Using the results from the TRE elements conducted to this point, alternatives for reducing receiving water toxicity may be identified and the most feasible approach(es) may be selected. Pollution Prevention measures are designed to target pollutants and wastes before they are generated, while Source Controls are designed to reduce or eliminate pollutants before entering the MS4. These measures may include outreach, incentive programs, regulatory controls, and enforcement activities, as well as broader “true source controls” that must be implemented at a national or state level (e.g., product regulation). Institutional Programs, such as street sweeping, MS4 cleaning and repair, and other institutional services are typically maintenance activities implemented by agencies at various targeted frequencies to meet pollutant load reduction goals and minimum National Pollutant Discharge Elimination System (NPDES) Permit compliance criteria. Treatment Controls include structural systems designed to remove pollutants from stormwater and non-stormwater flows and may include a variety of low impact development (LID) and best management practices (BMPs) (e.g., infiltration-type, bioremediation, treatment trains, etc.). These BMPs are intended to protect receiving waters by eliminating or reducing the discharge of pollutants to the maximum extent practicable (MEP). Advantages and disadvantages of BMP alternatives should be considered, and appropriate BMPs should be selected based on site-specific conditions and pollutant(s) of concern. An integrated approach using a combination of Pollution Prevention measures, Institutional Programs, and Treatment Controls may be appropriate if more than one pollutant is identified to be causing or contributing to toxicity, or if the source is unknown. These three components of the toxicity control evaluation are shown in Figure 3-2.

Figure 3-2. Components of Toxicity Control Evaluation

3.5 Toxicity Control Implementation

Once the selected toxicity control method(s) are implemented, monitoring may be continued and possibly accelerated to confirm that toxicity reduction objectives are being met. Depending on the location and pollutant(s) being evaluated, some of this monitoring may be satisfied by Permit-required monitoring of receiving water and outfall locations (see Section 3.3).

Compliance with the monitoring and assessment requirements of the 2013 Permit, including Provision D.1.c.(4)(f) which requires the implementation of the TIE/TRE process described in this Work Plan, is intended to meet the discharge and receiving water limitations outlined in the 2013 Permit to the MEP. Updates to the monitoring programs developed to comply with these provisions will be incorporated into the WQIP through the adaptive management process outlined in Provisions B.4 and B.5 in order to continually monitor effectiveness and re-evaluate the programs.

3.6 Quality Assurance/Quality Control

A quality assurance/quality control (QA/QC) program for the TIE/TRE should be developed in order to ensure reliability of data collected throughout the process. The QA/QC program should include the QA/QC objectives, sample collection and preservation techniques, chain of custody procedures, analytical QA/QC, laboratory equipment maintenance, QA/QC training requirements, documentation and reporting procedures, and corrective action protocols (USEPA, 1993c). In addition, toxicology and analytical laboratories should be experienced and qualified to conduct the TIE/TRE.

3.7 TIE/TRE Limitations

There are inherent limitations associated with the TIE/TRE process summarized in this Work Plan, including the difficulty of characterizing intermittent toxicity (USEPA, 1993c) and/or toxicity resulting from multiple toxicants (USEPA, 2001). In addition, existing TRE guidance was developed primarily for point source discharges from wastewater treatment plants whereas receiving waters potentially capture pollutants from many sources and contain contaminants at more variable concentrations than those from a wastewater treatment facility, especially during a storm event.

4.0 REFERENCES

CWP (Center for Watershed Protection) and R. Pitt. 2004. *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*. EPA Cooperative Agreement X-82907801-0. Washington, D.C. USEPA Office of Water. October 2004.

RWQCB (Regional Water Quality Control Board). 2013. *California Regional Water Quality Control Board San Diego Region, Order No. R9-2013-0001, NPDES No. CAS0109266, 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*. May 2013.

USEPA (U.S. Environmental Protection Agency) 2010. National Pollutant Discharge Elimination System Test of Significant Toxicity Implementation Document. EPA 833-R-10-003. Office of Wastewater Management. June.

USEPA (United States Environmental Protection Agency). 1991. *Methods for Aquatic Toxicity Identification Evaluations. Phase I Toxicity Characterization Procedures.* EPA/600/6-91/003. EPA Office of Research and Development. Second Edition. February 1991.

USEPA (United States Environmental Protection Agency). 1992. *Toxicity Identification Evaluation. Characterization of Chronically Toxic Effluents, Phase I.* EPA/600/6-91/005F. EPA Office of Research and Development. May 1992.

USEPA (United States Environmental Protection Agency). 1993a. *Methods for Aquatic Toxicity Identification Evaluations. Phase II Toxicity Characterization Procedures for Samples Exhibiting Acute and Chronic Toxicity*. EPA/600/R-92/080. EPA Office of Research and Development. September 1993.

USEPA (United States Environmental Protection Agency). 1993b. *Methods for Aquatic Toxicity Identification Evaluations. Phase III Toxicity Characterization Procedures for Samples Exhibiting Acute and Chronic Toxicity*. EPA/600/R-92/081. EPA Office of Research and Development. September 1993.

USEPA (United States Environmental Protection Agency). 1993c. Investigation of inappropriate pollutant entries into storm drainage systems. Office of Research and Development, Washington, DC. EPA/600/R-92/238.

USEPA (United States Environmental Protection Agency). 1995. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms*. First Edition. EPA-600-R-95-136. EPA Office of Water. August 1995.

USEPA (United States Environmental Protection Agency). 1999. *Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants.* EPA/833B-99/002. EPA Office of Wastewater Management. August 1999.

USEPA (United States Environmental Protection Agency). 2001. *Clarifications Regarding Toxicity Reduction and Identification Evaluations in the National Pollutant Discharge Elimination System Program*. Office of Wastewater Management. March 27, 2001.

USEPA (United States Environmental Protection Agency). 2002. *Short-term Methods for Evaluating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*. Fourth Edition. EPA-821-R-02-013. EPA Office of Water. October 2002.

ATTACHMENT 4A-5: SAN DIEGO RIVER WATERSHED STORM DRAIN OUTFALL MONITORING PLAN

San Diego River Watershed
Storm Drain Outfall Monitoring Plan

Prepared For:
San Diego River Watershed
Participating Agencies

Prepared By:
AMEC Environment and Infrastructure, Inc.
9177 Sky Park Court
San Diego, California 92123
January 2015

This page intentionally left blank

TABLE OF CONTENTS

PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

%	percent
<	less than
303(d) list	Clean Water Act Section 303(d) List of Impaired Waterbodies
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) (Regional Board, February 10, 2010)
CMP	corrugated metal pipe
CP	concrete pipe
CWA	Clean Water Act
ELAP	California Environmental Laboratory Accreditation Program
GIS	Geographic Information System
IDDE	Illicit Discharge Detection and Elimination
JRMP	Jurisdictional Runoff Management Program
STORM DRAIN	Municipal Separate Storm Sewer System
Permit	San Diego Regional Water Quality Control Board Order Number R9-2013-0001, National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer System (MS4) Draining the Permits Within the San Diego Region
NAL	non-stormwater action level
NPDES	National Pollutant Discharge Elimination System
PID	photoionization detector
QA	quality assurance
RCC	reinforced concrete channel
RCP	reinforced concrete pipe

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

Regional Board	Regional Water Quality Control Board, San Diego Region
SAL	stormwater action level
SWAMP	Surface Water Ambient Monitoring Program
TBD	to be determined
TKN	total Kjeldahl nitrogen
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WATERSHED	Permit Management Area
WQBEL	Water Quality Based Effluent Limit
WQIP	Water Quality Improvement Plan
WQO	Water Quality Objective
WURMP	Permit Urban Runoff Management Program

INTRODUCTION

In May 2013, the San Diego Regional Water Quality Control Board (Regional Board) Order No. R9-2013-0001, *National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirement for Discharges From The Municipal Separate Storm Sewer Systems (MS4s) Draining The Permits Within the San Diego Region* (Permit; Regional Board, 2013) was adopted, replacing REGIONAL BOARD Order No. R9-2007-0001 (Regional Board, 2007), and became effective June 27, 2013. The Permit prescribes monitoring programs for the storm drain outfalls during wet and dry weather for the duration of the Permit cycle.

PROGRAM OVERVIEW

In the San Diego River Permit Watershed Management Area (Watershed), five Municipal Copermittees (Copermittees) are named under the Permit:

- City of El Cajon
- City of La Mesa
- City of San Diego
- City of Santee
- County of San Diego

The Copermittees are required to perform storm drain outfall monitoring in accordance with Provision D of the Permit. Permit-required storm drain outfall monitoring is composed of two major components:

- Dry Weather Storm Drain Outfall Discharge Monitoring (Provision D.2.b; Regional Board, 2013)
- Wet Weather Storm Drain Outfall Discharge Monitoring (Provision D.2.c; Regional Board, 2013)

The purpose of this monitoring plan is to describe the monitoring and assessment requirements and procedures for the San Diego River Watershed Storm Drain Outfall Discharge Monitoring Program required by the Permit.

DRY WEATHER STORM DRAIN OUTFALL DISCHARGE MONITORING

This section details the dry weather storm drain outfall monitoring required to comply with the Permit. Each Copermittee is required to perform dry weather Storm Drain outfall prioritization and monitoring to aid in the identification of non-stormwater and illicit discharges within its respective jurisdictions as required by Provision D.2.b of the Permit.

STORM DRAIN OUTFALL INVENTORY

The Copermittees have identified the known major storm drain outfalls that discharge directly to receiving waters within their respective jurisdictions within the San Diego River Watershed. The identified major storm drain outfalls have been geo-located on respective Geographic Information

System (GIS) jurisdictional map of the San Diego River Watershed as required by Provision D.2.a.(1) of the Permit. Each Copermittee will individually maintain, confirm, and update its respective maps during annual field screening (Provision D.2.2). The respective jurisdictional storm drain maps contain the following items that, at a minimum, will be confirmed and updated during annual field screening as applicable:

- Segments of the storm drain owned, operated, and maintained by the Copermittee
- Known locations of inlets that discharge and/or collect runoff into the Copermittee's storm drain
- Known locations of connections with other storm drains not owned or operated by the Copermittee
- Known locations of storm drain outfalls and private outfalls that discharge runoff collected from areas within the Copermittee's jurisdiction
- Segments of receiving waters within the Copermittee's jurisdiction that receive and convey runoff discharged from the Copermittee's storm drain outfalls
- Locations of the storm drain outfalls within each Copermittee's respective jurisdiction
    - Latitude and longitude of storm drain outfall point of discharge
    - Permit Management Area
    - Hydrologic subarea
    - Outlet size
    - Accessibility (i.e. safety and without disturbance of critical habitat)
    - Approximate drainage area
    - Classification of whether the storm drain outfall is known to have persistent non-stormwater flows, transient non-stormwater flows, no non-stormwater flows, or unknown non-stormwater flows
- Locations of the selected non-stormwater persistent flow storm drain outfall discharge monitoring stations within each Copermittee's respective jurisdiction (Provision D.2.3.2)

Because of their size, geo-located storm drain outfall maps are not included in this monitoring plan. Table 2-1 presents the number of identified major outfalls in the San Diego River Watershed by Copermittee.

Table 2-1. Number of Identified Major Storm Drain Outfalls by Copermittee

Copermittee	Number of Identified Major Outfalls
City of El Cajon	To Be Determined (TBD)
City of La Mesa	13
City of San Diego	502
City of Santee	57
County of San Diego	50

Field Screening

Each Copermittee is required to conduct field screening to determine which non-stormwater storm drain outfall discharges are transient flows and which are persistent flows, and to prioritize the non-stormwater storm drain discharges that will be investigated and eliminated in accordance with the Illicit Discharge Detection and Elimination (IDDE) program.

Monitoring Locations And Frequency

Per the requirements of Provision D.2.a.(2).(a) of the Permit, the number of major outfalls required to be screened is dependent upon the number of known major outfalls present in a Copermittee's inventory. For the San Diego River Watershed Copermittees, the following requirements apply:

- For Copermittees with fewer than 125 known major storm drain outfalls that discharge to receiving waters within a Watershed, at least 80 percent of the outfalls are required to be visually inspected two times per year during non-stormwater conditions. The following Copermittees in the San Diego River Watershed fall into this category:
  - City of El Cajon (TBD, not confirmed)
  - City of La Mesa
  - City of Santee
  - County of San Diego
- For Copermittees with 125 major storm drain outfalls or more, but fewer than or equal to 500 that discharge to receiving waters within a Watershed, all the outfalls are required to be visually inspected at least annually during non-stormwater conditions. The following Copermittees in the San Diego River Watershed fall into this category:
  - City of San Diego

Based on these criteria, Table 2-2 details the number of major outfalls and inspection frequency for each Copermittee 's jurisdiction.

Table 2-2. Storm Drain Outfall Screening Number and Frequency by Copermittee

Copermittee	Number of Identified Major Outfalls	Frequency of Screening
City of El Cajon	TBD	TBD
City of La Mesa	11[1] (13)	80% of major outfalls, twice annually
City of San Diego	500	500 major outfalls, once annually
City of Santee	46[1] (57)	80% of major outfalls, twice annually
County of San Diego	40[1] (50)	80% of major outfalls, twice annually

1. For Copermittees with fewer than 125 major storm drain outfalls in the watershed, 80% of major outfalls must be screened twice per year. Total number of major outfalls within each jurisdiction in the watershed is provided in parentheses.

Visual Observations

Per the Permit, during a field screening visual observation inspection, each storm drain outfall selected for screening will be inspected following at least 72 hours of dry weather after any storm event producing greater than 0.10 inch of rainfall within a 24-hour period. Table 2-3 details the visual observations that will be recorded during each field screening visual observation inspection, per the requirements of Provision D.2.a.(2) of the Permit. An example field observation form used to record field screening visual observations is included in Attachment A. Example procedures for flow estimation are described in Attachment B.

Table 2-3. Field Screening Visual Observations for Storm Drain Outfall Discharge Monitoring Stations

Field Observations
Station identification and location
Presence of flow, or pooled or ponded water
If flow is present:
Flow estimation (i.e., width of water surface, approximate depth of water, approximate flow velocity, flow rate)
Flow characteristics (i.e., presence of floatables, surface scum, sheens, odor, color)
Flow source(s) suspected or identified from non-stormwater source investigation
Flow source(s) eliminated during non-stormwater source identification
If pooled or ponded water is present:
Characteristics of pooled or ponded water (i.e., presence of floatables, surface scum, sheens, odor, color)
Known or suspected source(s) of pooled or ponded water
Station description (i.e., deposits or stains, vegetation condition, structural condition, observable biology)
Presence and assessment of trash in and around station
Evidence or signs of illicit connections or illegal dumping

NON-STORMWATER PERSISTENT FLOW STORM DRAIN OUTFALL DISCHARGE MONITORING

Each Copermittee is required to perform non-stormwater persistent flow storm drain outfall discharge monitoring to determine whether persistent non-stormwater discharges may be impacting receiving water quality.

OUTFALL PRIORITIZATION

Copermittees must each identify a minimum of the 5 highest priority major storm drain outfalls with non-stormwater persistent flows that they will monitor within their respective jurisdictions in the San Diego River Watershed, in accordance with Permit Provision D.2.b.(2)(b) (Regional Board, 2013). If a Copermittee has less than 5 major outfalls within the Watershed, the Copermittee will monitor all its major Storm Drain outfalls with persistent flow. The Copermittees selected dry weather storm drain outfall discharge monitoring stations from the inventories developed pursuant to Provision D.2.b.(2)(a) for the San Diego River Watershed as follows:

- *Based upon the dry weather storm drain outfall discharge field screening monitoring records developed pursuant to Provision D.2.a.(2)(c), each Copermittee must identify and prioritize the storm drain outfalls with persistent flows based on the highest priority water quality conditions identified in the Water Quality Improvement Plan and any additional criteria developed by the Copermittee, which may include historical data and data from sources other than what the Copermittee collects.*

MONITORING LOCATIONS AND FREQUENCY

The highest priority major storm drain outfalls with non-stormwater persistent flows selected by each Copermittee are presented in Table 2-4 and Figure 2-1.

Each selected highest priority major outfall will be monitored at least semi-annually. A Copermittee may substitute a next-highest priority major outfall for a selected major outfall in the event that one of the following criteria becomes applicable, until no qualifying major storm drain outfalls remain within the Copermittee's jurisdiction in the San Diego River Watershed:

- The non-stormwater discharges have been effectively eliminated (i.e., no flowing, pooled, or ponded water) for three consecutive non-stormwater monitoring events.
- The source of the persistent flows has been identified as a category of non-stormwater discharges that does not require an NPDES permit and does not have to be addressed as an illicit discharge because it was not identified as a source of pollutants.
- The constituents in the persistent flow non-stormwater discharge do not exceed NALs.
- The source of the persistent flows has been identified as a non-stormwater discharge authorized by a separate NPDES permit.

In the event of a substitution, each Copermittee will document the reprioritization of its highest priority persistent flow storm drain outfalls in the Water Quality Improvement Plan (WQIP) Annual Report.

Table 2-4. Selected Highest Priority Major Storm Drain Outfalls for Non-Stormwater Persistent Flow Monitoring

Jurisdiction	Site ID	Outfall Size	Outfall Type	Latitude	Longitude
City of El Cajon	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD
City of La Mesa	OF-ALV-5	36 x 60	RCB	32.77373	-117.02757
	OF-ALV-8	(2x) 48	Manhole[1]	32.77411	-117.02288
	OF-ALV-11	57	Manhole[1]	32.7777	-117.01769
City of San Diego	DW0067	60"	CP	32.83539	-117.12212
	DW0369	54"	CP	32.80243	-117.06845
	DW0081	54"	CP	32.8205	-117.11705
	DW0681	48"	Manhole[1]	32.77597	-117.13115
	DW0696	36"	CP	32.83938	-117.09311
City of Santee	E5g1	2 x 72”	Manhole[1]	32.84885	-117.00471
	R20a	54	Outfall[2]	32.8319	-116.98602
	RCP1	42	Outfall[2]	32.84949	-116.96659
	S5c	60	Outfall[2]	32.84363	-116.98795
	S15h	48	Outfall[2]	32.84326	-116.98969
County of San Diego	STORM DRAIN-SDR-036	60"	CMP	32.8469	-116.87153
	STORM DRAIN-SDR-064	5 X 66"	RCC	32.86168	-116.94471
	STORM DRAIN-SDR-127	64"	CMP	32.84911	-116.88414
	STORM DRAIN-SDR-151	48"	RCP	33.00782	-116.82069
	STORM DRAIN-SDR-207	96" X 60"	RCB	32.83269	-116.90533

Notes:

RCB = Reinforced Concrete Box; CP = Concrete Pipe; CMP = Corrugated Metal Pipe; RCC = Reinforced Concrete Channel; RCP = Reinforced Concrete Pipe; TBD = To Be Determined

1. Manhole type structure; the outfall is not accessible

2. Outfall structure located at point of discharge

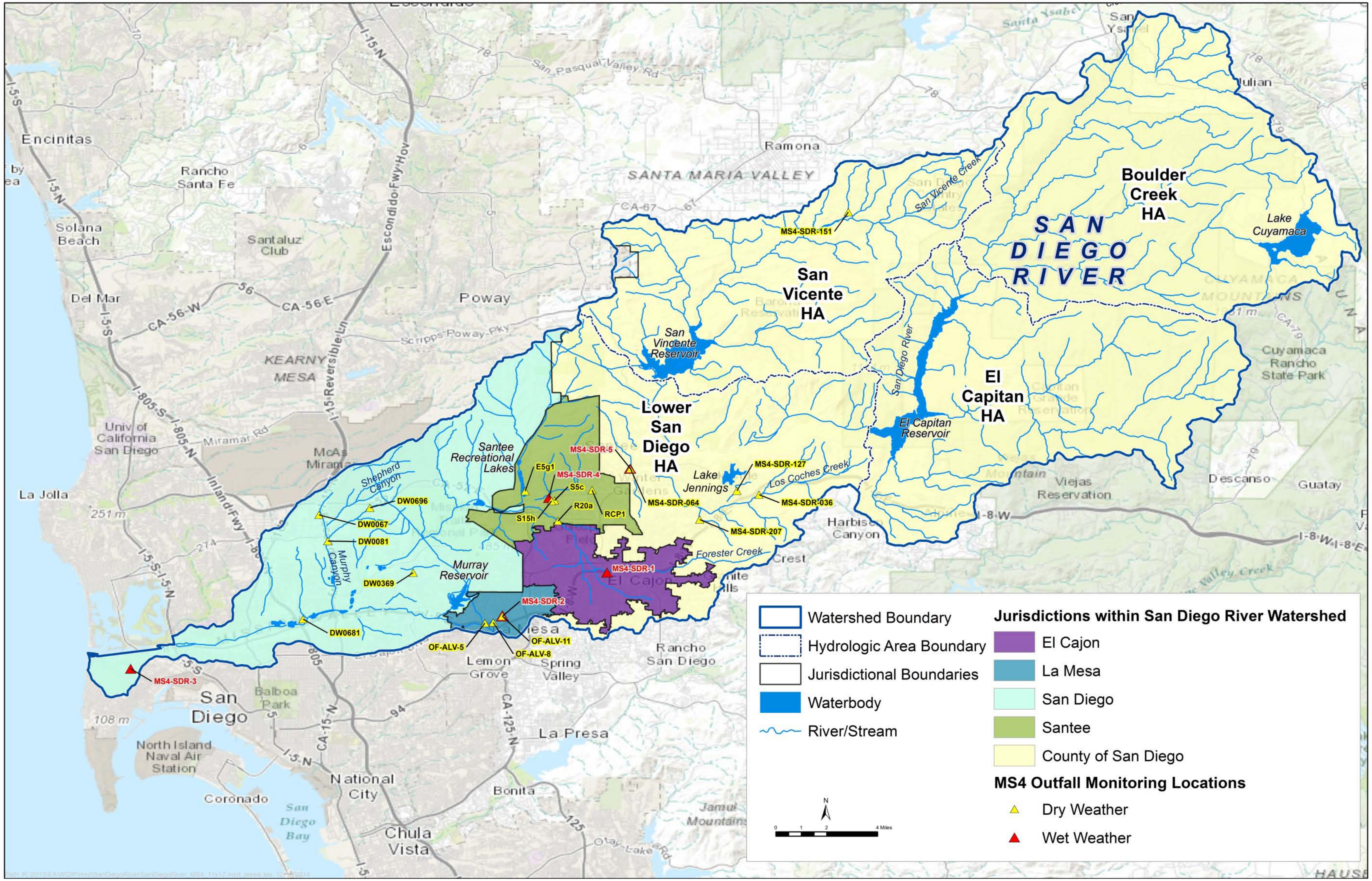


Figure 2-1. Selected Major Outfalls for Dry and Wet Weather Storm Drain Discharge Monitoring

This page intentionally left blank

Field Observations

During the monitoring events, field observations will be recorded at each of the selected major outfall persistent flow monitoring sites. The flow rates and volumes will be measured or estimated using data from nearby USGS gauging stations, or by manual measurements performed in accordance with the USEPA Storm Water Sampling Guidance Document (EPA-833-B-92-001), section 3.2.1. Alternative flow measurement or estimation methods that are acceptable to the San Diego Water Board may be employed. An example dry weather field observations form is provided in Attachment A. A list of required field observations is presented in Table 2-3.

Field Monitoring

During the monitoring events, *in-situ* measurements will be collected at each of the selected major outfall persistent flow monitoring sites. These will include:

- pH
- Temperature
- Specific conductivity
- Dissolved oxygen
- Turbidity

Field monitoring will be documented on a field observation form. A list of parameters, monitored corresponding target reporting limits, and suggested analytical methods is provided in Attachment A.

Analytical Monitoring

Sample Collection

During the monitoring events, provided sufficient measurable flow is present, samples will be collected for analysis by an analytical laboratory. Grab samples will be collected in accordance with the Surface Water Ambient Monitoring Program (SWAMP) protocols. An example chain-of-custody (COC) form is included in Attachment C. Quality assurance and quality control procedures are outlined in Attachment F.

Laboratory Analysis

The required analyses are based upon the following five groupings of constituents:

1) Constituents contributing to the highest priority water quality conditions identified in the San Diego River Watershed WQIP
2) Constituents listed as a cause for impairment of receiving waters in the San Diego River Watershed as listed on the 303(d) list
3) Constituents for implementation plans or load reduction plans (e.g., Bacteria Load Reduction Plans, Comprehensive Load Reduction Plans) developed for the San Diego River Watershed where the Copermittees are listed responsible parties to a Total Maximum Daily Load (TMDL)

4) Applicable NAL constituents listed in Provision C.1 of the Permit
5) Constituents listed in Table D-7 of the Permit

Attachment A details the analyses required for selected STORM DRAIN outfall persistent flow monitoring, including target reporting limits. Per Provision 2.i.(3)in Attachment B of the Permit, all chemical and bacteriological analysis of samples will be performed by laboratory(ies) certified for such analyses by the California Department of Public Health or laboratory(ies) approved by the San Diego Water Board.. All sampling, analysis and quality assurance/quality control will be conducted in accordance with the Quality Assurance Management Plan (QAMP) for the State of California's Surface Water Ambient Monitoring Program (SWAMP), adopted by the State Water Resources Control Board (State Water Board).

WET WEATHER STORM DRAIN OUTFALL DISCHARGE MONITORING

This section details the wet weather storm drain outfall monitoring required to comply with the Permit. Each Copermittee is required to perform wet weather storm drain outfall monitoring to identify pollutants in stormwater discharges from the storm drains, guide pollutant source identification efforts, and determine compliance with the Water Quality Based Effluent Limits (WQBELs) associated with the Bacteria TMDL within its respective jurisdiction as required by Provision D.2.c of the Permit. This section is based on the Wet Weather MS4 Outfall Discharge Monitoring Work Plan (San Diego County Regional Copermittees [SDCRC], 2014).

STORMWATER STORM DRAIN OUTFALL DISCHARGE MONITORING

Each Copermittee is required to perform wet weather storm drain outfall prioritization and monitoring to aid in the identification of pollutants in stormwater discharges from the storm drains, to guide pollutant source identification efforts, and to determine compliance with the WQBELs associated with the applicable TMDLs within its respective jurisdiction as required by Provision D.2.c of the Permit.

OUTFALL PRIORITIZATION

The Copermittees selected wet weather storm drain outfall discharge monitoring stations from the inventories developed pursuant to Provision D.2.a.(3).(a).(1) of the Permit for the San Diego River Watershed as follows:

- *At least five wet weather storm drain outfall discharge monitoring stations that are representative of stormwater discharges from areas consisting primarily of residential, commercial, industrial, and typical mixed-use land uses present within the Permit Management Area*
- *At least one wet weather storm drain outfall discharge monitoring station for each Copermittee within the Permit Management Area*

The Copermittees may adjust the wet weather storm drain outfall discharge monitoring locations in the San Diego River Watershed, as needed, to identify pollutants in stormwater discharges from storm drains, to guide pollutant source identification efforts, and to determine compliance with the

WQBELs associated with applicable TMDLs in accordance with the highest priority water quality conditions identified in the San Diego River Permit WQIP

MONITORING LOCATIONS AND FREQUENCY

The monitoring locations for wet weather storm drain outfall monitoring are provided in Table 3-1 and Figure 2-1.

Table 3-1. Wet Weather Storm Drain Outfall Monitoring Locations

STORM DRAIN Site Name	Jurisdictional Identifier	Jurisdiction	Latitude	Longitude
MS4-SDR-1	27	City of El Cajon	32.80256	-116.95808
MS4-SDR-2	OF-ALV-11	City of La Mesa	32.77776	-117.01751
MS4-SDR-3	DW136	City of San Diego	32.74773	-117.22927
MS4-SDR-4	G30c	City of Santee	32.84501	-116.99122
MS4-SDR-5	COSD MS4 SDR01	County of San Diego	32.86165	-116.94474

Per the requirements of the Permit, the Copermittees will monitor wet weather storm drain outfall discharge monitoring station(s) in the San Diego River Watershed once annually.

WET WEATHER EVENTS

Storm events will be considered viable for mobilization if they are predicted to produce at least 0.1 inch of rainfall in the drainage area. Storm forecasts can be obtained from the National Weather Service website (http://www.wrh.noaa.gov/sgx/) or an equivalent source.

FIELD OBSERVATIONS

During each wet weather monitoring event, narrative descriptions and field observations will be recorded at each wet weather storm drain outfall discharge monitoring station. Narrative descriptions and observations include:

- Station location
- Date and duration of the storm event(s) sampled
- Rainfall estimates of the storm event
- Duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event

Flow estimation or measurement will be performed as described in Attachment B, using data from nearby United States Geological Survey (USGS) gauging stations, or flow rates may be measured or estimated in accordance with the United States Environmental Protection Agency (USEPA) Storm Water Sampling Guidance Document (EPA-833-B-92-001), Attachment B, or other method proposed by the Copermittees that is acceptable to the Regional Board.

Field Monitoring

During each wet weather monitoring event, *in-situ* measurements for field monitoring parameters will be collected at each of the selected outfall sites. Field monitoring parameters include:

- pH
- Temperature
- Specific conductivity
- Dissolved oxygen
- Turbidity

Field monitoring will be documented on the field observation form. A list of field monitoring parameters and corresponding target reporting limits for field monitoring parameters is provided in Attachment A.

Analytical Monitoring

Sample Collection

Samples will be collected as follows:

- Consistent sample collection methods will be employed for regional comparability of data, unless site-specific conditions indicate the need for alternate methods;
- Grab samples will be collected for the analytes not amenable to composite sampling. These include pH, temperature, specific conductivity, dissolved oxygen, turbidity, and indicator bacteria;
- For all other constituents, composite samples will be collected for a duration adequate to be representative of changes in pollutant concentrations and runoff flows using one of the following techniques:
  - Time-weighted composites collected over the length of the storm event or the first 24 hour period whichever is shorter, composed of discrete samples, which may be collected through the use of automated equipment, or
  - Flow-weighted composites collected over the length of the storm event or a typical 24 hour period, whichever is shorter, which may be collected through the use of automated equipment, or
  - If automated compositing is not feasible, a composite sample may be collected using a minimum of 4 grab samples, collected during the first 24 hours of the stormwater discharge, or for the entire stormwater discharge if the storm event is less than 24 hours; and

All samples will be collected, transported, processed and analyzed in accordance with SWAMP protocols.

Laboratory Analysis

The required analyses are based upon the following four groupings of constituents:

1) Constituents contributing to the highest priority water quality conditions identified in the San Diego River Watershed WQIP
2) Constituents listed as a cause for impairment of receiving waters in the San Diego River Watershed as listed on the 303(d) list
3) Constituents for implementation plans or load reduction plans (e.g., Bacteria Load Reduction Plans, Comprehensive Load Reduction Plans) developed for the San Diego River Watershed where the Copermittees are listed as responsible parties under a TMDL
4) Applicable stormwater action level (SAL) constituents listed in Provision C.2 of the Permit.

Attachment A details the analyses required for wet weather storm drain outfall monitoring, including corresponding target reporting limits and suggested analytical methods. Equivalent analytical methods may be substituted for those listed in Attachment A. Analytes that are field measured are not required to be analyzed by a laboratory. Per Provision 2.i.(3)in Attachment B of the Permit, all chemical and bacterial analysis of samples will be performed by laboratory(ies) certified for such analyses by the California Department of Public Health or laboratory(ies) approved by the San Diego Water Board.. All sampling, analysis and quality assurance/quality control will be conducted in accordance with the Quality Assurance Management Plan (QAMP) for the State of California's SWAMP, adopted by the State Water Board.

STORM DRAIN OUTFALL ASSESSMENT AND REPORTING

San Diego River Watershed Copermittees will evaluate dry and wet weather storm drain data collected pursuant Permit Provisions D.2.b and D.2.c as outlined in Provision D.4.b. Assessments required for the WQIP Annual Reports are presented in Section 4.1. Assessments required for inclusion in the Report of Waste Discharge (ROWD) in Section 4.2.4.

WQIP Annual Report Assessments

The STORM DRAIN outfall discharge assessments include evaluating both the dry weather monitoring data associated with the IDDE program collected as part of the Jurisdictional Runoff Management Program (JRMP) and wet and dry weather storm drain outfall monitoring data collected by the Copermittees as described in Sections 2 and 3 above. Details of the wet and dry weather storm drain outfall assessments are provided below. The San Diego River Watershed Copermittee will report the results in the San Diego River Watershed WQIP Annual Report.

Dry Weather STORM DRAIN Outfall Assessments

Each Copermittee must assess and report the progress of its IDDE program (required pursuant to Permit Provision E.2) toward effectively prohibiting non-stormwater and illicit discharges into the storm drains within its jurisdiction. Additionally, each Copermittee will assess its dry weather storm drain outfall monitoring data and provide results annually for inclusion in the San Diego River Watershed WQIP Annual Report. The following dry weather storm drain outfall assessments are required per Provision D.4.b.(1) of the Permit (a summary of the assessments is provided in Table 4-1).

- Identify sources of non-stormwater discharges.
  - Identify the known and suspected controllable sources (e.g., facilities, areas, land uses, and pollutant generating activities) of transient and persistent flows within each Copermittee's jurisdiction in the San Diego River Watershed.
  - Identify sources of transient and persistent flows within each Copermittee's jurisdiction in the San Diego River Watershed that have been reduced or eliminated.
  - Identify modifications of the field screening monitoring locations and frequencies for the storm drain outfalls in each Copermittee's inventory necessary to identify and eliminate sources of persistent flow non-stormwater discharges (Provision D.2.b).
  - The JRMP Annual Report will be used to guide this assessment in the WQIP Annual Report. Known and suspected sources will be identified during the implementation of JRMP activities. These activities include the facility inspections that complement the IDDE program and information gathered by the stormwater hotline or other public complaints. The JRMP Annual Report now consists of a one-page form that summarizes the JRMP activities in Attachment D of the Permit, along with supporting information. Section IV of the JRMP Annual Report Form summarizes the findings of the IDDE Program. The back-up that will be provided along with the form may include the following information to help identify sources:
    - Identify the subPermit of the source or complaint
    - Identify the potential receiving water of the source or complaint
    - Identify the potential pollutant or pollutant category that could be contributed by the source or complaint
- Rank and prioritize non-stormwater discharges.
  - Based on the data collected and applicable numeric action levels described in San Diego River Watershed WQIP, the Copermittees must rank the persistently flowing major outfalls in their jurisdictions according to the potential threat to receiving water quality and produce a prioritized list of major storm drain outfalls. The WQIP will be updated annually on the basis of these findings and with the goal of implementing (in the order of the ranked priority list) targeted programmatic actions and source investigations to eliminate persistent non-stormwater discharges and/or pollutant loads. The list will be reprioritized according to one or more of the following criteria (Provision D.2.b.(2)(b)(ii)):
    - The non-stormwater discharges have been effectively eliminated (i.e., there is no flowing, pooled, or ponded water) for three consecutive dry weather monitoring events.
    - The sources of the persistent flows have been identified as a category of non-stormwater discharges that do not require an NPDES permit and do not have to be addressed as an illicit discharge because they were not identified as sources of pollutants (i.e., the constituents in the non-stormwater discharge do not exceed numeric action level) and the persistent flow can be reprioritized to a lower priority.

- The constituents in the persistent flow non-stormwater discharge do not exceed NALs (Provision C.1).
- The source(s) of the persistent flows has (have) been identified as a non-stormwater discharge authorized by a separate NPDES permit.

  - Where these criteria have not been met but the threat to water quality has been reduced by the Copermittee, the highest priority persistent flow storm drain outfall monitoring stations may be reprioritized accordingly for continued dry weather storm drain outfall discharge field screening monitoring as part of the Dry Weather Storm Drain Outfall Discharge Field Screening Program.
  - Each Copermittee must document removal or reprioritization of the highest priority persistent flow storm drain outfall monitoring stations identified under the Non-Stormwater Persistent Flow Storm Drain Outfall Discharge Monitoring Program in the WQIP Annual Report. When a Copermittee removes a persistent flow storm drain outfall monitoring station, it will be replaced with the next highest prioritized major storm drain outfall designated by that jurisdiction in the San Diego River Watershed. If there are no remaining qualifying major storm drain outfalls within its jurisdiction, the number of major storm drain outfalls monitored will be reduced.
- Identify sources contributing to NAL exceedances.
  - For the highest priority major storm drain outfalls with persistent flows that exceed NALs (Provision C1.), each Copermittee must identify the known and suspected sources within its jurisdiction in the San Diego River Watershed that may cause or contribute to the numeric action limit exceedances and report them annually.
- Estimate volumes and loads of non-stormwater discharges.
  - Annually, each Copermittee must (1) analyze the data collected as part of the Non-Stormwater Persistent Flow storm drain Outfall Discharge Monitoring Program from the highest priority major storm drain outfalls, and (2) use a model or another method to calculate or estimate and report the non-stormwater volumes and pollutant loads collectively discharged from all the major storm drains outfalls in its jurisdiction that have persistent dry weather flows during the monitoring year. These calculations or estimates must include:
    - The percent contribution from each known source for each storm drain outfall
    - The annual non-stormwater volumes and pollutant loads collectively discharged from the Copermittee's major storm drain outfalls to receiving waters within the Copermittee's jurisdiction
    - The annual volumes and pollutant loads for sources of non-stormwater not subject to the Copermittee's legal authority that are discharged from the Copermittee's major storm drain outfalls to downstream receiving waters

Table 4-1. Annual Dry Weather STORM DRAIN Outfall Assessments

Assessment	Components	Reporting
Identify known and suspected controllable sources	Identify known and suspected controllable sources (e.g., facilities, areas, land uses, pollutant generating activities) of transient and persistent flows	Provide annually in WQIP Annual Report
Identify sources that have been reduced or eliminated	Identify sources of transient and persistent flows that have been reduced or eliminated	
Identify necessary modifications to monitoring locations and frequencies	Identify necessary modifications to monitoring locations and frequencies necessary to identify and eliminate sources of persistent flows	
Rank and prioritize non-stormwater discharges	Rank persistently flowing outfalls according to potential threat to receiving water quality	
	Produce/update prioritized list of outfalls	
Identify sources contributing to NAL exceedances	Identify known and suspected sources that may cause or contribute to exceedances	
Estimate volumes and loads of non-stormwater discharges	Analyze data collected as part of the Permit-required dry weather outfall monitoring	
	Use a model or other method to calculate and estimate collective persistent non-stormwater discharge volumes and pollutant loads. Specific calculations/estimates include: 1) Annual non-stormwater volumes and loads discharged from the Copermittee's major storm drain outfalls to receiving waters within its jurisdiction, with an estimate of the percent contribution from each known source for each storm drain outfall 2) Annual identification and quantification (by volume and pollutant load) of sources of discharged non-stormwater not subject to the Copermittee's legal authority	
Evaluate progress in achieving non-stormwater volume and load reductions	Identify reductions and progress in achieving reductions	Provide at minimum once during Permit cycle in WQIP Annual Report
	Assess the effectiveness of WQIP improvement strategies, with estimates of volume and load reductions attributed to specific strategies when possible	
	Identify modifications necessary to increase the effectiveness of WQIP strategies	
Identify data gaps	Identify data gaps in the monitoring data necessary to fulfill assessment requirements	Provide annually in WQIP Annual Report

Wet Weather Outfall Assessments and Illicit Discharges

According to the Permit Provision D.4.b.(2), the Copermittees must assess and report the progress of the water quality improvement strategies implemented as part of the WQIP and the JRMP toward reducing pollutants in stormwater discharges from the storm drains. This is designated as the Wet Weather Storm Drain Outfall Discharge Monitoring Program. The assessment of this program will contain the elements provided below and summarized in Table 4-2.

The elements for assessment of this program include the following:

- Estimate volumes and loads of stormwater discharges.
    - Analyze data collected as part of the Wet Weather storm drain Outfall Discharge Monitoring Program. For each monitoring year, calculate or estimate the following:
        - The average stormwater runoff coefficient for each land use type within the San Diego River Watershed.
        - For storm events with measurable rainfall greater than 0.1 inch, the volume of stormwater and pollutant loads discharged from the monitored storm drain outfalls to receiving waters within the San Diego River Watershed.
        - The total flow volume and pollutant loadings discharged from each Copermittee's jurisdiction within the San Diego River Watershed over the course of the wet season, extrapolated from the data produced from the monitored storm drain outfalls.
        - For storm events with measurable rainfall greater than 0.1 inch, the percent contribution of stormwater volumes and pollutant loads discharged from the land use type within (1) each hydrologic subarea with a major storm drain outfall to receiving waters or (2) each major storm drain outfall to receiving waters.
- Evaluate WQIP analysis.
    - The Copermittees will evaluate the WQIP analysis on the basis of the wet weather storm drain outfall monitoring data collected and the applicable stormwater numeric action levels (Provision C.2). This evaluation will include analyzing and comparing the monitoring data collected as part of the wet weather storm drain outfall monitoring program to the analysis and assumptions used to develop the WQIP. This will include the water quality improvement strategies developed pursuant Provision B.3 of the Permit. Additionally, the Copermittees will evaluate whether those analyses and assumptions should be updated as a component of the adaptive management described in the WQIP.

Table 4-2. Annual Wet Weather Storm Drain Outfall Assessments

Assessment	Component	Reporting
Estimate loads and volumes	Calculate or estimate the average stormwater runoff coefficient for each land use type	Provide annually in WQIP Annual Report
	Calculate or estimate the volume of stormwater and pollutant loads discharged from each monitored storm drain outfall for each qualifying storm event	
	Calculate or estimate the total volume and pollutant load discharged from the Copermittee's jurisdiction over the course of the wet season	
	Calculate or estimate the percent contribution of stormwater volumes and pollutant loads discharged from each land use type within each hydrologic subarea with a major storm drain outfall or each major storm drain outfall for each qualifying storm event	
Evaluate WQIP analysis	Using data and applicable SALs, evaluate and compare data collected to the analyses and assumptions used to develop the WQIP	
	Evaluate whether analyses and assumptions should be updated as a component of the adaptive management efforts	
Evaluate progress in achieving stormwater pollutant reductions	Identify reductions and progress in achieving reductions from different land uses and/or drainage areas	Provide minimum once during Permit cycle in WQIP Annual Report
	Assess the effectiveness of WQIP improvement strategies, with estimates of volume and load reductions attributed to specific strategies when possible.	
	Identify modifications necessary to increase the effectiveness of WQIP strategies	
Identify data gaps	Identify data gaps in the monitoring data necessary to fulfill assessment requirements	Provide annually in WQIP Annual Report

Report of Waste Discharge Once Per Permit Cycle Assessments

Dry Weather STORM DRAIN Outfall Assessments

Progress in achieving non-stormwater volume and load reductions will be assessed based on the data collected under the dry weather storm drain outfall monitoring program and annual assessments at least once per Permit cycle as follows:

- Identify reductions and progress in achieving reductions in non-stormwater and illicit discharges to each Copermittee's storm drain system.

- Evaluate the effectiveness of the water quality improvement strategies being implemented toward reducing or eliminating non-stormwater and pollutant loads discharging from each Copermittee's storm drain to receiving waters, with an estimate of the volume and/or pollutant load reductions attributable to specific strategies, if possible.
- Identify modifications necessary to increase the effectiveness of the WQIP strategies being implemented toward reducing or eliminating non-stormwater and pollutant loads discharging from the storm drain to receiving waters.

DRY WEATHER STORM DRAIN OUTFALL ASSESSMENTS

Progress in achieving stormwater pollutant reductions will be assessed based on the data collected under the wet weather storm drain outfall monitoring program and annual assessments at least once per Permit cycle as follows:

- Identify reductions and progress in achieving reductions in stormwater discharges to the Copermittee's storm drain system from different land uses and/or drainage areas
- Evaluate the effectiveness of the water quality improvement strategies being implemented toward reducing pollutants in stormwater discharging from the Copermittee's storm drain to receiving waters, with an estimate of the pollutant load reductions attributable to specific strategies, if possible
- Identify modifications necessary to increase the effectiveness of the WQIP strategies being implemented toward reducing pollutants discharging from the storm drain to receiving waters.

DATA MANAGEMENT AND REPORTING

Data sharing templates have been developed to support reporting under previous Permit cycles. Copermittees may leverage existing data sharing templates in order to facilitate compilation of Watershed-wide datasets for assessment and reporting purposes. Data compiled should be CEDEN-compatible and contain the following categories of information:

- General site description
- Visual observations
- Field measurements
- Laboratory data

This page intentionally left blank

REFERENCES

Hach. 2009. Catalog Number 3314: Sigma 950 Flow Meter User Manual. August, 2009. Available online at: http://www.hachflow.com/pdf/3314_950.pdf.

United States Environmental Protection Agency (USEPA). 1992. NPDES Storm Water Sampling Guidance Document Storm Water Sampling Guidance Document (EPA-833-B-92-001). July, 1992. Available online at: http://www.epa.gov/npdes/pubs/owm0093.pdf.

Environmental Monitoring and Assessment Program Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Wadeable Streams (USEPA 1998)

Regional Water Quality Control Board, San Diego (Regional Board). 2007. Resolution No. R9-2007-0001, Waste Discharge Requirements for Discharges Of Urban Runoff fromthe Municipal Separate Storm Sewer Systems (Storm drains) Draining The Permits Of The County Of San Diego, The Incorporated Cities Of San Diego County, The San Diego Unified Port District, And The San Diego County Regional Airport Authority.

EWQCB. 2010. 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 for Indicator Bacteria Project I—Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek). February 10.

REGIONAL BOARD. 2013. Resolution No. R9-2013-0001, National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the STORM DRAINs Draining the Permit in the San Diego Region (Permit). May 14.

San Diego County Regional Copermittees, 2014. 2013-2014 and 2014-2014 Transitional Wet Weather MS4 Outfall Discharge Monitoring Work Plan. Prepared by Weston Solutions. October.

State Water Resources Control Board (SWRCB). 2010. 2010 Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report). Available online at: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml Accessed on May 30th, 2014.

This page intentionally left blank

ATTACHMENT A
FIELD OBSERVATION FORMS

This page intentionally left blank

ATTACHMENT B
FLOW MONITORING AND EQUIPMENT CALIBRATION PROCEDURES

This page intentionally left blank

B FLOW MONITORING AND EQUIPMENT CALIBRATION PROCEDURES

This attachment describes potential methodologies and equipment that may be used to complete flow monitoring and field measurements for the Storm Drain Outfall Monitoring Program, as well as the installation and maintenance procedures.

Flow estimation and water quality sampling are dynamic processes which may require modification based on current site and channel conditions. Thus, the methodologies presented are subject to modification or substitution in order to meet the requirements of this monitoring program.

B.1 FLOW MONITORING

B.1.1 DRY WEATHER STORM DRAIN OUTFALL FLOW MONITORING

B.1.1.1 FIELD-BASED FLOW ESTIMATION

During non-stormwater screening and storm drain outfall monitoring, flow will be estimated visually and/or manually using one of the methodologies detailed in Section 3.2.2 of the National Pollutant Discharge Elimination System (NPDES) Storm Water Sampling Guidance Document (EPA-833-B-92-001; United States Environmental Protection Agency (USEPA), 1992). These methodologies include, but are not limited to the “float method” and the “bucket and stopwatch method”.

B.1.1.2 EQUIPMENT-BASED FLOW ESTIMATION

Copermittees may choose to perform optional equipment-based flow monitoring of non-stormwater persistent flows. Equipment-based flow estimation procedures are described in Section B.1.2.1.

B.1.2 WET WEATHER STORM DRAIN OUTFALL FLOW MONITORING

Per the San Diego County Copermittees’ (SDCRC) Transitional Wet Weather MS4 Outfall Discharge Monitoring Work Plan, flow monitoring may be conducted as described herein (SDCRC, 2014). During wet weather storm drain outfall monitoring, the flow rates and volumes will be measured or estimated from the storm drain outfalls. Flow rates will be measured or estimated in accordance with the NPDES Storm Water Sampling Guidance Document Section 3.2.1 (USEPA, 1992), or by another method proposed by the Copermittees that is acceptable to the San Diego RWQCB. Flow monitoring may need to be adapted specifically for tidally influenced sites.

B.1.2.1 EQUIPMENT-BASED FLOW ESTIMATION

Flow hydrograph and volume estimations will be captured utilizing estimated flow rates in accordance with the Section 3.2.1 of the USEPA document NPDES Storm Water Sampling Guidance Document (USEPA, 1992).

Measurement devices, sensor types, and equipment program settings will be selected on a site specific basis using best professional judgment. Due to flood control concerns typically associated with storm drain outfalls during storm events especially, a primary measurement device such as a weir or flume is unlikely to be selected. Thus, a lower profile secondary flow measurement device, such as an area-velocity senor or bubbler pressure transducer, is recommended for flow estimation from storm drain outfalls.

Flow will be monitored at each site to determine the volume of runoff. Flow may be estimated with a Sigma 920 Flow Meter (or similar type device) with an area velocity sensor and pressure transducer (Figure B-1). An area velocity sensor measures water level and velocity. Flow will be calculated based on the cross sectional area of the pipe, level of water, slope, and velocity. Flow may also be estimated using a HOBO level logger (or similar type device) (Figure B-2). The HOBO level logger is a pressure transducer only, and the flow will be estimated based on the area of the pipe, level of water, and slope.

Field teams will mount equipment securely using best professional judgment. Sampler tubing and wiring will be routed through conduits that will be placed between the monitoring locations and the sampling equipment or enclosures. Above-ground instruments will be protected within a site equipment enclosure. Depending on site configuration, enclosures may be semi-permanent (installed before monitoring begins and removed only when the monitoring program ends) or temporary. Exposed conduit, intakes, and sensors will be securely fastened using stainless steel brackets, screws, and anchors (Figure B-3).

Figure B-1. Sigma 910 Flowmeter and Area/Velocity Pressure Sensor

Figure B-2. HOBO Level Logger

Figure B-3. Example of Sensor Installation

The flow meter may be connected to an automated sampler through a 4-20 milliampere (mA) range output. In this configuration, the flow meter provides a method to control or pace the sampler, and store sampling data and other auxiliary data. The flow meter may measure and log estimated flow, rainfall, and sample history.

At each site, the pipe diameter and slope will be measured and recorded. Level and flow measurements will be logged at minimum 5-minute intervals for the duration of the monitoring event when using continuous logging devices. Data downloads will occur after the monitoring event is complete. Due to the velocities and potential for debris to be carried by storm flows, it is possible that the flow sensor may be damaged during storm flows. Damage to a flow sensor may result in a data gap of actual recorded flows. In this event, flows from the respective drainage area will be modeled for any data gaps based on the drainage area and impervious cover.

B.1.2.1.1 Data Downloads and Storage

All recorded flow data downloaded to a field computer will be immediately copied to a main office data server. The server will be backed up daily in accordance with standard server practices. Data will also be copied to project folders for QA review and approval prior to moving to the project file.

B.2 Equipment Calibration

B.2.1 Field Meter Calibration

Calibration of all field meters will be conducted immediately prior to deployment or use. Water quality probes will be calibrated with specified calibration solutions, and it will be verified that the solution expiration date has not been exceeded. All calibrations will be conducted in accordance with the manufacturer's specifications.

B.2.2 Flow Equipment Calibration

Calibration of flow equipment will be conducted immediately prior to deployment or use using the procedures described in the corresponding operations and maintenance manual.

All level logging equipment will be calibrated on-site and field verified for accuracy with a level measurement tape.

B.2.3 AUTOSAMPLER CALIBRATION

Calibration of autosampling equipment will be conducted immediately prior to deployment or use using the procedures described in the corresponding operations and maintenance manual.

All autosampling equipment will be calibrated on-site and field verified for aliquot collection accuracy using a graduated flask or beaker.

B.3 REFERENCES

San Diego County Regional Copermittees, 2014. 2013-2014 and 2014-2014 Transitional Wet Weather MS4 Outfall Discharge Monitoring Work Plan. Prepared by Weston Solutions. October.

United States Environmental Protection Agency (USEPA). 1992. NPDES Storm Water Sampling Guidance Document Storm Water Sampling Guidance Document (EPA-833-B-92-001). July, 1992. Available online at: http://www.epa.gov/npdes/pubs/owm0093.pdf.

ATTACHMENT C
CHAIN-OF-CUSTODY FORM

This page intentionally left blank

ATTACHMENT D
LIST OF ANALYTES, SUGGESTED METHODS, AND TARGET REPORTING LIMITS

This page intentionally left blank

Storm Drain Outfall Monitoring Analyte List

Analyte	Suggested Analytical Method*	Target Reporting Limit	Dry Weather Storm Drain Outfall Monitoring	Wet Weather Storm Drain Outfall Monitoring
Conventional Parameters				
Chloride	USEPA 300.0	0.5	X[4]	X[4]
Color	SM 2120B	3	X[4]	X[4]
Dissolved Oxygen	Meter	0.01	X[1,2,4,6C]	X[1,2,4,9]
pH	Meter	0.01	X[1,2,4,6B,6C]	X[1,2,4,9]
Specific Conductivity	Meter	1	X[1,2]	X[1,2,9]
Sulfates	USEPA 300.0	0.5	X[4]	X[4]
Temperature	Meter	0.1	X[1,2]	X[1,2,9]
Total Hardness	SM 2340B	0.662	X[7]	X[9]
Turbidity	Meter	0.1	X[1,2,6B,6C]	X[1,2,8,9]
Indicator Bacteria				
Enterococcus	SM 9230C	20	X[3,4,5,6A,6B,6C,7]	X[3,4,5,9]
Fecal Coliform	SM 9221E	20	X[3,4,5,6A,6B,6C,7]	X[3,4,5,9]
Total Coliform	SM 9221B	20	X[3,4,5,6A,7]	X[3,4,5,9]
Inorganic Analytes				
Cadmium (Dissolved)	USEPA 200.8	0.0001	X[6B,6C,7]	-
Cadmium (Total)	USEPA 200.8	0.0001	X[6B,6C,7]	X[8]
Chromium (Dissolved)	USEPA 200.8	0.0002	X[6B,6C,12]	-
Chromium (Total)	USEPA 200.8	0.0002	X[6B,6C,12]	-

Storm Drain Outfall Monitoring Analyte List (Continued)

Analyte	Suggested Analytical Method*	Target Reporting Limit	Dry Weather Storm Drain Outfall Monitoring	Wet Weather Storm Drain Outfall Monitoring
Chromium III (Dissolved)	Calculated from Chromium and Chromium VI	NA	X[6B,6C]	-
Chromium III (Total)	Calculated from Chromium and Chromium VI	NA	X[6B,6C]	-
Chromium VI (Dissolved)	USEPA 218.6	0.0003	X[6B,6C]	-
Chromium VI (Total)	USEPA 218.6	0.0003	X[6B,6C]	-
Copper (Dissolved)	USEPA 200.8	0.0005	X[6B,6C,7]	-
Copper (Total)	USEPA 200.8	0.0005	X[6B,6C,7]	X[8]
Iron (Dissolved)	USEPA 200.7	0.01	X[6C]	-
Iron (Total)	USEPA 200.7	0.01	X[6C]	-
Lead (Dissolved)	USEPA 200.8	0.0002	X[6B,6C,7]	-
Lead (Total)	USEPA 200.8	0.0002	X[6B,6C,7]	X[8]
Manganese (Dissolved)	USEPA 200.8	0.0002	X[4,6C]	X[4]
Manganese (Total)	USEPA 200.8	0.0002	X[4,6C]	X[4]
Nickel (Dissolved)	USEPA 200.8	0.0008	X[6B,6C]	-
Nickel (Total)	USEPA 200.8	0.0008	X[6B,6C]	-
Selenium (Dissolved)	USEPA 200.8	0.0002	X[4]	X[4]
Selenium (Total)	USEPA 200.8	0.0002	X[4]	X[4]

Storm Drain Outfall Monitoring Analyte List (Continued)

Analyte	Suggested Analytical Method*	Target Reporting Limit	Dry Weather Storm Drain Outfall Monitoring	Wet Weather Storm Drain Outfall Monitoring
Silver (Dissolved)	USEPA 200.8	0.0002	X[6B,6C]	-
Silver (Total)	USEPA 200.8	0.0002	X[6B,6C]	-
Zinc (Dissolved)	USEPA 200.8	0.005	X[6B,6C,7]	-
Zinc (Total)	USEPA 200.8	0.005	X[6B,6C,7]	X[8]
Nutrients				
Ammonia	USEPA 350.1	0.1	X[4,7]	X[4]
Dissolved Phosphorus	USEPA 365.1	0.01	X[4]	X[4]
Nitrate	USEPA 353.2	0.1	X[4,7,10]	X[4,8,11]
Nitrite	USEPA 353.2	0.1	X[4,7,10]	X[4,8,11]
Orthophosphate	USEPA 365.1	0.002	X[4,7]	X[4]
TKN	USEPA 351.2	0.1	X[4,7]	X[4]
Total Nitrogen	Calculated from TKN, Nitrate, and Nitrite	NA	X[4,5,6C]	X[4,5]
Total Phosphorus	USEPA 365.1	0.01	X[4,5,6C,7]	X[4,5,8]
Solid Parameters				
TDS	SM 2540C	10	X[4,7]	X[4]
TSS	SM 2540D	5	X[7]	-
Synthetic Organic Compounds				
MBAS	SM 5540C	0.05	X[6C]	-

NA = Not applicable; mL = milliliter; L = liter; D = day; H = hour; M = month

Storm Drain Outfall Monitoring Analyte List (Continued)

* The methods presented in the table are optional. Other equivalent EPA-approved methods may be substituted as long as the target reporting limits are met for the corresponding constituents

1. Parameter listed in Table D-2 of the Permit.
2. Analytes that are field measured are not required to be analyzed by a laboratory.
3. Parameter contributes to a highest priority water quality condition identified in the San Diego River Watershed Water Quality Improvement Plan.
4. Parameter listed as a cause for impairment of receiving waters in the San Diego River Watershed on the 303(d) list.
5. Parameter for CLRP developed for a TMDL in the San Diego River Watershed.

6A. Parameter listed in NALs for discharges from storm drains to Ocean Surf Zone (Permit Provision C.1.a(1))

6B. Parameter listed in NALs for discharges from storm drains to Bays, Harbors, and Lagoons/Estuaries (Permit Provision C.1.a(2))

6C. Parameter listed in NALs for discharges from storm drains to Inland Surface Waters (Permit Provision C.1.a(3))

7. Parameter listed in Table D-7 of the Permit.
8. Parameter listed in SALs for discharges from storm drains to receiving waters (Table C-5 of the Permit).
9. Grab samples may be collected for pH, temperature, specific conductivity, dissolved oxygen, turbidity, hardness, and indicator bacteria.
10. Nitrite and nitrate may be combined and reported as nitrite+nitrate.
11. Nitrite and nitrite will be reported as nitrite+nitrate.
12. Analysis of Chromium in storm drain discharges is not explicitly required in the permit. Chromium is analyzed to calculate Chromium III.

ATTACHMENT E
SAMPLE COLLECTION PROCEDURES

This page intentionally left blank

E. Sample Collection Procedures

This attachment describes the sampling procedures for the Storm Drain Outfall Monitoring Program.

E.1 Dry Weather Storm Drain Outfall Sample Collection

For dry weather monitoring events, the Copermittees will collect and analyze grab samples from each dry weather storm drain outfall discharge monitoring station to satisfy the requirements of the Permit. Analytes that are field measured are not required to be analyzed by a laboratory.

E.2 Wet Weather Storm Drain Outfall Sample Collection

Per the San Diego County Copermittees' (SDCRC) Transitional Wet Weather MS4 Outfall Discharge Monitoring Work Plan, prepared by Weston Solutions, wet weather sample may be collected as described herein (SDCRC, 2014). For wet weather monitoring events, the Copermittees will collect and analyze samples from each wet weather storm drain outfall discharge monitoring station to satisfy the following requirements in accordance with the Permit:

- Analytes that are field measured are not required to be analyzed by a laboratory;
- The Copermittees must implement consistent sample collection methods for regional comparability of data, unless site-specific conditions indicate the need for alternate methods;
- Grab samples may be collected for pH, temperature, specific conductivity, dissolved oxygen, turbidity, and indicator bacteria;
- For all other constituents, composite samples must be collected for a duration adequate to be representative of changes in pollutant concentrations and runoff flows using one of the following techniques:
    - Time-weighted composites collected over the length of the storm event or the first 24 hour period whichever is shorter, composed of discrete samples, which may be collected through the use of automated equipment, or
    - Flow-weighted composites collected over the length of the storm event or a typical 24 hour period, whichever is shorter, which may be collected through the use of automated equipment, or
    - If automated compositing is not feasible, a composite sample may be collected using a minimum of 4 grab samples, collected during the first 24 hours of the stormwater discharge, or for the entire stormwater discharge if the storm event is less than 24 hours; and
- Only one analysis of the composite of aliquots is required

To ensure the most consistent sample collection method for all sites, the Copermittees will collect a single time-weighted composite at each site. When unattended automated sampling is feasible, time-weighted composites will be collected over the length of the storm event or in the first 24 hour period, whichever is shorter, composed of discrete samples, which may be collected through the use of automated equipment set at the time intervals listed in Table E-1 based on the anticipated size of the storm.

Table E-1. Automated Sample Pacing for Time-Weighted Composites Per Storm Duration

Storm Duration (Hours)	Sample Aliquot Interval (Minutes)	Sample Volume (mL)	Total Sample Aliquots	Total Volume (mL)
2	10	800	12	9,600
4	10	800	24	19,200
6	10	400	36	14,400
8	10	400	48	19,200
12	10	400	72	28,800
16	20	400	48	19,200
20	20	400	60	24,000
24	20	400	72	28,800

mL = milliliter

When unattended automated sampling is not feasible (i.e., security or safety issues), a composite sample will be collected using a minimum of four grab samples, collected during the first 24 hours of the stormwater discharge, or for the entire stormwater discharge if the storm event is less than 24 hours at the time intervals listed in Table E-2 based on the anticipated size of the storm. Some variation may occur depending on the actual storm intensity and duration. After the storm event, the discrete samples will be composited into one time-weighted composite for chemistry analysis.

Table E-2. Grab Sample Pacing for Time-Weighted Composites Per Storm Duration

Storm Duration (Hours)	Sample Aliquot Interval (Minutes)	Sample Volume (mL)	Total Sample Aliquots	Total Volume (mL)
2	20	2,000	6	12,000
4	20	2,000	12	24,000
6	40	2,000	9	18,000
8	40	2,000	12	24,000
12	60	2,000	12	24,000
16	60	2,000	16	32,000
20	120	2,000	10	20,000
24	120	2,000	12	24,000

Automated samples for chemistry will be collected with a Sigma 900MAX autosampler (or similar type device). Teflon-lined tubing will be installed and secured at each monitoring location prior to the wet weather event. The autosampler will be deployed by the field team upon arrival at each site. Samples will be pumped with the autosampler into a clean glass bottle. The sample bottle will be appropriately labeled with the sample identifier (ID), date, and time, and will be preserved on ice for transport to the laboratory. After compositing, samples will be subsampled into the appropriate bottles for analysis. Grab samples will be collected using either the Sigma 900MAX autosampler or a sample bottle connected to a sample pole that will be used to collect the sample directly from the outfall location. Nitrile or latex gloves will be worn during sample handling.

Bacteria samples and field measurements will not be taken from the composite sample; therefore, a grab sample will be collected for bacteria and field measurements during elevated flows. The grab sample will be collected after the second hour of stormwater runoff and before the sixth hour of stormwater runoff. If the stormwater runoff is less than 2 hours, the grab sample will be collected as close to the peak of flow as possible.

Bacteria samples will be collected using sterile techniques. Nitrile or latex type gloves will be worn during sample handling. During the sampling event, a 100-milliliter (mL) sterile bacteria bottle will be secured to a sample pole that will be used to collect the sample directly from the outfall location. Care will be employed to not allow contact with area structures or the bottom sediments. The container will be opened only for the needed time to collect the sample and will then be closed immediately following sample collection. If it is suspected that the container was compromised at any times, the sample container will be discarded, and a new sample will be collected with a new sample bottle. The sample bottle must be filled only to the 100-mL mark on the bottle (not over topped or under filled).

Field parameters will include hydrogen ion concentration (pH), conductivity, temperature, dissolved oxygen (DO), and turbidity. Samples will be collected and the measurements will be made using a YSI Inc. 6600 series water quality probe or similar type device. Calibration of the instruments will be conducted in accordance with Attachment D.

A field observation data sheet will be completed (Attachment A) for each sample collected to be representative of site conditions during each sample collection. Chain-of-custody (COC) documentation (Section E.3) will be completed, and samples will be delivered to the respective laboratory to allow for all applicable analyte holding times.

E.3 Chain-of-Custody Procedures

Chain-of-custody (COC) procedures will be used for all samples throughout the collection, transport, and analytical process. A copy of a COC form is included in Attachment C. Samples will be considered to be in custody if they are: 1) in the custodian's possession or view, 2) retained in a secured place (under lock) with restricted access, or 3) placed in a container and secured with an official seal so that the sample cannot be reached without breaking the seal. The principal documents used to identify samples and to document possession will be COC records, field logbooks, and field tracking forms.

The COC procedures will be initiated during sample collection. A COC record will be provided with each sample or group of samples. Each person who had custody of the samples will sign the form and ensure that the samples were not left unattended unless properly secured. Documentation of sample handling and custody will include the following:

- Sample identifier.
- Sample collection date and time.

- Any special notations on sample characteristics or analysis.
- Initials of the person collecting the sample.
- Date the sample was sent to the analytical laboratory.
- Shipping company and waybill information.

Completed COC forms will be placed into a plastic envelope and kept inside the cooler containing the samples. Upon delivery to the analytical laboratory, the COC form will be signed by the person receiving the samples. COC records will be included in the final reports prepared by the analytical laboratories and will be considered an integral part of the laboratory report.

E.4 HEALTH AND SAFETY

Field sampling events have the potential for dangerous situations to arise. Field personnel need to be aware of safety hazards and take appropriate precautions. A health and safety tailgate meeting will be held prior to any on-site activity. During this meeting, site-specific hazards will be discussed and addressed appropriately. There are several health and safety issues that pertain to the proposed sampling and equipment installation within any areas.

E.4.1 TRAFFIC HAZARDS AND TRAFFIC CONTROL

Because this study is being conducted in residential areas, traffic control procedures must be employed. All traffic rules and regulations and all traffic control signs and devices should be obeyed. Field personnel should allow for extra time when planning travel routes. Vehicle traffic is a major concern during field monitoring activities. Traffic presents hazards when site workers are working close to roadways and the potential exists to be hit by oncoming traffic, and when driving to, from, and on the site. Driving during rain events also presents hazards as slick roadway conditions exist. It is recommended that safe speeds and distances be maintained to avoid rain-related accidents.

Whenever possible, field personnel should park as far off the road as possible to avoid interfering with any traffic flow and should comply with the following guidelines when working:

- Turn on the vehicle's flashing yellow warning light and hazard lights.
- Put out safety cones to mark off the work area.
- Place yellow barricade around open manhole to clearly mark the area.
- Avoid steep slopes and stream banks.
- Always use a flashlight in the dark.
- Always wear bright orange and reflective safety vests to be more visible.

E.4.2 CONFINED SPACE

Several monitoring locations for this project are located in the underground storm drain conveyance system. To install, maintain, and uninstall monitoring equipment within the storm drain conveyance system, confined space entry will need to be performed. Confined spaces are defined as any space with only one entry and exit point; therefore, an outfall is considered a confined space. To perform confined space entry, project personnel must have confined space entry, attendant, and supervisor training, and must have their certificate card. Entering confined spaces presents many health and safety hazards if not performed properly. These hazards include asphyxiation, falls, burns, drowning, engulfment, toxic exposure, and electrocution. A confined space represents the potential for unusually high concentrations of contaminants, explosive atmospheres, limited visibility, physical injury, and restricted movement.

A five-gas meter will be used to monitor the atmosphere within the storm drain outfall prior to any personnel entering the system. If the outfall is unsafe for entry, field personnel may attempt to ventilate the space. If the outfall is still determined to be unsafe for entry, then no personnel will enter the outfall. Once the outfall has been determined to be safe for entry, the personnel may enter. A harness and retrieval system are used for personnel entering the system. When field personnel are in the outfall, continued air monitoring will occur to ensure that the atmosphere remains non-hazardous. Should air monitoring determine at any time that the air is becoming hazardous, field staff will immediately evacuate the confined space.

E.4.3 Weather Hazards

Installation and maintenance activities will be conducted during dry weather periods only. Though the San Diego region is generally mild during the fall season, the most likely safety issue related to weather is excessive heat. Extreme heat can adversely affect monitoring instrument response and reliability, respiratory protection performance, and chemical protective clothing materials. Standard precautions should be taken to mitigate heat exhaustion during field monitoring events.

Storm event monitoring will occur during wet weather. Wet weather conditions increase slipping and tripping hazards, braking distances of vehicles, and the potential for slippage or handling difficulties of field equipment. Rain fills holes and obscures trip-and-fall hazards. Tools and personnel can slip on wet surfaces. Rain and wet weather conditions may decrease visibility and increase the potential for driving accidents. Rain and high humidity may also limit the effectiveness of certain direct-reading instruments (e.g., photoionization detectors (PIDs)).

This page intentionally left blank

ATTACHMENT F
QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

This page intentionally left blank

F. QUALITY ASSURANCE / QUALITY CONTROL

F.1 FIELD QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance (QA) and quality control (QC) for sampling processes will include proper collection of the samples to minimize the possibility of contamination. All samples will be collected in laboratory-supplied, laboratory-certified, contaminant-free sample bottles. Field staff will wear powder-free nitrile gloves or a similar type of gloves at all times during sample collection.

Target measurement objectives for field quality control samples are provided in Table F-1

Table F-1. Field Quality Control Samples

Sample Type	Measurement Objective			Frequency of Analysis
	Field Duplicate	Field Blank	Equipment Blank	
Conventionals	RPD<25%[(a)]	<RL for target analyte	<RL for target analyte	Per batch of samples submitted to the laboratory[b]
Indicator Bacteria	RPD<25%[(c)]	Negative Response	Negative Response	Per batch of samples submitted to the laboratory[b]
Metals	RPD<25%[(a)]	<RL for target analyte	<RL for target analyte	Per batch of samples submitted to the laboratory[b]
Nutrients	RPD<25%[(a)]	<RL for target analyte	<RL for target analyte	Per batch of samples submitted to the laboratory[b]
Solid Parameters	RPD<25%[(a)]	<RL for target analyte	<RL for target analyte	Per batch of samples submitted to the laboratory[b]
Organics	Per method	<RL for target analyte	<RL for target analyte	Per batch of samples submitted to the laboratory[b]
Toxicity	NA	NA	NA	NA

Notes:
RL = reporting limit.
RPD = relative percent difference.
a. NA if native concentration of either sample<RL.
b. For equipment blanks, the frequency is 10% of the cleaned material. Equipment blanks are only analyzed for TOC and total metals per Section F.1.5
c. Field duplicates are not a current SWAMP requirement for indicator bacteria. However, the collection and analysis of a field duplicate is recommended.

F.1.1 TRAINING

All sampling personnel will be trained according to field sampling standard operating procedures (SOPs). Additionally, the field staff will be made aware of the significance of the project's detection limits and the requirement to avoid contamination of samples at all times.

F.1.2 *Field Blank*

A field blank will be collected and analyzed to assess contamination from field-related conditions to ensure that positive bias of the sample has not been introduced, and to remain in compliance with the Surface Water Ambient Monitoring Program (SWAMP) protocols. One field blank will accompany each batch of samples submitted to the analytical laboratory.

F.1.3 *Field Duplicate*

A duplicate sample may be collected and analyzed to assess the variability in sampling and to remain in compliance with the SWAMP protocols. One field duplicate will accompany each batch of samples submitted to the analytical laboratory.

F.1.4 *Temperature Blank*

A temperature blank will be used to ensure that sample holding temperatures were maintained from sample collection through delivery to the laboratory.

F.1.5 *Equipment Blank*

The selected analytical laboratory Teflon-lined tubing, silicone pump tubing, silicone bottle stoppers, and stainless steel sample intake strainers. The following blank samples will be created for analysis:

- One blank sample representative of the cleaned silicone and Teflon-lined tubing. Blank water will be passed through at least 10% of cleaned tubing and be representative of both silicone and Teflon-lined tubing.
- One blank representing the bottles and stoppers. Blank water will be passed into/over at least 10% of cleaned bottles and stoppers.

The analytical laboratory will analyze the equipment blanks for total organic carbon and total metals at a minimum. The analytical laboratories will analyze blank water from the cleaned sampling equipment at the same detection level proposed for sample analysis; this will verify that the sampling equipment in contact with sample water is clean and is not a likely source of contamination.

If a blank sample produces an analyte detection above the RL, the equipment will be cleaned and blanked again. Cleaned and blanked sampling equipment will not be deployed for sampling until an acceptable blank analysis has occurred unless directed by the Copermittees.

F.1.6 *Inspection/Acceptance of Supplies and Consumables*

Sample bottles (provided by the laboratory) and collection equipment will be inspected prior to their use. Procured supplies will be examined for damage prior to use per Table F-2.

Field supplies will be stored at the sampling team's offices; laboratory supplies will be stored at the laboratory. Inspection and testing requirements for laboratory supplies are covered in the laboratory's QA/QC procedures.

Table F-2. Inspection/Acceptance Testing Requirements for Consumables and Supplies

Project-Related Supplies/ Consumables	Inspection/ Testing Specifications/ Source	Acceptance Criteria	Frequency	Responsible Party
Pre-cleaned sample bottles	Closed bottle	Lids screwed on bottles	100%	Sampling Team
Silicone tubing	Laboratory cleaned	Pass blanking analysis	New tubing each season	Laboratory/Sampling Team
Teflon tubing	Laboratory cleaned	Pass blanking analysis	New tubing each season	Laboratory/Sampling Team
Gloves	New box	New box	As needed	Sampling Team

F.2 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

This section addresses QA/QC activities associated with laboratory analyses. Laboratory QA/QC samples provide information to assess potential laboratory contamination, analytical precision, and accuracy. Analytical quality assurance for this program includes the following:

- Employing analytical chemists trained in the procedures to be followed.
- Adherence to documented procedures, United States Environmental Protection Agency (USEPA) approved methods, and written Standard Operating Procedures (SOPs).
- Calibration of analytical instruments.
- Use of quality control samples, internal standards, surrogates, and Standard Reference Materials (SRMs).
- Complete documentation of sample tracking and analysis.

Internal laboratory quality control checks will include the use of laboratory replicates, method blanks, matrix spikes/matrix spike duplicates (MS/MSDs), and laboratory control samples (LCSs). The quality control checks performed by constituent class is presented in Table F-3. The frequency of the laboratory QA/QC samples will a minimum of once per batch per analyte unless otherwise adjusted by Copermittees.

Table F-3. Laboratory Quality Control Samples by Constituent Class

Laboratory Quality Control	Constituent Class							
	Conventionals	Indicator Bacteria	Inorganic Analytes	Nutrients	Solid Parameters	Acute Toxicity	Chronic Toxicity	Synthetic Organic Compounds
Calibration Standard	✓	–	✓	✓	–	–	–	–
Calibration Verification	✓	–	✓	✓	–	–	–	✓
Laboratory Blank	✓	✓	✓	✓	✓	–	–	✓
Reference Material	✓	–	✓	✓	–	–	–	✓
Matrix Spike	✓	–	✓	✓	–	–	–	✓
Matrix Spike Duplicate	✓	–	✓	✓	–	–	–	✓
Laboratory Duplicate	✓	✓	✓	✓	✓	–	–	–
Internal Standard	✓	–	✓	–	–	–	–	✓
Sterility Checks	–	✓	–	–	–	–	–	–
Laboratory Positive Control	–	✓	–	–	–	–	–	–
Laboratory Negative Control	–	✓	–	–	–	–	–	–
Laboratory Water Control	–		–	–	–	✓	✓	–
Conductivity/Salinity Control Water	–	–	–	–	–	✓	✓	–
Additional Control Water	–	–	–	–	–	✓	✓	–
Sediment Control	–	–	–	–	–	✓	✓	–
Reference Toxicant Tests	–	–	–	–	–	✓	✓	–
Tuning	–	–	–	–	–	–	–	✓
Surrogate	–	–	–	–	–	–	–	✓
Calibration	–	–	–	–	–	–	–	✓

F.2.1 Data Quality Objectives

Data quality objectives (DQOs) are quantitative and qualitative statements that define project objectives and specify the acceptable ranges of field sampling and laboratory performance. DQOs include accuracy, precision, and completeness.

Accuracy describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value. The accuracy of chemical measurements will be checked by performing tests on a standard prior to and/or during sample analysis. A standard is a known concentration of a certain solution. Standards can be purchased from chemical or scientific supply companies. Standards might also be prepared by a professional partner (e.g., a commercial or research laboratory). The concentrations of the standards should be within the mid-range of the equipment. Recovery measurements are determined by spiking a replicate sample in the laboratory with a known concentration of the analyte. Accuracy of the project data will be determined by comparing results from MS/MSDs, LCSs, field blanks, and equipment blanks to the accuracy objectives to be developed by Copermittees.

Precision describes how well repeated measurements agree. The evaluation of precision described here applies to repeated measurements and samples collected in the field (field duplicates) or the laboratory (laboratory replicates and MS/MSDs). Precision measurements will be determined by comparing results from field duplicates, laboratory replicates and MSD to the precision objectives. Relative Percent Differences (RPDs) will be calculated to determine the precision between duplicate samples. This calculation is presented in Equation 1. Precision objectives will be developed by the Copermittees.

$$RPD = \frac{abs[x_1 - x_2]}{0.5 * (x_1 + x_2)} \qquad \text{Equation 1}$$

where:

abs is the absolute value.

x1 is measurement 1.

x2 is measurement 2.

Completeness is the fraction of planned data that must be collected to fulfill the statistical criteria of the project. There are no statistical criteria that require a certain percentage of data. However, the anticipated target is 90%. This accounts for adverse weather conditions, safety concerns, and equipment problems. The project team determined completeness by comparing the number of measurements planned to be collected with the number of measurements actually collected that are deemed valid. An invalid measurement would be one that does not meet the sampling method requirements. Completeness will be measured as a percentage of the number of samples collected that meet the respective DQOs compared to the anticipated number of samples. This calculation is presented in Equation 2.

$$Completeness = \frac{Actual\ number\ of\ samples\ collected}{Project\ required\ total\ samples\ to\ be\ collected} * 100 \qquad \text{Equation 2}$$

F.2.2 Instrument/Equipment Calibration and Frequency

Laboratory equipment will be calibrated based on manufacturer recommendations and in accordance with the method and laboratory SOP. The laboratory SOP is maintained by the respective Laboratory Directors and QA officers, and is available upon request.

F.2.3 CORRECTIVE ACTION

Corrective action will be taken when an analysis is deemed suspect. Reasons a sample may be considered suspect consist of exceedances of the RPD ranges, spike recoveries, and blanks. The corrective action may vary from analysis to analysis, but typically will involve the following:

Check of procedures.

- Review of documents and calculations to identify possible errors.
- Error correction.
- Re-analysis of the sample extract, if available, to see if results can be improved.
- Reprocessing and re-analysis of additional sample material, if it is available.

Malfunctions that occur during data collection and laboratory analyses will be the responsibility of the field crew or laboratory conducting the work, respectively. In the case of field instruments, problems will be addressed through instrument cleaning, repair, or replacement of parts or the instrument, as warranted. Field crews should carry basic spare parts and consumables with them, and have access to spare parts. The laboratories have procedures in place to follow when failures occur, and have identified individuals responsible for corrective action and developed appropriate documentation as needed.

ATTACHMENT G
VOLUME AND LOAD ESTIMATE CALCULATIONS

This page intentionally left blank

G. Calculation of Runoff Volumes and Load Estimations for Assessment and Reporting

The methods to complete the wet weather storm drain outfall discharge monitoring assessment, as described in the Transitional Wet Weather Storm Drain Outfall Monitoring Work Plan prepared by Weston Solutions, are detailed in this section (Weston, 2014)

The assessment methods were formulated with the purpose of providing a means to calculate various parameters required by Section II.D.4.b.(2)(b) of the Permit based on the storm drain outfall wet weather monitoring data collected during the 2013-2014 and 2014-2015 wet seasons. Section II.D.4.b.(2)(b) of the Permit states:

(b) Based on the transitional wet weather storm drain outfall discharge monitoring required pursuant to Provision D.2.a.(3) the Copermittees must assess and report the following:

- (i) The Copermittees must analyze the monitoring data collected pursuant to Provision D.2.a.(3), and utilize a watershed model or other method, to calculate or estimate the following for each monitoring year:
  - [a] The average stormwater runoff coefficient for each land use type within the Watershed;
  - [b] The volume of stormwater and pollutant loads discharged from each of the Copermittee's monitored storm drain outfalls in its jurisdiction to receiving waters within the Watershed Management Area for each storm event with measurable rainfall greater than 0.1 inch;
  - [c] The total flow volume and pollutant loadings discharged from the Copermittee's jurisdiction within the Watershed Management Area over the course of the wet season, extrapolated from the data produced from the monitored storm drain outfalls; and
  - [d] The percent contribution of stormwater volumes and pollutant loads discharged from each land use type within each hydrologic subarea with a major storm drain outfall to receiving waters or within each major storm drain outfall to receiving waters in the Copermittee's jurisdiction within the Watershed for each storm event with measurable rainfall greater than 0.1 inch.
- (ii) Identify modifications to the wet weather storm drain outfall discharge monitoring locations and frequencies necessary to identify pollutants in stormwater discharges from the storm drain conveyance system in the Watershed Management Area pursuant to Provision D.2.c.(1) (RWQCB, 2013).

G.1 Land Use Categorization

Geographic information system (GIS) mapping software, in combination with data from the San Diego Geographic Information Source (SanGIS), will be used to determine the quantities of the various land use types within each monitored outfall drainage area. The SanGIS land use dataset has numerous land use classifications, and the assessment included categorizing the SanGIS land use classifications into several assessment land use categories. The correlations between SanGIS land use data and the assessment land use classes are shown in Table G-1. Table G-2 shows the assessment land use classes along with the San Diego Hydrology Manual (Hydrology Manual) land use types runoff coefficient (Runoff "C") values.

SanGIS land uses will be grouped into a minimum of four assessment categories listed by the Permit (e.g., Commercial, Industrial, Residential, and Mixed Land Use). The Commercial land use category will incorporate all "commercial" and most of the "public facility," "parking lot," and "commercial recreation" SanGIS classifications. The Industrial land use category will incorporate "industrial," "airport," "communications and utilities," and "terminal" SanGIS classifications. The Residential land use category will incorporate Rural Residential (1 to 4 dwelling units per acre (DU/A)), Single-Family Residential (4.3 to 20 DU/A), and Multi-Family Residential (>20 DU/A). The Multi-Family Residential land use categorization will incorporate high density housing types, such as barracks, dormitories, monasteries, and other group quarters. The Mixed Land Use classification will incorporate the SanGIS classes 9700 (mixed use). These additional land uses will include a combination of roads, parking areas, various types of impervious surfaces (tennis courts, buildings, sidewalks/paved areas), and less than 90% open space (maintained fields and undeveloped lands).

SanGIS land uses classes that are not easily grouped into one of the four main land use categories will be identified as "other" and will undergo further assessment. Two additional land use categories, Open Space and Agriculture, will be used to address less developed regions in San Diego County. In accordance with the Hydrology Manual (County of San Diego, 2003), these land uses will undergo a separate analysis based on the soil type and associated pervious Runoff "C" value.

The Open Space land use category will include open space, vacant and undeveloped land, parks and recreation, and most of the remaining military SanGIS land uses. Given that areas classified as water, bay, lagoon, lake, reservoir, and large pond would likely turn into a sink for runoff storage, water-related land use classifications (9200, 9201, and 9202) will be excluded from this analysis.

Traditionally, Transportation land uses were considered a unique land use classification. The Hydrology Manual does not include unique Runoff "Cs" for roads, freeways, right of ways, and other Transportation land uses. These SanGIS classes will be grouped into a Transportation land use category and assigned a Runoff "C" based on the approximate percentage of impervious cover and associated Runoff "C" listed in the Hydrology Manual.

Table G-1. Assessment Land Use Categories Developed from SanGIS Land Use Classes

Assessment Land Use Category	SanGIS Land Use Classification	
Agriculture	7204	Golf Course
	8001	Orchard or Vineyard
	8002	Intensive Agriculture
	8003	Field Crops
Commercial	1401	Jail/Prison
	1501	Hotel/Motel (Low-Rise)
	1502	Hotel/Motel (High-Rise)
	1503	Resort
	4111	Rail Station/Transit Center
	4114	Parking Lot - Surface
	4115	Parking Lot - Structure
	4116	Park and Ride Lot
	5001	Wholesale Trade
	5002	Regional Shopping Center
	5003	Community Shopping Center
	5004	Neighborhood Shopping Center
	5005	Specialty Commercial
	5006	Automobile Dealership
	5007	Arterial Commercial
	5008	Service Station
	5009	Other Retail Trade and Strip Commercial
	6001	Office (High-Rise)
	6002	Office (Low-Rise)
	6003	Government Office/Civic Center
	6101	Cemetery
	6102	Religious Facility
	6103	Library
	6104	Post Office
	6105	Fire/Police Station
	6108	Mission
	6109	Other Public Services
	6501	UCSD/VA Hospital/Balboa Hospital

Table G-1. Assessment Land Use Categories Developed from SanGIS Land Use Classes (Continued)

Assessment Land Use Category	SanGIS Land Use Classification	
Commercial (continued)	6502	Hospital - General
	6509	Other Health Care
	6807	School District Office
	7201	Tourist Attraction
	7202	Stadium/Arena
	7203	Racetrack
	7205	Golf Course Clubhouse
	7206	Convention Center
	7207	Marina
	7209	Casino
	9501	Residential Under Construction
	9502	Commercial Under Construction
	9504	Office Under Construction
	7208	Olympic Training Center
	7210	Other Recreation - High
	7607	Residential Recreation
Educational	6801	SDSU/CSU San Marcos/UCSD
	6802	Other University or College
	6803	Junior College
	6804	Senior High School
	6805	Junior High School or Middle School
	6806	Elementary School
	6809	Other School
	9505	School Under Construction

Table G-1. Assessment Land Use Categories Developed from SanGIS Land Use Classes (Continued)

Assessment Land Use Category	SanGIS Land Use Classification	
Industrial	2001	Heavy Industry
	2101	Industrial Park
	2103	Light Industry - General
	2104	Warehousing
	2105	Public Storage
	2201	Extractive Industry
	2301	Junkyard/Dump/Landfill
	4101	Commercial Airport
	4102	Military Airport
	4103	General Aviation Airport
	4104	Airstrip
	4113	Communications and Utilities
	4120	Marine Terminal
	9503	Industrial Under Construction
Transportation	4112	Freeway
	9507	Freeway Under Construction
	4117	Railroad Right of Way
	4118	Road Right of Way
	4119	Other Transportation
	9506	Road Under Construction
Mixed Use	9700	Mixed Use
Residential: Multi-Family	1200	Multi-Family Residential
	1280	Single Room Occupancy Units (SRO's)
	1290	Multi-Family Residential Without Units
	1300	Mobile Home Park
	1402	Dormitory
	1403	Military Barracks
	1404	Monastery
	1409	Other Group Quarters Facility

Table G-1. Assessment Land Use Categories Developed from SanGIS Land Use Classes (Continued)

Assessment Land Use Category	SanGIS Land Use Classification	
Residential: Rural	1000	Spaced Rural Residential
Residential: Single-Family	1100	Single Family Residential
	1110	Single Family Detached
	1110	Single Family Detached
	1120	Single Family Multiple-Units
	1190	Single Family Residential Without Units
Open Space	6701	Military Use
	6702	Military Training
	6703	Weapons Facility
	7211	Other Recreation - Low
	7601	Park - Active
	7603	Open Space Park or Preserve
	7604	Beach - Active
	7605	Beach - Passive
	7606	Landscape Open Space
	7609	Undevelopable Natural Area
	9101	Vacant and Undeveloped Land
Water	9200	Water
	9201	Bay or Lagoon
	9202	Lake/Reservoir/Large Pond
Source: SanGIS, 2014		

Table G-2. Assessment Land Use Hydrology Manual Runoff “C” Values

Land Use Type	Hydrology Manual Runoff “C”
Agriculture-A	0.2
Agriculture-B	0.25
Agriculture-C	0.3
Agriculture-D	0.35
Commercial	0.82
Educational	0.58
Industrial	0.87
Mixed Use	0.66
Multi-Family Residential	0.6
Open Space-A	0.2
Open Space-B	0.25
Open Space-C	0.3
Open Space-D	0.35
Rural-Residential	0.41
Single-Family Residential	0.49
Transportation	0.71

Source: County of San Diego, 2003

G.2 STORMWATER RUNOFF COEFFICIENT CALCULATIONS

Measured flow values will be used in combination with the hydrological features associated with the drainage areas of the monitored outfalls to calculate the average stormwater Runoff “C” for each land use type within the WMA. First, for each monitored outfall, the actual event Runoff “C” will be calculated based on outfall drainage area, rainfall, and measured flow. Next, the Hydrology Manual land use Runoff “C” values and overall outfall drainage area Hydrology Manual Runoff “C” value will be calculated based on the individual land use areas within each monitored outfall drainage area. For each monitored outfall, a correction factor will be calculated based on the comparison between the actual Runoff “C” value and the overall Hydrology Manual Runoff “C” value. The associated correction factor will be applied to the individual land use Runoff “C” values for each outfall. Finally, the WMA individual land use Runoff “C” values will be determined based on the area-weighted average of the monitored outfalls’ individual land use Runoff “C” values. The steps in this process are discussed in more detail in the following paragraphs

The actual Runoff “C” for each outfall will be calculated based on the measured stormwater runoff, rainfall, and overall size of the drainage area. Flow equipment will be installed in each monitored outfall, except in rare cases where it is not feasible, in order to estimate the volume of stormwater runoff for the monitored event. Rainfall data for each event will be obtained from the County of San Diego Automatic Local Evaluation in Real Time (ALERT) System rain gauge database for the gauge nearest to the monitored outfall. The delineation of each monitored outfall drainage area will be performed by the responsible Copermittee. The actual Runoff “C” for each outfall will be calculated using the following formula:

$$Runoff\ "C"_{Outfall\ Actual} = \left(\frac{Monitored\ Storm Water\ Runoff\ Volume}{Area \times Rainfall}\right)_{Outfall} (UC)$$

Volume in cubic feet (ft3)
Area in acres
Rainfall in inches (in)

$$UC = Unit\ Conversion = \left(\frac{1\ ft}{12\ in}\right)\left(\frac{43{,}560\ ft^2}{1\ acre}\right)$$

The Hydrology Manual Runoff “C” for each monitored outfall will be selected based on the guidance found in Section 3 (Rational Method) of the Hydrology Manual. The area-weighted Hydrology Manual Runoff “C” for each monitored outfall will be calculated using the following formula:

$$Runoff\ "C"_{Outfall\ HM\ Calculated} = \frac{\sum\left(Area_{Outfall\ LU} \times HM\ Runoff\ "C"_{LU}\right)}{\sum Area_{Outfall\ LU}}$$

Where: LU = land use type
HM = Hydrology Manual

A Runoff “C” correction factor will be calculated for each monitored outfall using the following formula:

$$CF_{Outfall\ Runoff\ "C"} = \frac{Runoff\ "C"_{Outfall\ Actual}}{Runoff\ "C"_{Outfall\ HM\ Calculated}}$$

Where: CF = correction factor

For each monitored outfall, the calculated correction factor will be applied to the Hydrology Manual land use Runoff “C” values within the applicable drainage area as follows:

$$Runoff\ "C"_{Outfall\ LU} = CF_{Outfall\ Runoff\ "C"} \times Runoff\ "C"_{HM\ LU}$$

The land use type Runoff "C" calculation results for the monitored outfalls within the WMA will be compiled as follows to determine the WMA Runoff "C" value for each land use type:

$$Runoff\ "C"_{WMA\,LU} = \frac{\sum(Runoff\ "C" \times Area)_{Outfall\ LU}}{\sum Area_{Outfall\ LU}}$$

Monitored Outfalls Annual Runoff Volumes and Pollutant Loads Calculations

The annual stormwater runoff volumes and pollutant loads discharged from monitored storm drain outfalls for storm events greater than 0.1 inch of measurable rainfall will be calculated using the actual Runoff "C" values, drainage area sizes, ALERT rain gauge data, and chemistry results obtained from the collection of stormwater samples during the 2013-2014 and 2014-2015 wet seasons. The actual Runoff "C" value and drainage area size for each monitored outfall will be determined as described in Section 5.2. Annual rainfall will be obtained from the ALERT rain gauge database for the gauge nearest to each monitored outfall. The rain gauge data will be analyzed, and rainfall values will be identified and excluded from the annual stormwater volume calculations when precipitation totals do not exceed 0.1 inch over a 24-hour period. The annual volume discharge from each monitored outfall will be calculated as follows:

$$Storm\,Water\,Volume_{Outfall} = \left(Runoff\ "C"_{Outfall\ Actual} \times Area_{Outfall}\right)\left(\sum Rainfall_{Event}\right)(UC)$$

Where:

$$UC = Unit\,Conversion = \left(\frac{1\ ft}{12\,in}\right)\left(\frac{43{,}560\ ft^2}{1\,acre}\right)$$

The pollutant loads discharged from each monitored storm drain outfall will be calculated based on the calculated annual volume and the chemistry results specific to each outfall as follows:

$$Pollutant\ Load_{Outfall} = (Storm\ Water\,Volume \times\ Pollutant\ Concentration)_{Outfall}\ (UC))$$

Where:

$$UC = \left(\frac{28.317\ L}{1\ ft^3}\right)\left(\frac{1\,g}{1000\,mg}\right)\left(\frac{1\,lbs}{453.592\ _g}\right),\ for\ \frac{mg}{L}\ concentration\,units;$$

$$UC = \left(\frac{28.317\ L}{1\ ft^3}\right)\left(\frac{1\,g}{10^6\ \mu g}\right)\left(\frac{1\,lbs}{453.592\ _g}\right),\ for\ \frac{\mu g}{L}\ concentration\,units;or$$

Watershed Jurisdictional Annual Runoff Volumes and Pollutant Loads Calculations

The total flow volume and pollutant loads discharged from each Copermittee's jurisdiction within the watershed over the course of the wet season will be calculated based on the data produced from monitoring storm drain outfalls during the 2013-2014 and 2014-2015 wet seasons. The Watershed Runoff "C" values, calculated as described in Section 5.2, will be used in combination with land use data and ALERT rain gauge data to calculate the total flow volume for each jurisdiction. The annual volumes will be applied to pollutant event mean concentrations (EMCs) in order to estimate the annual pollutant loads conveyed by the storm drain conveyance system in each Copermittee's jurisdiction. The EMC for each applicable pollutant will be determined by compiling the results from the outfalls monitored in the WMA. More details on the flow volume and pollutant load calculations are provided in the paragraphs that follow.

The total flow volume conveyed by each Copermittee's storm drain conveyance system will be calculated using the land use data, watershed land use type Runoff "C" values (see Section 5.2), and ALERT rain gauge data. GIS mapping software will be used to determine the quantities of the various land use types for each Copermittee by comparing the watershed boundary with the Copermittees' boundaries. The areas associated with hydrologic subareas (HSAs) without a major outfall will be included in the total area to calculate the assessment required by Section II.D.4.b.(2)(b)(i)[c]; however, an HSA without a major outfall will not be included in the assessment required by Section II.D.4.b.(2)(b)(i)[d].

Properties owned by state or federal agencies and indian reservations will also be excluded from the total jurisdictional watershed area. An ALERT rain gauge located within the watershed will be selected for the volume calculations. In the event that data from more than one ALERT gauge are available for the watershed, the ALERT gauge that has the most representative data related to the monitored outfalls will be selected (i.e., the station closest to the majority of monitored outfalls was selected to perform outfall-specific calculations for more of the outfalls and was also selected for watershed calculations). The ALERT data will be analyzed, and rainfall values will be identified and excluded from the calculations when precipitation totals do not exceed 0.1 inch of rainfall over a 24-hour period. The following formulas will be used to calculate the annual flow volume from each land use type and total flow volume within each Copermittee's jurisdiction in the watershed during the wet season:

$$Storm\ Water\ Volume_{WMA\,Jurisd\,LU} = \left(Runoff\ "C"_{WMA\,LU}\right)\left(Area_{WMA\,LU}\right)\left(\sum Rainfall_{Event}\right)\left(UC\right)$$

Where:

$$UC = \left(\frac{1\ ft}{12\,in}\right)\left(\frac{43{,}560\ ft^2}{1\ acre}\right)$$

$$Storm\,Water\,Volume_{WMA\,Jurisd,} = \sum Storm\,Water\,Volume_{WMA\,Jurisd\,LU}$$

The chemistry results obtained from analyzing samples collected at the monitored outfalls during the 2013-2014 and 2014-2015 wet seasons will be evaluated in order to estimate the watershed EMC values for the measured constituents for each general land use type assessed. This evaluation includes estimating each monitored outfall drainage area's EMC values for the measured constituents for each general land use type assessed. The monitored outfalls will be selected, where practical, to have a single primary land use type in order to facilitate the correlation between land use type and pollutant loading; however, due to the general mixed composition of urban development, the drainage areas of the monitored outfalls may typically consist of a combination of land use types (e.g., primarily single-family residential with some commercial, open space, transportation.).

The correlation of measured pollutant concentrations to EMC values for various land use types, therefore, will incorporate the use of published, typical EMC values so that the measured chemistry results will be proportioned to the different land use types within each drainage area. The methods to proportion the measured chemistry results will be similar to the methods to determine the land use type Runoff “C” values (Section 5.2). The measured chemistry results will be the actual EMC values for each monitored outfall drainage area. Typical EMC values will be selected from the literature for each land use type for the measured constituents. The typical EMC values that will be selected are shown in Table 7. Typical overall or comingled EMC values will be calculated for each monitored outfall based on the weighted average of the outfall land use type Runoff “C” values and drainage area land use type areas. The actual EMC values (comingled chemistry results) of the monitored outfall will then be compared to the calculated, typical outfall EMC values in order to determine correction factors for each constituent. For each constituent, the correction factor will then be applied to the typical land use type EMC values for the associated monitored outfall drainage area. The WMA EMC values for the various land use types will be calculated based on corrected land use type EMCs of the monitored outfalls within the WMA, which are weighted by the product of the land use type Runoff “C” values and land use type areas. The following formulas will be used to complete these calculations:

$$EMC_{Outfall\ Actual} = Sampling\ \ Chemisty\ Result_{Outfall}$$

The overall or comingled outfall typical EMC for each measured constituent will be calculated using the following formula:

$$EMC_{Outfall\ Calculated} = \frac{\sum\left(Area_{Outfall\ LU} \times Runoff\ "C"_{Outfall\ LU} \times Typical\ EMC_{LU}\right)}{\sum\left(Area_{Outfall\ LU} \times Runoff\ "C"_{Outfall\ LU}\right)}$$

An EMC correction factor will be calculated for each constituent for each monitored outfall using the following formula:

$$CF_{Outfall\ EMC} = \frac{EMC_{Outfall\ Actual}}{EMC_{Outfall\ Calculated}}$$

For each monitored outfall for each constituent, the calculated EMC correction will be applied to the land use type typical EMC value as follows:

$$EMC_{Outfall\ LU} = CF_{Outfall\ EMC} \times Typical\ EMC_{LU}$$

The calculation results for the monitored outfalls within the watershed will be compiled to determine the EMC value for each constituent of each land use type assessed within the watershed.

$$EMC_{WMA\,LU} = \frac{\sum\left(Runoff\ "C" \times Area \times EMC\right)_{Outfall\ LU}}{\sum\left(Area \times Runoff\ "C"\right)_{Outfall\ LU}}$$

The total watershed pollutant load for each constituent within each jurisdiction will be calculated utilizing the follow the formula:

$$Pollutant\ Load_{WMA\ Jurisd,} = \sum\left(Storm\,Water\,Volume_{WMA\ Jurisd\ LU} \times\ EMC_{WMA\,LU} \times UC\right)$$

Where:

$$UC = \left(\frac{28.317\ L}{1\ ft^3}\right)\left(\frac{1\ g}{1000\ mg}\right)\left(\frac{1\,lbs}{453.592\ _g}\right),\ for\ \frac{mg}{L}\ \ concentration\,units;$$

$$UC = \left(\frac{28.317\ L}{1\ ft^3}\right)\left(\frac{1\ g}{10^6\ \mu g}\right)\left(\frac{1\,lbs}{453.592\ _g}\right),\ for\ \frac{\mu g}{L}\ \ concentration\,units;or$$

$$UC = \left(10\,\frac{100\ mL}{L}\right)\left(\frac{28.317\ L}{1\ ft^3}\right),\ \ for\ \frac{MPN}{100\ mL}\ \ EMC\ units;$$

G.3 REFERENCES

Weston, 2014. 2013-2014 and 2014-2014 Transitional Wet Weather Storm Drain Outfall Discharge Monitoring Work Plan. Prepared for San Diego County Regional Copermittees. October.

COUNTY OF SAN DIEGO
WATERSHED PROTECTION PROGRAM

DEPARTMENT OF PUBLIC WORKS
5510 OVERLAND AVE., SUITE 410
SAN DIEGO, CA 92123

SAMPLE

MS4 Outfall Visual Observation Field Datasheet

New Site? ☐ Yes ☐ No ☐ **Source Investigation Follow-up for**____________________

General Site Description

Site ID			**Site Type**		**Sample Event ID**		
Location					**Sample Event Type**		
Date		**Time**		**Latitude**	° N (NAD83)	**HU**	
Staff		**TB Guide**		**Longitude**	° W (NAD83)	**HSA**	

Historical Outfall Dry Weather Flow Info: ☐ Unknown ☐ Persistent ☐ Transient ☐ Dry

Conveyance (Check one only) ☐ Concrete Channel ☐ Natural Creek ☐ Earthen Channel ☐ Manhole ☐ Outfall ☐ Other_____

Flow Status ☐ Flowing ☐ Ponded ☐ Tidal ☐ Dry

Flow Reaches Receiving Water? ☐ Yes ☐ No

Non-Stormwater Flow Source? ☐ Yes ☐ No ☐ Unknown

Evidence of Obvious IC/ID?* ☐ Odor ☐ Color ☐ High Flow
***Requires immediate follow-up**

Outfall Structural Condition
☐ Normal
☐ Damaged
☐ Scour Pond
☐ Blockage

Potential Source ☐ Ground Water ☐ Irrigation Runoff ☐ Permitted Discharge
☐ Vehicle Washing ☐ Power Washing ☐ Pool/Spa Discharge ☐ Water Line Break
☐ Unknown ☐ Tidal ☐ Other_______________________________________

Was Flow Source Eliminated? ☐ Yes ☐ No
Notes:____
____

Weather ☐ Clear ☐ Partly Cloudy ☐ Overcast ☐ Fog
Last Rain ☐ > 72 hours ☐ < 72 hours but ≤ 0.1"
Tide ☐ N/A ☐ Low ☐ Incoming ☐ High ☐ Outgoing Tide Height______ft.

Observations

Odor	☐ None	☐ Sewage	☐ Sulfides	☐ Petroleum		☐ Manure	☐ Other
Color	☐ None	☐ Yellow	☐ Brown (Silty)	☐ White (Milky)		☐ Gray	☐ Other
Clarity	☐ Clear	☐ Cloudy(>4" vis)	☐ Murky(<4" vis)				☐ Other
Floatables	☐ None	☐ Trash	☐ Bubbles/Foam	☐ Sheen	☐ Algae	☐ Biofilm	☐ Other
Deposit	☐ None	☐ Coarse Particulate	☐ Fine Particulate	☐ Stains/Minerals		☐ Oily Deposit	☐ Other
Vegetation	☐ None	☐ Limited	☐ Normal	☐ Excessive			☐ Other
Biology	☐ None	☐ Insects	☐ Algae ☐ Snails	☐ Fish	☐ Birds	☐ Cray Fish	☐ Other

MS4 Outfall Flow Estimate

Width	ft
Depth	ft
Velocity	ft/sec
Length of Ponded Area	ft

Flowing Pipe Diameter _______ft. Depth________ft. Velocity_______ft/sec
Bottle Fill Volume_______ml Time to Fill________seconds
Leaf Float Distance__________ft. Time___________seconds

Estimated Flow Rate ___________ ☐ cfs ☐ gpm

Trash Present? ☐ Yes ☐ No **Trash Assessment** ☐ High (>400 pieces) ☐ Medium (50 to 400 pieces) ☐ Low (<50 pieces)
Evidence of Illegal Dumping ☐ Yes ☐ No **Evidence of Illegal Connection** ☐ Yes ☐ No
Accessibility ☐ Easy ☐ Moderate ☐ Difficult ☐ Critical Habitat

Comments:____
____
____
____

DEPARTMENT OF PUBLIC WORKS
5510 OVERLAND AVE., SUITE 410
SAN DIEGO, CA 92123

Site Type: VOM (Visual Outfall Monitoring) – For sites that are within the visual outfall monitoring program.
A, B, C, D… (Source Investigation) – For locations that are aimed at source follow-up investigations.

Sample Event Type: Visual Observation
Confirmation
Source Investigation
Duplicate
Blank
Lab Standard

Watersheds

Hydro. Unit	Watershed
902	Santa Margarita River
903	San Luis Rey River
904	Carlsbad Management Area
905	San Dieguito River
906	Los Penasquitos
907	San Diego River
908	Pueblo San Diego
909	Sweetwater River
910	Otay River
911	Tijuana River

EXAMPLE - CHAIN-OF-CUSTODY FORM

Date: _________ ***Page*** ____ ***of*** ____

Analyzing Laboratory: ____________________________

Project Name / Project Number

Project Manager / Contact

Client

Address

Phone / Fax / Email

Site ID (Location)	**Sample ID**	**Date**	**Time**	**Matrix**	**Container Type / Volume**	**Total Number of Containers**	**Analysis / Test Requested**								**Preservation**	**Laboratory Use Only: Temp (C) Upon Receipt**	**Laboratory Use Only: Laboratory ID**

Sample Matrix Code: FW = Freshwater; SW = Storm Water; SLT = Saltwater; SED = Sediment; BIO = Biologic; O = Other (Specify) __________________

Container Code: G = Glass; P = Plastic; B = Bags; O = Other (Specify) ______________

Shipped By: ☐ Courier ☐ FedEx ☐ UPS ☐ USPS ☐ Client Drop-Off ☐ Other ________________

Turnaround Time: ☐ 2-day ☐ 5-day ☐ 7-day ☐ 10-day ☐ 14-day ☐ Standard ☐ Other _______________________

Reporting Requirements: ☐ PDF ☐ EDD ☐ Hard Copy ☐ Email ☐ Other _______________________

Sampled By:

Name (Print): _____________________________

Signature: _____________________________

Comments/Special Instructions:

Relinquished By				**Received By**			
Print Name	Signature	Firm	Date/Time	Print Name	Signature	Firm	Date/Time
1				1			
2				2			
3				3			
4				4			
5				5			

ATTACHMENT 4A-6: SAN DIEGO RIVER WATERSHED SURFER HEALTH STUDY

This page intentionally left blank

FULL STUDY WORKPLAN:

Wet Weather Epidemiology Study and Quantitative Microbial Risk Assessment In San Diego, California

FINAL: October 20, 2014

Table of Contents

Problem Statement

Fecal indicator bacteria (FIB) such as *Enterococcus* are commonly used for monitoring water quality at marine recreational beaches. FIB do not cause human illness, but are used as indicators of human fecal contamination because they are found in sewage at high concentrations, are relatively easy and cheap to measure in the laboratory, and co-vary with the human pathogens found in sewage that do cause illness. Several epidemiology studies, almost exclusively conducted at beaches impacted by human fecal pollution, have demonstrated predictive relationships between FIB and swimming related illness. It is for this reason that FIB water quality objectives have been adopted for public health decision making at swimming beaches.

One important caveat to the use of FIB for public health decision making is that not all FIB come from human sources. FIB can arise from any warm blooded animals including dogs, cats, horses, and birds. However, the human pathogen content of these non-human sources is often lower than in human sources. Hence, the potential risk of illness from these sources can also be less. Regardless of the risk, water quality objectives currently remain the same regardless of fecal source.

Wet weather is particularly problematic for virtually all beach managers. Stormwater runoff has consistently high concentrations of FIB. Because of the dynamic nature of rainfall, runoff, and source locations, reducing FIB concentrations in stormwater discharges to attain existing water quality objectives is an extremely difficult and expensive proposition. However, most beach managers are uncertain if human sources exist in stormwater runoff, and, if present, what relative proportion of FIB is of human origin. If the relative human fecal contribution to stormwater is negligible, then existing water quality objectives may be over-protective (Soller et al, 2014).

The US EPA has recently promulgated revised national beach water quality criteria for FIB. One element of the new regulation is the option of using Quantitative Microbial Risk Assessment (QMRA) for establishing site-specific FIB water quality objectives. Similarly, California has existing regulatory options for altering FIB water quality objectives through the use of natural source (i.e., non-human) exclusions. However, neither QMRA nor natural source exclusions have been used previously for successfully creating a site-specific objective in California.

Purpose Statement

The purpose of this study is to evaluate the risk of illness after body contact recreation following storm events. If the risk is lower than expected based on current FIB water quality objectives, then options for new site-specific objectives that are equally protective as current water quality objectives will be developed. To accomplish this goal, this study will answer four questions:

(Q1) Is water contact associated with an increased rate of illness?

(Q2) Are illness rates greater following exposure to wet weather events compared to dry weather?

(Q3) What is the association between levels of *Enterococcus* and illness following wet weather events?

(Q4) What level of *Enterococcus* corresponds to the same risk of illness as current water quality standards?

The questions build one upon the other; the approach to answering the next question is dependent upon the answer to the previous question.

General Study Approach

We will use a two-phased approach for this study. The first phase is an epidemiology study that will quantify the illness associated with body contact recreation following wet weather. Epidemiology studies have been used for decades to establish health standards. We will use a study design relatively similar to previous epidemiology studies in California and by the US EPA to set current water quality objectives. This first phase will address Q1, Q2, and Q3. However, this study will be unique in that this design has never been used at beaches specifically following storm events.

The second phase is a QMRA that will predict future risk of illness after body contact recreation following wet weather. QMRA studies have also been used for decades to establish benchmarks for human exposure to pathogens and other toxicants. We will use and build upon risk models recommended by the US EPA as part of their recent revised national beach water quality criteria. This second phase will address Q4. However, this study will be unique in that QMRA has not previously been attempted in California for the purposes of establishing a site specific criteria for recreational activities.

Together, these two phases will identify if there is an increased risk of illness from recreational water contact, if this illness is related to FIB concentrations, then identify options for FIB site-specific objectives that provides equivalent (or greater) health protections as the existing water quality objective.

Pilot Study Resolution of Three Key Issues

There are three key issues that require special consideration for our study approach. These include: a) using surfers as our target population; b) following individuals across multiple beach exposures, and; c) utilizing multiple beaches. We will target surfers as our body contact recreation users because they are the most abundant group of beach users in the winter. Sufficient sample size to make confident assessments of illness is a critical element of a successful epidemiology study. That is why previous epidemiology studies have focused on dry, summertime conditions when swimmers are most abundant. Swimming is relatively rare in San Diego during the winter, especially following wet weather events. In contrast, surfing can increase following wet weather conditions when wave conditions excel. Moreover, surfers are an important target population because they will have full-body water contact and frequent head underwater exposures. Higher levels of water exposure have consistently been associated with greater illness risk among swimmers.

Following surfers also requires an approach that examines multiple water contact exposures. Previous epidemiology studies have focused on one-time swimmers in order to isolate water exposure, but this approach is insufficient for surfers for three reasons. First, multiple exposures is a realistic scenario for wet weather users like surfers. Second, this approach provides us the opportunity to evaluate different sized storm events. Third, this approach allows us to increase effective sample size through the use of multiple water contact days. Longitudinal surveys (following an individual through time) allow not only comparisons among different surfers, but also comparisons within an individual surfer by comparing illness rates during periods following ocean contact with periods when they do not enter the ocean.

Following surfers also requires an approach that examines multiple beaches. Some surfers will visit different beaches to chase good waves, while others return to the same beach repeatedly. To accommodate these different utilization patterns, our study approach will prioritize beaches into two categories. The first category is a broad spectrum approach, which includes any beach in San Diego County to capture the range of beaches (and water exposures) encountered by surfers. Our second category is a fixed approach, which includes a pair of "sentinel" beaches for focused effort.

These three key issues were addressed in a Pilot Study completed in the winter of 2013-14. During this Pilot Study, we were able to demonstrate the feasibility and applicability of the study approach. We were able to recruit surfers into the study, utilize their multiple water contact exposures to our advantage in the study design, and quantify their rate of single vs. multi-beach exposures. We demonstrated that the study approach was capable of identifying changes in health effects in a surfing population that is exposed in wet and dry weather conditions. We will use the insights from the Pilot Study to ensure success of the full-scale study design, described by task, below. Moreover, the information about surfer exposure and illness from pilot study was so successful that we plan to incorporate all of the data into the main study results.

Specific Approach

This project will consist of five major tasks including: 1) creation of an Advisory Committee; 2) creation of a project Workplan; 3) epidemiology study; 4) QMRA study, and; 5) Reporting. The general task descriptions follow.

Task 1. Advisory Committee

Much of the technical work for this project is being conducted to address policy issues of great magnitude. It is important that this type of study be formulated, evaluated, and interpreted with policy relevance in mind. That is, the primary goal of this study is to fill the information gaps policy makers need to make the wisest decisions regarding public health protection and water quality regulation. Equally important, is the need to set precedence when implementing regulatory-based studies such as QMRA.

The goal of this task is to convene an Advisory Committee to provide guidance on both technical robustness and policy relevance. The Committee will be comprised of representatives from the following agencies and/or sectors, at a minimum:

- County of San Diego
- Environmental Advocacy Group
- San Diego Public Health Services
- Regional Water Quality Control Board
- State Water Resources Control Board
- US Environmental Protection Agency, Office of Science and Technology
- US Environmental Protection Agency, Region IX

The Advisory Committee shall meet for milestone specific decisions and guidance including:

- Study design development
- Workplan approval
- Epidemiology study review and interpretation
- QMRA study review and interpretation
- Contingency approval
- Oral presentation and Final report approval

Task 2. Workplan (This document)

The Study Team will prepare a Workplan that will detail each of the design elements and tasks. The workplan will include sampling locations, frequency and timing, laboratory methods, quality assurance and quality control, contingency plans, reporting requirements, and schedule. The workplan will be reviewed and approved by the project Advisory Committee.

Task 3. Epidemiology Study (Details: Appendix B)

We propose to conduct a prospective cohort based epidemiology study. The epidemiology study task will be divided into three subtasks: a) surfer recruitment and illness reporting; b) water quality sampling and analysis, and; c) data management and analysis.

Task 3a. Surfer recruitment and illness reporting

Surfer recruitment into the study is a key element of the epidemiology study because these individuals will form the basis of our illness evaluations. We will target a cohort of 22,000 person-days of exposure, or roughly 200 surfers followed longitudinally for 16 weeks. Based on the Pilot Study, this level of follow-up should provide comparable statistical confidence to previous epidemiology studies under assumptions of similar surfing and illness rates observed in the pilot study, and a similar number of storm events during the winter (which is conservative – 2013-14 winter was the driest in decades). This level of reporting and follow-up is very achievable, but is subject to variables such as quantity and timing of rainfall. Since our pilot study was so successful, we plan to incorporate all of the surfer exposure and illness information collected in the pilot study into the overall analysis of the full study.

To maximize surfer enrollment, we will develop smartphone applications and web sites with online consent forms. Online enrollment proved to be equally effective as placing staff on the beach with tablet computers during the Pilot Study. We also found that individuals enrolled online were highly similar to those we enrolled on the beach based on all measurable characteristics. We will still place staff members on the beach following storm events to help advertise (i.e., post cards or QR codes) the study and specifically ensure enrollment of post-storm surfers.

After enrollment, we will use weekly surveys to collect daily information about surfer marine water exposure activities and reported illness using incentivized mobile- and web- based data collection. Incentives may include Swell.com gift cards. The data entry for water exposure will include location, timing, duration, and volume estimate of water ingestion. The data entry for illness will include symptoms on gastrointestinal illness (nausea, cramps, vomiting), sinus pain/infections, ear pain/infections, eye infections, fever, infected cuts or scrapes, cough, congestion, and skin rash. The data entry will also include potential confounding factors such as food consumption or illness in the household, age, employment status, and household income. The data entry will also include economic impacts such as lost work or school days and doctor's visits. All data will be blind to surfer identity and the Office for the Protection of Human Subjects at the University of California, Berkeley will continue to oversee the study protocol.

Task 3b. Water quality sampling and laboratory analysis

Water quality sampling and laboratory analysis will focus on assessing exposure of surfers to FIB. FIB monitoring will mimic existing protocols used by the City of San Diego and San Diego County Department of Environmental Health, which sample beaches during the swimming season (April to October). Samples will be analyzed for *Enterococcus*, fecal and total coliforms (the same FIB as City and County monitoring programs). However, there will be three important differences between this study and routine monitoring programs. First, the samples will be collected during the wet season. Second, samples will be collected only at two sentinel beaches. Third, there will be more collection sites and times at the sentinel beaches than just those collected by the routine monitoring agencies.

The two sentinel beaches will include Tourmaline Surfing Park and Ocean Beach. These two beaches were evaluated in the Pilot Study and identified as appropriate for this project. These beaches met several important selection criteria including:

- Surfing location with numerous return users (local surfers)
- Northwest facing for good winter swell
- Creek, stream, or storm drain outlet nearby
- Ongoing FIB monitoring program
- Access and safety of crew, even in wet weather
- Proximity to microbiology laboratory

To ensure a robust assessment of surfer exposure, our monitoring design will include additional sites (at least one per beach) and enhanced frequency (daily) relative to the City and County routine monitoring design. One of these additional sites will be collected from the Ocean Beach Pier, located offshore in the line-up of surfers waiting for waves.

All FIB water quality data will be provided to the San Diego County Department of Environmental Health.

Task 3c. Data management and analysis

All data on recruitment, water contact, and water quality will be compiled for analysis. Three categories of analysis will be completed. The first analysis will quantify the relationship between surfer exposure and illness in subsequent time periods. By following a cohort of surfers over time, we will observe individuals during periods when they surf and recreate in marine water ("exposed periods") and during periods when they do not ("unexposed periods"). Comparing the rate of illness following exposed periods and unexposed periods will allow us to estimate the excess rate (if any) associated with surf exposure (question Q1). We will conduct an analogous analysis comparing water exposure during or following wet weather events to water exposure during dry weather and to periods of no water exposure (question Q2). Finally, the daily reports that surfers provide will enable us to match exposure with water quality data and quantify the association between FIB levels with subsequent surfer illness (question Q3).

Task 3d. Drought contingency

The Governor of California declared a drought emergency in early 2014. In southern California, annual rainfall totals have been below the long term average for three years in a row. Since this project is entirely contingent upon rain storms, a contingency plan is in place to maximize information collection if insufficient rain falls to sample our six planned storm events and optimum number of surfer exposure days. The contingency has three optional components, which are not mutually exclusive and can be used in combination. The decision to engage the contingency plan(s) will be made in consultation with the Advisory Committee. The three contingencies include:

1) extend the study for two additional weeks, until approximately April 15, utilizing the existing sampling plan. This contingency works well if recent wet weather has occurred or an approaching storm is imminent and we can easily and confidently capture additional post-storm sampling days.

2) if the daily concentrations are consistently and predictably low when not raining, reduce daily dry weather sampling to every other day and utilize these resources to extend the sampling until April 30, This contingency must make an assumption that water quality on unsampled days is comparable to sampled days. This contingency is most attractive if the near-term forecast is predicting an upcoming storm pattern. Since an additional four weeks of sampling is necessary, the decision to utilize this

contingency should occur approximately four weeks before the end of the study (February 28).

3) if the daily concentrations are consistently and predictably low when not raining, reduce daily dry weather sampling to every other day and utilize these resources to extend the sampling to a third beach. Like contingency 2, this contingency makes an assumption that water quality on unsampled days is comparable to sampled days. The third beach is La Jolla Shores, the next beach to meet all of our beach selection criteria. Inclusion of a third beach will also require the sampling of a third discharge to support the QMRA. Therefore, this decision will need to be made at least 8 weeks before the end of the study (January 30).

Task 4. QMRA (Details: Appendix D)

The goal of the QMRA task is to predict future risk of illness after body contact recreation following wet weather. The QMRA is linked, but separate from the epidemiology study for two reasons. First, the epidemiology study will be distributed across surfers countywide, but the QMRA (especially if it used for developing site-specific water quality objectives) needs to be focused at a single beach. Second, this study will be used to help set precedence for how to conduct a QMRA so that future site-specific water quality objectives have an example to follow. Undoubtedly, the issue of setting appropriate water quality objectives, particularly if the epidemiology study identifies reduced risk following wet weather relative to existing water quality standards, will continue well beyond this project.

Conceptually, QMRA risk modeling requires four pieces of information to estimate illness. Those pieces of information are pathogen concentration, volume of water ingested, a mathematical relationship between the number of pathogens ingested and infection, and the proportion of infections that result in illness. This QMRA study follows EPA's recommended procedures for using QMRA for developing site specific alternative water quality criteria (US EPA, in preparation) and will require three subtasks: a) Source identification and pathogen loading; b) Swimmer exposure; and c) Illness response modeling.

Task 4a. Source identification and Pathogen loading

The first task of the QMRA is to identify source(s) of fecal contamination and quantify the loading of pathogens and FIB to the waterbodies of interest. For this study, we are considering the watershed discharge as a "point source" and are using a study approach focused on quantification and confirmation.

The first step in this process is to conduct a sanitary characterization of the sentinel watersheds. EPA has developed and tested an approach specifically for the purpose of informing QMRA activities. We will use the EPA sanitary characterization template for each of our sentinel watersheds to identify and document the most likely sources of fecal contamination. The predominant source of contamination in a waterbody is important to understand because different sources (i.e. birds, humans, etc) can contribute different relative levels of FIB and pathogens. These different contributions can result in relatively higher or lower risks at a specific level of FIB (Soller et al., 2010).

For quantification, we will sample wet weather discharges at the terminus of each watershed discharging to our sentinel beaches. Storm composite samples, approximately 20 L in volume, will be collected from Tourmaline Creek and San Diego River for a minimum of six storm events. Samples will be collected using automated sampling equipment that includes rainfall and flow sensors, as well as programmable peristaltic pumps. All pump tubing and sample bottles will be sterilized prior to each storm event. Each sample will be analyzed for host-specific markers, which may include other types of bacteria, genetic markers of host origin, chemical signatures, and direct pathogen measurements. The goal will be to understand the myriad of sources responsible for FIB and pathogens during wet weather. The hosts to be quantified include humans, birds, dogs, cattle, and horses. These sources and methods are consistent with the new Source Identification Project Protocol developed by SCCWRP and being promulgated by the State of California.

In addition to source tracking measurements, human pathogens will also be measured in wet weather watershed discharges. These measurements will include the 7 most common pathogens responsible for swimming related activities published by the Center for Disease Control (CDC). These pathogens are comprised of viruses (i.e., norovirus, adenovirus, enterovirus), bacteria (i.e., *Salmonella, Campylobacter*), and protozoans (i.e., *Giardia, Cryptosporidium*).

For confirmation, we will sample scats of non-human fecal contamination sources identified from the sanitary characterization and wet weather host marker analysis for human pathogens and FIB content. This will be especially important if non-human hosts are quantified and low levels of human pathogens are detected in the discharge. The number of scat samples required from these non-human host sources is a function of number of hosts, host density, proportion of host population with infection, and host pathogen concentration in the scats. Variation in any of these parameters will ultimately require more samples to attain the confidence necessary for confirming lack of pathogen loading.

Task 4b. Swimmer exposure

Once the pathogen load is quantified, the next step in the QMRA modeling is to quantify exposure. Exposure is a function of water ingestion rate including the frequency and duration of swimming (or surfing), along with pathogen concentration. Together, these factors provide the estimate of "dose". This portion of the QMRA will be inextricably linked to epidemiology study.

To estimate water ingestion, we will use the data from the epidemiology study to provide frequency and duration of exposure. These data will be used in conjunction with literature-based data on water ingestion rates to confirm that the site specific ingestion data are consistent with the data from the literature which are commonly used in QMRA.

Pathogen concentrations will initially be derived from watershed loads measured in the previous task (Task 4a). The Pilot Study indicated that discharge plume fate and transport played a significant role in the distribution of FIB following storm events. Therefore, we will incorporate two fate and transport models into this study to account for dispersion and advection of FIB and pathogens after the discharge enters the ocean. We intend to use two model approaches to assess the level of complexity necessary for future QMRA applications, either at additional beaches or at the sentinel beaches following some management action that involves changes in fate and transport. The first model will be a straightforward statistical model based upon monitoring data collected along the beach during surfer exposure immediately following storm events. These measurements will include FIB (e.g. sampled from the epidemiology study) and physical water quality parameters (i.e., temperature, salinity) measured at regular intervals upcoast and downcoast from the discharge. This type of model provides either measured point-in-time exposure during monitored events or estimates of average condition when combining time estimates.

The second model approach will be a mathematical computational model such as Qual2K, available from the US EPA. This model predicts shoreline FIB concentrations based on several parameters that drive advection and dispersion including watershed loading, wind strength and direction, wave height and direction, and bacterial decay. Watershed loading will be measured in the previous task, wind and wave data are available from local measurements through NOAA. Calibration and validation data will be derived from the shoreline physical water quality, surface currents from the Southern California Coastal Ocean Observing System, and FIB measurements used in the statistical model. This model can estimate exposure either point-in-time or average condition similar to the statistical model, but can also provide these estimates for unmeasured storm events, which will be useful if many events occur at our sentinel beaches or if one attempts a QMRA at another beach.

Task 4c. Illness response modeling

Illness-response modeling predicts the illness rates in swimmers (surfers) based on exposure, ingestion, and pathogen dose-response relationships. Exposure and ingestion will be estimated based on the previous task. As is commonplace in QMRA studies worldwide, we will use peer reviewed dose response relationships for this study. We will also use peer reviewed data from the scientific literature to characterize the proportion of infections that lead to illness for each of the reference pathogens. EPA has summarized the scientific literature and we will use that information as a basis for this work.

We will focus much of our illness modeling on sensitivity analysis using monte-carlo simulations. The sensitivity analysis will help us to assess if uncertainty or variability in the modeled parameters are important components of the risk modeling. The sensitivity analysis of illness rates will help to determine which model parameters (ingestion rate, fate and transport, pathogen concentration, dose-response relationship) are the most critical factors, and then focus refinements in these assumptions for this (and future) QMRA interpretations.

More importantly, the sensitivity analysis will provide decision-makers with estimates of confidence in the risk analysis. This estimate of uncertainty is crucial for managers to determine if risks of swimming related illnesses are greater or less than existing predictions of illness rates based on commonly used FIB water quality objectives and if further consideration of regulatory options are warranted.

One way to capture the management response to the combination of epidemiology and QMRA results is captured in Figure 1. In this paradigm, managers will make some initial decisions based on a comparison of risk estimates from the empirical epidemiology results at the beach to the modeled QMRA risk estimates of undiluted stormwater discharge at the outfall:

- If both the epidemiology and QMRA indicate little to no risk, then managers can assume that an effort at site specific objectives dilution is likely productive.
- If the epidemiology results from the beach indicate little to no risk, but the QMRA at the outfall does indicate risk, then application of the study fate and transport models is the next management step. In this scenario, the epidemiology study may not have sufficient resolution to detect health risks this low, and the QMRA model will be the key to successful site specific objectives.
- If the epidemiology results from the beach indicate risk, but the QMRA at the outfall indicates little to no risk, then there are likely other sources of pathogens than just the storm discharge. In this management scenario, a site specific objective is unlikely until the additional source of pathogens is identified and removed.
- If both the epidemiology results from the beach and the QMRA at the outfall indicate risk, then application of the study fate and transport models are appropriate. In this management scenario, site specific objectives may be appropriate based upon the magnitude of risk and how well the model fits the empirical results.

As is evident from Figure 1, we are most concerned about the uncertainty due to fate and transport of FIB and pathogens once they enter the ocean. If the relationship between the epidemiology study and the QMRA are not comparable when both indicate an increased risk of illness, then we may utilize a "reverse QMRA". A reverse QMRA, used by EPA, utilizes illness estimates from the epidemiology study in conjunction with the results of the sanitary characterization to estimate the dilution distribution between the discharge point and the points of exposure.

Figure 1. Management response based on comparisons between epidemiology study and QMRA results

	Epi at the beach indicates little to no risk	Epi at the beach indicates risk
QMRA at the outfall indicates little to no risk	Site specific objectives likely	Potentially unmeasured sources of pathogens. Site specific objectives unlikely.
QMRA at the outfall indicates risk	QMRA may provide estimate of risk below levels sensitive enough to capture empirically. Site specific objectives likely	Apply fate and transport models to QMRA for improving risk quantifications. If unsuccessful, may use reverse QMRA. Site specific objective may be possible, depending upon level of risk and uncertainty.

Task 5. Reporting

This task will be comprised of four subtasks: a) quarterly reports; b) oral reports and presentations; c) draft final report, and; d) final report.

Task 5a. Quarterly reports

Reports providing brief progress updates to the funding agencies will be provided quarterly.

Task 5b. Oral reports and presentations

Oral reports and presentations will be provided to the Advisory Committee. Since Advisory Committee meetings are milestone driven, each presentation also serves as task summary. Oral presentations will be given to the funding agencies upon request. Following completion of the study, additional presentations at scientific conferences may also be given.

Task 5c. Draft final report

A draft Final Report will be prepared for review by the Advisory Committee. The Advisory Committee will review and approve the draft final report.

Task 5d. Final report

The final report will be published as a SCCWRP Technical Report and one or more Peer-reviewed publications in appropriate scientific journals.

Study Team

The study team for this proposed project consists of:

- Southern California Coastal Water Research Project (SCCWRP) is an international leader in beach water quality research, recently completing the State's Source Identification Project Plan and conducting the premier evaluation of genetic source tracking tools. SCCWRP will be the Project Team Leader and will oversee all of the water quality sampling and analysis.

- UC Berkeley School of Public Health is an international leader in health effects studies for water contact recreation and drinking water. UC Berkeley has completed four epidemiology studies in southern California with SCCWRP including Mission Bay, Doheny State Beach, Avalon Bay, and Malibu Surfrider Beach. UC Berkeley will oversee the epidemiology study, with Professor Jack Colford as Principal Investigator.
- Soller Environmental is a private firm supporting the US EPA's development of QMRA guidance to accompany the recent beach water quality criteria. Soller is working with SCCWRP on a Clean Beach Initiative funded project to conduct a dry weather QMRA in California. Soller will oversee the QMRA.
- Surfrider Foundation is an internationally recognized non-profit grassroots organization dedicated to the protection and enjoyment of our world's oceans, waves and beaches. Surfrider will oversee the outreach and recruitment of surfers into the epidemiology study.

Schedule

TASK	Year	2014		2015				2016	
	Quarter	3	4	1	2	3	4	1	2
1. Advisory Committee		■	■	■	■	■	■	■	■
2. Workplan		■							
3. Epidemiology Study									
Surfer Recruitment		■	■	■	■				
Water Quality Sampling			■	■	■				
Data Management and Analysis				■	■	■	■	■	■
4. QMRA									
Source Identification and Pathogen Loading			■	■	■				
Swimmer Exposure			■	■	■	■			
Illness Response Modeling					■	■	■	■	■
5. Reporting									
Quarterly Reports		■	■	■	■	■	■	■	■
Oral Reports		■			■		■		■
Draft Final Report								■	■
Final Report									■

Advisory Committee Schedule

(Meetings in bold)

Aug 2014 – Study plan design

Nov 2014 – Workplan approval

June-July 2015 Preliminary results from Epidemiology and QMRA studies

Nov-Dec 2015 Results from Epidemiology and QMRA studies

March 2016 Draft Final Report

June 2016 Final Report

Appendix A Study Sites

The study sites chosen were previously evaluated in the pilot study; Ocean Beach and Tourmaline Surfing Park (Fig 1). Both of these beaches fit the beach *a priori* selection criteria (see main workplan). Ocean Beach and Tourmaline Surfing Park both receive significant winter use by surfers as evidenced by survey responses during the pilot study (Fig 2). Both beaches receive stormwater discharges; Ocean Beach is adjacent to the San Diego River (Fig 3) and Tourmaline Surfing Park is adjacent to Tourmaline Creek. (Fig 4) Both beaches have many years of beach water quality monitoring by the San Diego County Department of Environmental Health and this science team monitored water quality daily at multiple locations at each beach and in the San Diego River (Figs 3,4), every day from January 15 -March 1 2014. Historically, water quality is best during the dry, AB411 beach season (Apr 1 – Oct 31) and exceedences of the State single sample water quality standard increase during the non-AB411 winter season (Nov 1 – Mar 31).

Figure 1. Overview map of study area including Ocean Beach and Tourmaline Surfing Park

While both beaches consistently met our *a priori* selection criteria, Ocean Beach and Tourmaline Surfing Park have important differences that make them useful for both the Surfer Health Epidemiology study and for the concurrent QMRA study. Ocean Beach is influenced by the San Diego River, a large (1,088 km^2), varied land use watershed, with many flow control structures (i.e., dams). Tourmaline Surfing Park is influenced by

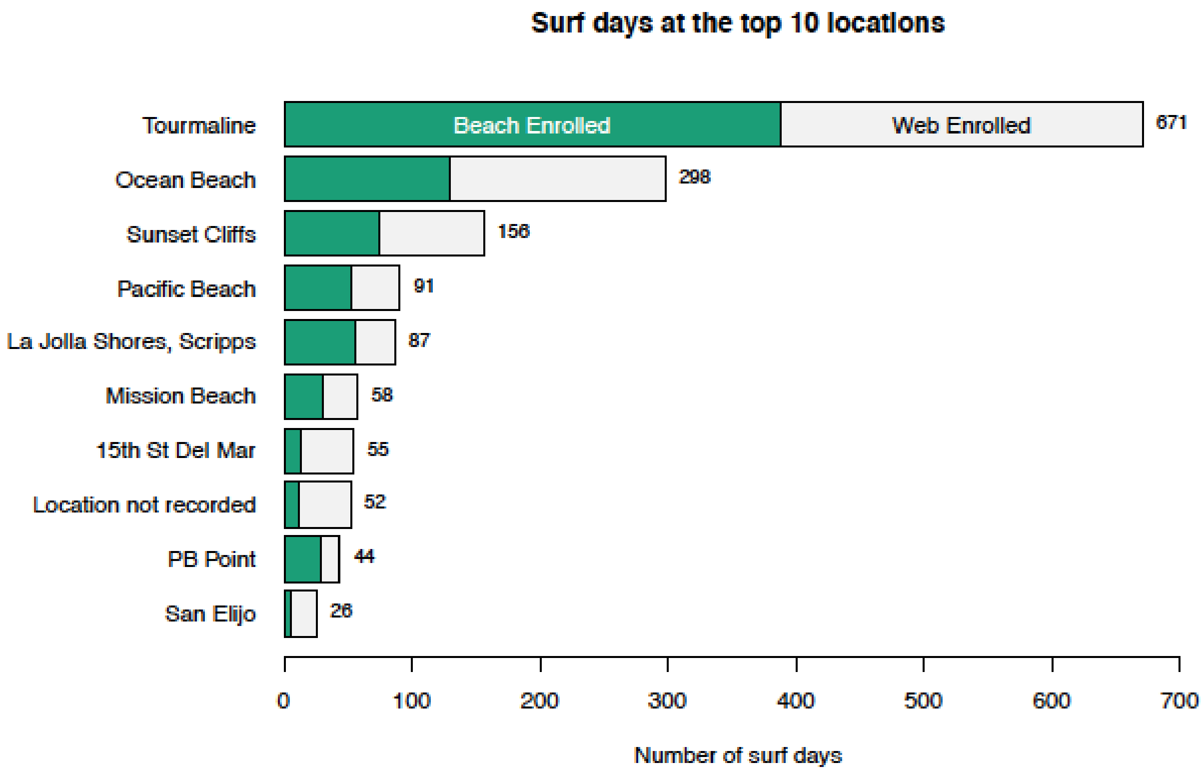


Figure 2. Survey responses indicating which break was most commonly surfed by surfers recruited during the Pilot Study. Green bars represent surfers enrolled on the beach, grey bars represent surfers enrolled on the internet.

Tourmaline Creek, a much smaller (6 km^2), homogeneous land use (urban) watershed that is highly impervious with few flow control structures; it also has a small storm drain at the North end of the beach which drains the neighborhood immediately North of the bluffs and a small storm drain in between Tourmaline Creek and the Northernmost storm drain which drains the neighborhood immediately East of the bluffs.

Because of watershed imperviousness and flow control structures, the San Diego River will likely flow only during larger storms, but Tourmaline may flow during even the smallest of storms. Therefore, a greater number of days with wet-weather flows would occur at Tourmaline Surfing Park. However, the much larger volumes discharged from the San Diego River may impact the entire length of Ocean Beach or surrounding beaches, but the smaller discharge volumes at Tourmaline Creek may only impact portions of Tourmaline Surfing Park. Therefore, all concurrent surfers will likely receive a similar water quality exposure at Ocean Beach, but there may be differential exposure among concurrent surfers at Tourmaline Surfing Park based on size of storm, distance from creek mouth, tides, and prevailing ocean currents.

Tourmaline Creek and the San Diego River had exceedences of Fecal Indicator Bacteria during the February 2014 storm that occurred during the Pilot Study, but the San Diego River had a much higher and more consistent level of FIB, e.g. *Enterococcus* (Fig 5). Furthermore, the human fecal source markers (e.g. Bacteroidales HF183, Figure 5) were both higher at Ocean Beach compared to Tourmaline Surfing Park during the storm in late February-early March. Finally, surfers at Ocean Beach may be exposed to a greater number of pollution sources than surfers at Tourmaline Surfing Park because of the differences in land use composition between their respective watersheds.

Figure 3 Overview picture of Ocean Beach with sampling sites at the Beach, FM-010, PL-110, PL-100 and the Ocean Beach Pier site labeled.

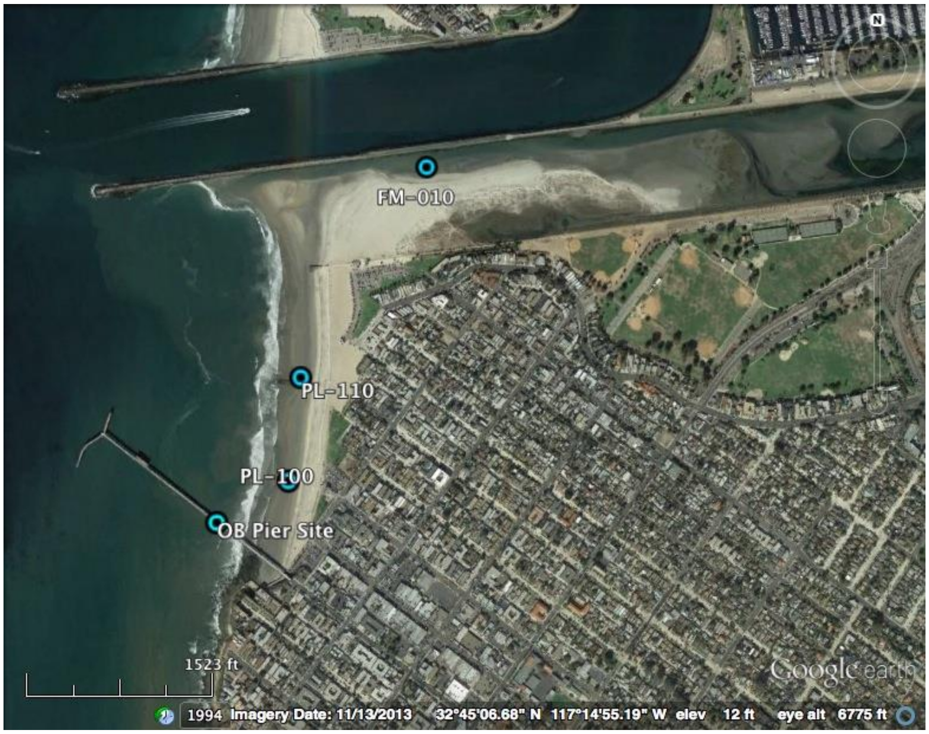
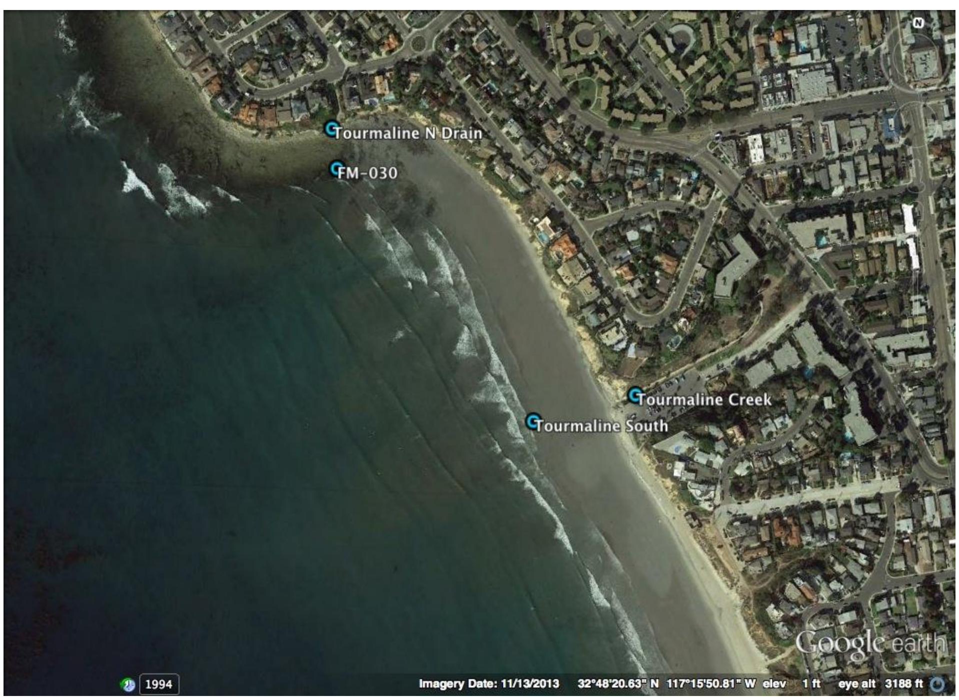


Figure 4 Overview map of Tourmaline Surfing Park with sampling sites and discharge sites labeled.



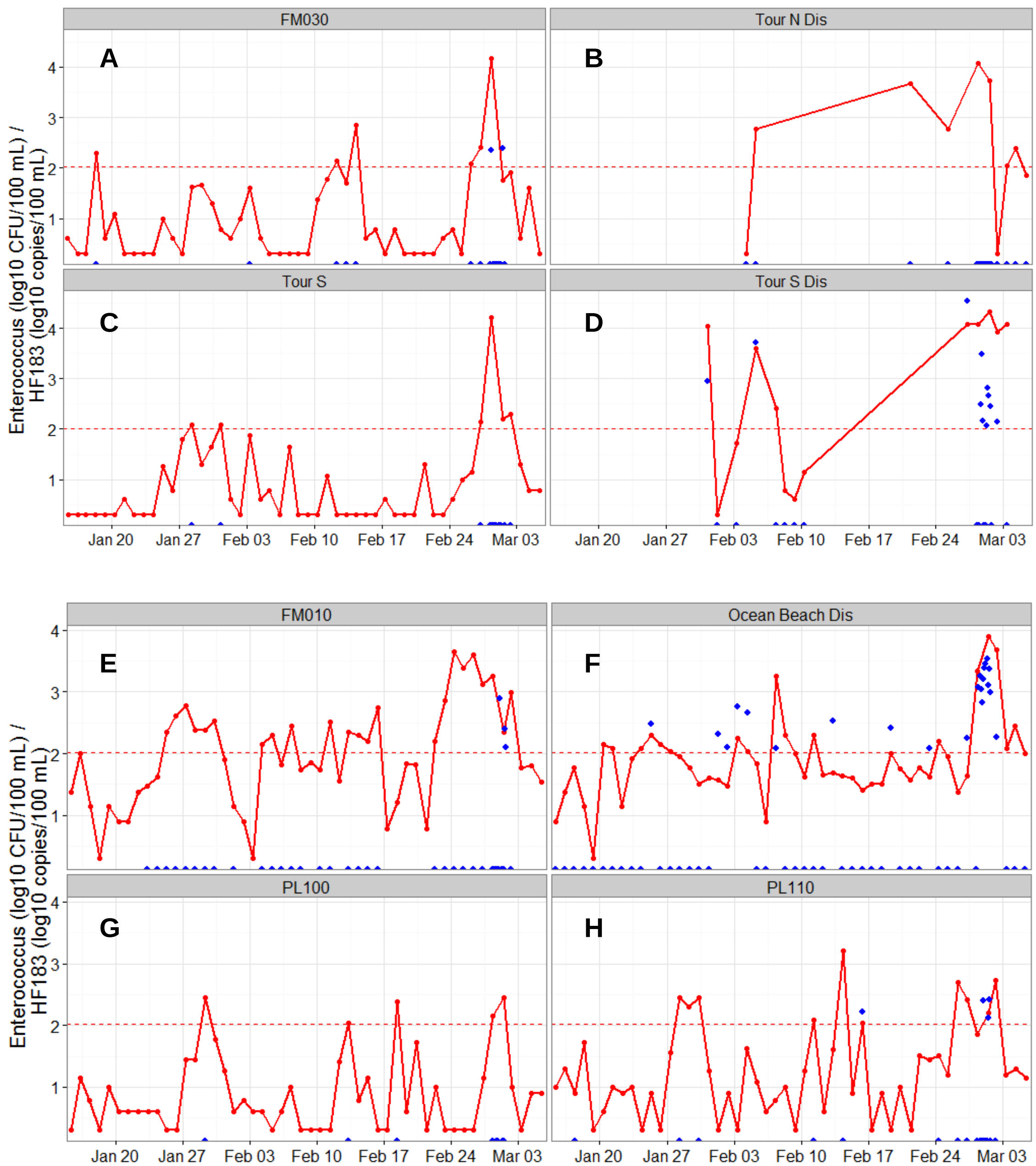


Figure 5. Enterococcus (red line) and human fecal marker (HF183, blue dots) at beach and discharge sites at Tourmaline Surfing Park (A-D) and Ocean Beach (E-H). The axis is in log CFU/100ml for *Enterococcus* and log copies/100ml for HF183.The dashed line indicates the single sample maximum for *Enterococcus.* Note: the break in the red line from panels B and D indicates that these storm drains did not flow during storms in February.

Appendix B Task 3: Epidemiology Study Details

Task 3a: Surfer Recruitment and Enrollment

Target population and inclusion criteria:
The epidemiology study will aim to enroll surfers in San Diego County who enter the ocean during the winter months. The rationale for focusing the study on surfers is that they are a segment of the population who consistently enters the ocean during the winter months and following wet weather events. Anecdotally, we expect this population to be predominantly male, and the study will focus enrollment on adults (details below). Our enrollment strategy and inclusion criteria are designed to help ensure that we enroll participants who fit this profile.

The study will have the following four inclusion criteria:

1. Can speak and read English
2. Is 18 years or older
3. Plan to surf in southern California during the study period
4. Has a valid email address and can access the internet with a computer or smart phone

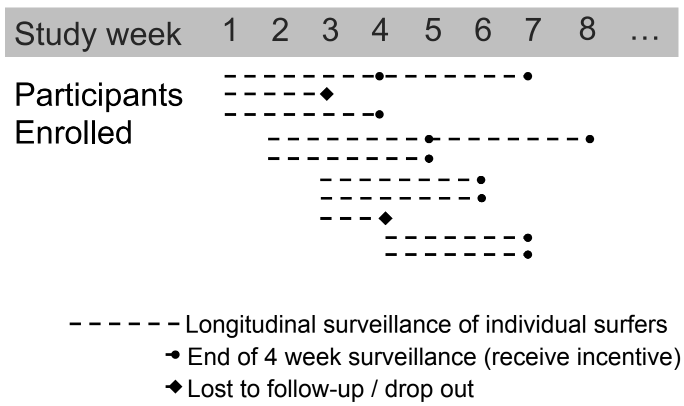
The rationale for these inclusion criteria is the following. We are restricting the study to people who can speak and read English to facilitate field staff hiring and survey development and administration (follow-up surveys will be self-administered by participants); based on past studies at California beaches, we expect the vast majority of individuals to speak and read English. We are restricting the study to adults (18+ years) to facilitate enrollment and follow-up: follow-up will require regular check-in via a web- or smartphone interface, and would likely require parental supervision for young children. We are restricting the study to individuals who plan to surf in southern California in the following 4 months because we want to ensure that participants have a reasonable likelihood of being exposed to marine water during the study period. Beyond the inclusion criteria, the analysis will exclude time periods when enrolled participants travel outside of California (e.g., to Mexico) to ensure that our measures of illness and exposure reflect conditions in California. Finally, we are restricting study to only include individuals who have Internet access through a computer or smartphone because our follow-up surveys will be web- or smartphone-based.

Targeting surfers for enrollment raises challenges: 1) surfers are a relatively small population, 2) surfers will have multiple exposures, and 3) surfers will enter the ocean at multiple locations. The study design will address these challenges by enrolling a smaller cohort than previous summer epidemiology studies, but collecting data on exposure and illness over many months with a smartphone application rather than single day exposures.

Surfer Recruitment and Enrollment:
The study will enable participants to self-enroll through a secure online website. The website will be advertised to members of the San Diego chapter of the Surfrider Foundation (N ≈ 10,000) through targeted emails sent from our partners at the Surfrider

Foundation, advertised on surfline.com, and will be advertised by volunteers at the targeted beaches (Ocean Beach and Tourmaline Surfing Park) periodically throughout the study. Advertisement will explain the objectives of the study, the activities involved should they choose to participate, and the incentives for participation. Our enrollment activities will begin in December 1, 2014, and will continue through March 30, 2015. More intensive outreach activities will take place at the start of the study and on the 3 days following each rainstorm. These activities will include on-beach distribution of study information cards and targeted emails to Surfrider San Diego chapter members. We will continue enrollment until we are confident we can achieve at least 22,000 person-days of observation during the 2014-15 winter season. Figure 5 includes a diagram of the enrollment plan for this longitudinal design:

Figure 5. Schematic of surfer enrollment and follow-up in the epidemiology study



At the time they first log-in to the study's survey software (either web-based or smartphone app-based), they will be asked to complete a 10 minute survey that collects contact information (mobile phone, email, zip code), recent ocean exposure, recent illness symptoms, basic surf history information and socio-demographic information. All survey instruments are based on EPA's National Beaches questionnaires used in many recent epidemiologic cohort studies [3–5,7–9]. Appendix C includes the current version of survey modules for this study. Our current IRB protocol proposes to cap the online enrollment at 3,200 person-weeks individuals, which is the number our study team felt, based on the pilot study, will provide a reasonable estimate of surf activity, illness, and drop-out among individuals enrolled through the online approach.

Longitudinal Measurement of Ocean Exposure and Illness

Surfers who enroll in the study will receive weekly notifications through SMS (text) or email to complete a short (<5 min) survey where they will report the following information irrespective of whether they entered the ocean (7 day recall):

- Daily surf and marine water activity (location, time) – from coded or mapped locations
- Daily illness symptoms
- Daily record of missed activities due to illness (e.g., work, school)

Participants will be able to complete the survey through a secure smartphone application or over a secure website that our team at SCCWRP has developed for this study. Participants will be reminded by SMS or email for 2 consecutive days each week (Monday, Tuesday) to complete the survey. During the Pilot Study, approximately 60% of surfers recruited into the study were retained for more than two weeks (Figure 6). Based on feedback from these participants, we will offer smaller incentives at more frequent intervals ($20 Swell.com gift cards after completing 4 weekly surveys). These smaller, more frequent incentives should promote increased participation and minimize dropout. We also expect lower levels of attrition by enrolling people through the web. Web-based enrollment establishes a relationship with the participants through their computers or phones from the beginning, and is likely one reason that web-enrolled participants had lower levels of attrition during the pilot compared to beach-enrolled participants (Figure 6).

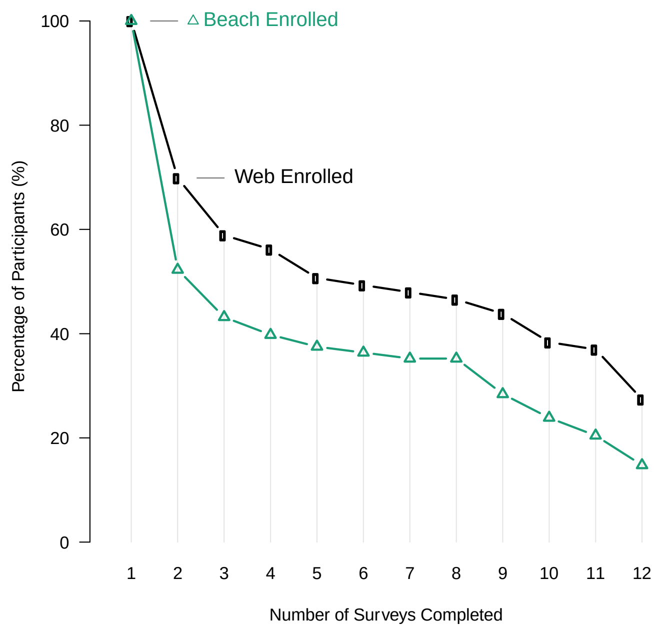


Figure 6. Proportion of participants who completed between 1 and 12 follow-up surveys during the pilot study, stratified by type of enrollment (beach vs. web).

Task 3b. Water Sample Collection and Analysis

The water quality portion of this study is designed to assess surfer exposure to fecal pollution in the ocean water near the storm water discharges. The exposure will be assessed with both qualitative and quantitative methods. Qualitative methods will examine relationship to rainfall. Currently, Public Health Departments issue blanket three-day warnings following measureable rainfall. We will use rainfall and channel flow data as proxies to wet weather exposure to see if the illness rate increases following precipitation and if that illness rate varies with quantity of rainfall. Rainfall and flow records will be collated from rain gauges and flow meters deployed in Tourmaline Creek and San Diego River just upstream of our sentinel beaches. For other beaches, we will use County Flood

Control rain gauges located nearest their location. Additional flow data will be compiled from USGS flow gauges on the San Diego River.

Quantitative methods will use traditional sampling and laboratory measures of FIB utilized by the City of San Diego and San Diego Public Health Laboratories. These methods examine *Enterococcus,* fecal coliforms, and total coliforms using approved culture-based assays: EPA method 1600 and Standard Methods 9222B and 9222D, or equivalent approved methods. In addition, we will analyze F+ coliphage(USEPA 1601, 1602), a virus that infects *E. coli* and as a result, is more numerous than human specific viruses. F+ coliphage has been linked to human sources of pollution and has been used by others to mimic human virus transport and survival (Cole et al 2003). There is some evidence that F+ coliphage has had some association with swimmer illness in previous epidemiology studies (Abdelzaher et al 2011; Colford et al 2003). However, this association has not been conclusive and the US EPA continues to pursue this indicator a possible tool for assessing swimmer risk.

We expect to collect at least 952 beach samples for FIB analyses during this portion of the study. These samples will be collected daily, beginning December 1, 2014 and continuing through March 30, 2015, to match water quality exposure data to surfer responses during the epidemiology survey. A contingency of two additional weeks, until April 15, 2015, will be utilized if insufficient rain has fallen or additional exposure weeks are necessary to meet our study targets. In addition, we will analyze at least 144 samples for F+ coliphage analysis during this same time period. Since this analysis requires live cultures we will sample only when we expect samples to have measureable quantities; following wet weather and during extreme tides. Results from the pilot study indicated that samples during routine dry weather were consistently non-detectable for F+ coliphage analysis.

A single sample of at least 500mL will be collected at ankle depth at a minimum of two locations at Tourmaline Surfing Park (sites FM030 and Tourmaline South; shown in Appendix A, Fig 3) and at a minimum of three locations at Ocean Beach (sites FM010, PL110, and PL100; shown in Appendix A, Fig 4) to replace public health monitoring sites, which are suspended during the non-AB411 winter time period. Samples will be taken between 7:00 and 9:00 in the morning to coincide with times of peak surfing activity and consistent with the timing of the public health monitoring program.

Samples taken from the shore will effectively measure exposure of surfers to FIB in the coastal zone, when they are entering or exiting the water. At Ocean Beach, a sample of at least 500mL will be taken from the Ocean Beach pier at a location adjacent to the surfer lineup to measure surfer exposure to FIB further from shore. For sample quality control, a replicate sample will be collected from each site on a rotating basis, and analyzed alongside the single 500mL samples (for a total of 7 samples per day) to assess field variability. In the laboratory, replicate samples will require a precision of <10% reproducible percent difference.

All sampling bottles will be sterilized with 10% HCl and rinsed three times with sample water prior to final sample collection. The samples will be delivered to City of San Diego Laboratory, Harbor Island. The standard 100 mL volume will be utilized for each FIB measurement. Medium blanks, and reagent blanks (e.g. 100ml of sterile PBS filtered in the same manner as the samples) will be collected at a 10% frequency, in order to check for contamination and false positives.

Task 3c: Data Management and Analysis

Epidemiology Data Structure

Since we will collect information weekly (with 7-day recall), the study will collect daily information about surf activity and illness for each individual surfer. We will enroll surfers at different times and surfers will likely participate in the study for different lengths of time (Fig 5); for this reason each participant will contribute a different number of observed weeks to the study. For each individual, we will collect daily records of surf/ocean activity and illness. We will use each individual's reported surf locations to merge precipitation data and water quality data (if available) to their data series. For each surfer, we will thus have a daily record of surf activity, illness, beach location, precipitation, and (for exposure during our monitoring at Ocean Beach and Tourmaline Surfing Park) water quality data.

Outcome Definition

The health outcomes of primary interest will include:

- Diarrhea, defined as 3 or more loose or watery stools in 24 hours [29].
- Gastrointestinal Illness, defined as (i) diarrhea; or (ii) vomiting; or (iii) nausea and stomach cramps; or (iv) nausea and missed daily activities due to gastrointestinal illness; or (v) stomach cramps and missed daily activities due to gastrointestinal illness [5,8,9].
- Sinus infection
- Earache / ear infection
- Skin rash
- Infection of open wounds

For all health outcomes, we will define incident episodes as the onset of new symptoms in an individual. For diarrhea and GI illness, a new episode will need to be preceded by 6 or more disease-free days [23]. We are currently investigating whether there are evidence-based disease-free periods to use for skin rash, earache, and open wound infections. Survey Module 4 in Appendix C includes the instrument for these measurements. In addition to these symptoms, we will measure whether individuals missed work, school or daily activities due to the illness, whether they sought medical care or took medication during the past week, and whether they avoided entering the ocean due to their illness.

Marine water and wet weather exposure definition:

Marine water exposure:

We will have information about reported marine exposure for each participant that is geo-located to specific beaches in San Diego County (and more broadly encompassing Southern California). The study focuses on surfers because we expect that population to be most likely to enter the ocean during the winter season, but we will include all marine water exposure in the analysis. We will ask participants about their activity in the ocean, which will enable us to summarize illness risk separately by different ocean recreational activities (surfing, swimming, body boarding, etc.). Survey Module 3 in Appendix C includes the instrument for these measurements.

Wet weather exposure:

We will use meteorological data for the region to identify wet weather events. At least initially, we will use daily rainfall records from San Diego Lindbergh Field. Currently. The County Health Department utilizes rainfall quantities of 0.1 inch or greater to trigger wet weather beach warnings of 3 days. However, beaches with freshwater storm drain inputs likely have different periods of impact from storms due to differences in watershed size and drainage systems [24]. For this reason, and because the relevant window of potential health risk following wet weather remains unknown, we will consider multiple windows of exposure following wet weather events that range from <0.1 to >0.5 inch precipitation and 1 to 5 days following each event. In a secondary analysis, pending availability of third-party data, we will attempt to calculate beach-specific exposure risk windows following wet weather events.

Analysis Approach

Collect illness rates and dropout rates

We will calculate the incidence rate for of each illness symptom (new episodes / total days at risk), counting new episodes preceded by at least 6-symptom free days [23]. We will calculate dropout rates in the epidemiology study. Based on past experience we expect dropout rates to be highest during the first 1-2 months of the study, but calculating these rates will allow us to check our assumptions about the magnitude and time trend of drop out in this study population, which will inform the design of future studies.

Measure illness rates among surfers in San Diego and determine if there is any evidence of greater risk following ocean exposure and exposure following wet weather events (research questions 1 & 2).

Multiple studies of marine water exposure have demonstrated that most of the excess gastrointestinal illness cases among swimmers compared to non-swimmers occur in the first 2-3 days following exposure [8,9,13,25]. This short latency period is consistent with viral pathogens, but bacterial and protozoan pathogens have longer latency periods. We will focus our analysis on the rates of illness associated with ocean exposure in the previous 3 days and we will repeat the analysis for rates associated with ocean exposure in the previous 5 days. Our experience in the pilot study was that for the surfer population, extending the window of exposure beyond 5 days is infeasible due to the frequency of ocean exposure in this population (median = 3 days per week).

With longitudinal follow-up, most surfers in the study will have periods during which they are "exposed" to potential pathogens in the ocean while surfing and periods during which they are unexposed. Since we will measure outcomes following these periods of exposure for each individual, we will estimate the effect of surf exposure using information from individuals under both exposed and unexposed periods. This effectively treats each individual in the study as his or her own control, and helps remove time-invariant confounding that could bias our estimate of the risk associated with ocean exposure. To estimate the illness rate associated with water exposure, we will consider water exposure in the 3 days prior to an outcome measurement on any given day. For the statistical models below we introduce some notation. Let Y_{it} be a binary indicator equal to 1 if individual i is ill on day t (0 otherwise), let T_{it} be the days at risk in the 3 day period before day t, and let E_{it} be a binary indicator of equal to 1 if individual i entered the water on day t (0 otherwise). Define $E^*_{it} = \max(E_{i,t-1}, \ldots, E_{i,t-3})$, which is a binary indicator of whether the individual entered the water in the 3 days prior to the outcome measurement on day t. To estimate the incidence rate ratio associated with marine water exposure, we will use a log-linear regression model [26]. We will model surfer illness for individual i on day t using the following model:

$$(1) \qquad \log \mathrm{E}[Y_{it} \mid T_{it}, E^*_{it}, \mathbf{X}_{it}] = \log(T_{it}) + \alpha + \beta E^*_{it} + \gamma\, \mathbf{X}_{it}$$

where Y_{it} is a dichotomous indicator of illness as described above (e.g, has diarrhea), α is an intercept, E^*_{it} is a dichotomous indicator of marine water exposure in the 3 days prior to day t (defined above), and $\mathbf{X}_{it}$ is a vector of individual- and time- varying covariates that are either associated with the outcome (Y) or could potentially confound the relationship between ocean exposure and illness. Covariates in $\mathbf{X}$ will include age, number of years surfed, type of surf equipment used (board length, earplugs, hood, wet suit type), illness among other household members, suspected food poisoning (for GI illness), and whether previous illness caused them to avoid entering the ocean. The parameter $\exp(\beta)$ estimates the incidence rate ratio associated with ocean exposure in the prior 3 days compared to unexposed periods. We will repeat the analysis for the health outcomes of interest, as well as 2 "negative control outcomes" (still to be determined) that we would not expect to be associated with marine water exposure [27]. If marine water exposure were associated with these negative control health outcomes in addition to the main study outcomes, it would suggest that residual confounding is present or that the participant-reported outcome measurement approach is biased (for example, participants over-reporting all symptoms following ocean exposure).

The question of whether ocean exposure increases illness rates more following a wet weather event compared to dry weather is a question of effect modification. We will extend the analysis outlined above to allow ocean exposure to be modified by wet- and dry-weather. Let W_t be a binary indicator of whether it rained on day t, and define $W^*_{i,t} = \max(W_{i,t-1}, \ldots, W_{i,t-6})$ as a binary indicator of whether it rained during the previous 3-day period at the surf location reported by individual i. The indicator uses a 3-day window for W^* under the assumption of a 3-day window of risk following a wet weather event.

As with equation (1), we model surfer illness using a log-binomial model:

(2) $$\log E[Y_{it} \mid E^*_{it}, W^*_{it}, \mathbf{X}_{it}] = \log(T_{it}) + \alpha + \beta_1 E^*_{it} + \beta_2 W^*_{it} + \beta_3 E^*_{it} W^*_{it} + \gamma \mathbf{X}_{it}$$

Here, the model includes an interaction between whether the individual entered the ocean in the previous 3-day period (E^*_{it}) and whether it rained in the previous 3-day period where individual i surfed (W^*_{it}). We will estimate separate incidence rate ratios for surf exposure during dry periods [$\exp(\beta_1)$] and for surf exposure during wet periods [$\exp(\beta_1 + \beta_3)$], and will test for the statistical significance of the interaction using a Likelihood Ratio test on the interaction term (β_3) [28]. While the pilot study provided us with preliminary information that suggests ocean exposure increases incidence rates more following wet weather events across a range of health symptoms, in this study we expect to have proper statistical power to rigorously test this hypothesis. The magnitude of the effects and the amount of exposure to wet weather conditions from the pilot study have informed the design for the main epidemiology study. We will estimate all parameters of interest using maximum likelihood and we will calculate the standard errors for all estimates using robust standard errors clustered at the individual level to account for repeated measures within individuals. We will summarize the results in a table similar to this for each health outcome:

Table 1. Example of health outcome Incidence Risk Ratio (IRR) results from San Diego pilot study. An incidence Rate Ratio of 1 indicates no difference.

	Unexposed Periods Episodes/Yr	Unadjusted IRR (95% CI)	Adjusted Model* IRR (95% CI)
Any illness	7.0	2.05 (1.39, 3.04)	1.81 (1.13, 2.92)
Any infectious symp†	3.7	1.56 (0.91, 2.66)	1.45 (0.70, 3.01)
Sinus pain / infection	1.7	3.59 (1.92, 6.73)	3.12 (1.46, 6.67)
Earache / infection	3.2	1.81 (0.93, 3.50)	1.56 (0.71, 3.44)
GI illness	1.9	1.89 (0.94, 3.79)	2.03 (0.82, 5.05)
Diarrhea	1.7	1.43 (0.66, 3.06)	1.46 (0.52, 4.05)
Infected cut	0.7	1.48 (0.36, 6.05)	0.90 (0.12, 6.76)

* IRR adjusted for day of the week, day of recall, survey number, and time spent in the water.

† Includes GI illness, diarrhea, vomiting, eye infections, infected cuts, and fever.

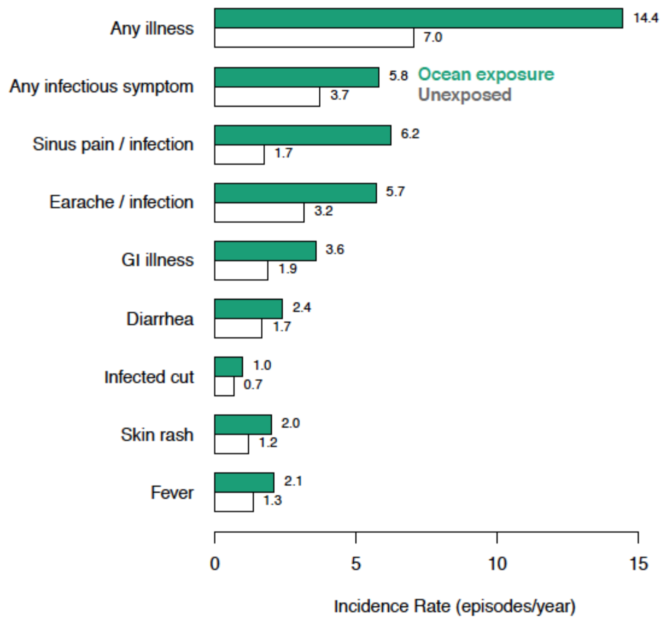


Figure 7 **Incidence Rates for surfer illness estimated for ocean exposed and unexposed periods during the pilot study. Green bars show ocean exposed incidence rates and white bars show the rates when not exposed. The corresponding incidence rate ratios (IRRs) associated with ocean exposure are reported in Table 1.**

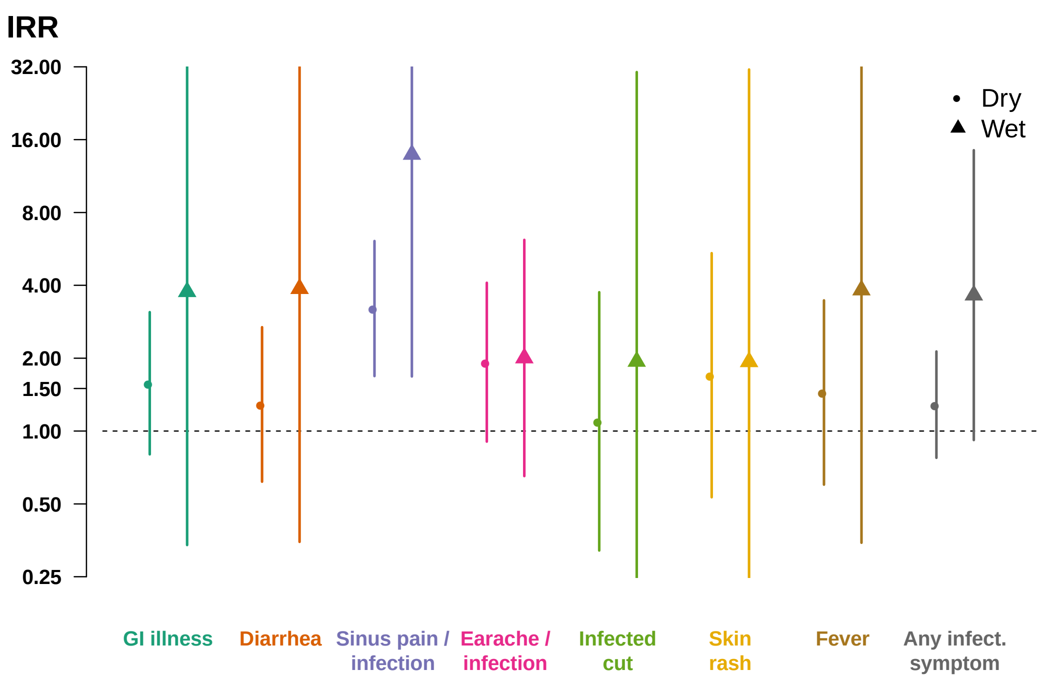


Figure 8. Summary of overall incidence rate ratios (IRRs) comparing ocean exposure to non-exposed periods during dry and wet weather from the San Diego pilot study

Measure the association between Fecal Indicator Bacteria and illness during the study period (research question 3).

In this analysis we will match individual surf sessions from participants that take place at Ocean Beach and Tourmaline Surfing Park with concurrent fecal indicator bacteria (FIB) counts measured on those same days. The FIB used in the analysis will include *Enterococcus* EPA method 1600 and fecal coliforms EPA method 9222D. Below, in the following section, we provide additional details about FIB measurement. Using the FIB measurements, we will examine the relationship between the FIB concentrations and subsequent illness rates using two approaches. First, we will estimate the log-linear relationship between continuous FIB concentrations and illness by estimating the following model:

$$(3) \qquad \log \mathrm{E}[Y_{it} \mid T_{it}, FIB_{it}, \mathbf{X}_{it}] = \log(T_{it}) + \alpha + \beta FIB_{it} + \gamma\, \mathbf{X}_{it}$$

where FIB_{it} is the FIB concentration in the water that the individual was exposed to in the 3 days prior to day t and the other variables are the same as described above. This is the standard approach used in swimmer exposure studies. Note that in cases where an individual has multiple days of FIB concentrations during prior 3 days, we will calculate a weighted average FIB value for that person, by weighting the log-concentrations on each day by the minutes spent in the water on that day. The model estimate $\exp(\beta)$ will estimate the incidence rate ratio associated with a 1-log increase in the FIB concentration.

Second, we will reduce the FIB concentrations to dichotomous exposure variables by flagging days when they exceed the single sample regulatory limit. For example, we will identify days in which the *Enterococcus* concentrations exceed 104 CFU per 100 ml. We will then compare the increase incidence associated with ocean exposure above versus below that cutoff using a model analogous to model 1, but restricting the analysis to periods with ocean exposure linked to water quality data. For individuals with multiple days of FIB exposure information in the past 3 days, we will take the maximum of the dichotomous indicator (identifying whether an individual was ever exposed to the above-regulatory levels in the past 3 days).

Assess the presence and relative concentrations of fecal indicators in receiving waters

Data from the daily water quality samples at Ocean Beach and Tourmaline Surfing Park will be recorded and stored electronically. The data will be checked for quality by comparing to Fecal Indicator Bacteria (FIB) counts from blank filters. Outliers and non-detects will be compared to replicate samples (where available) and verified using laboratory records. The data will also be compared to the pilot study data to check for consistency. Since these two datasets are directly comparable, they will, in effect also generate a dataset spanning more than one winter. The quality checked data will be submitted to the San Diego County Health Laboratory on a daily basis. The data products will resemble the tables and figures shown below.

These data will help demonstrate if and when FIB are present in the receiving waters (summarized in Table 2). Also, the relative concentration of FIB can be used to compare between beaches, study days (i.e., days since rainfall), and to follow the timing of when FIB from the watershed arrive at the beach during a storm (Fig 9). The figures from the pilot study are included below as examples of the data products that will be generated. Although there was large variability in this limited data set, the pilot study showed a difference between wet and dry FIB at both Tourmaline Surfing Park (Fig 9A) and Ocean Beach (Fig 9B). *Enterococcus* exceeded the maximum at both beaches in the first 24 hours after a storm, with concentrations tapering off over the next 48 hours. These data will be combined with tide, rainfall, and discharge flow data (Task 4a) to determine if any of these factors influence FIB concentrations or health outcomes. Depending upon rainfall quantity and timing, we will also examine the potential confounding effects of differing storm sizes and back-to-back storm events.

Table 2. Summary data for assessing the presence of human sources of fecal pollution from the pilot study

Indicator	N	% ND	Min	Med	Max	% Exceed
Coliform, Fecal	250	8.4	2	14	>15,000	5.6
Coliform, Total	250	14.4	2	40	>16,000	0.8
Enterococcus	250	7.2	2	10	>16,000	20

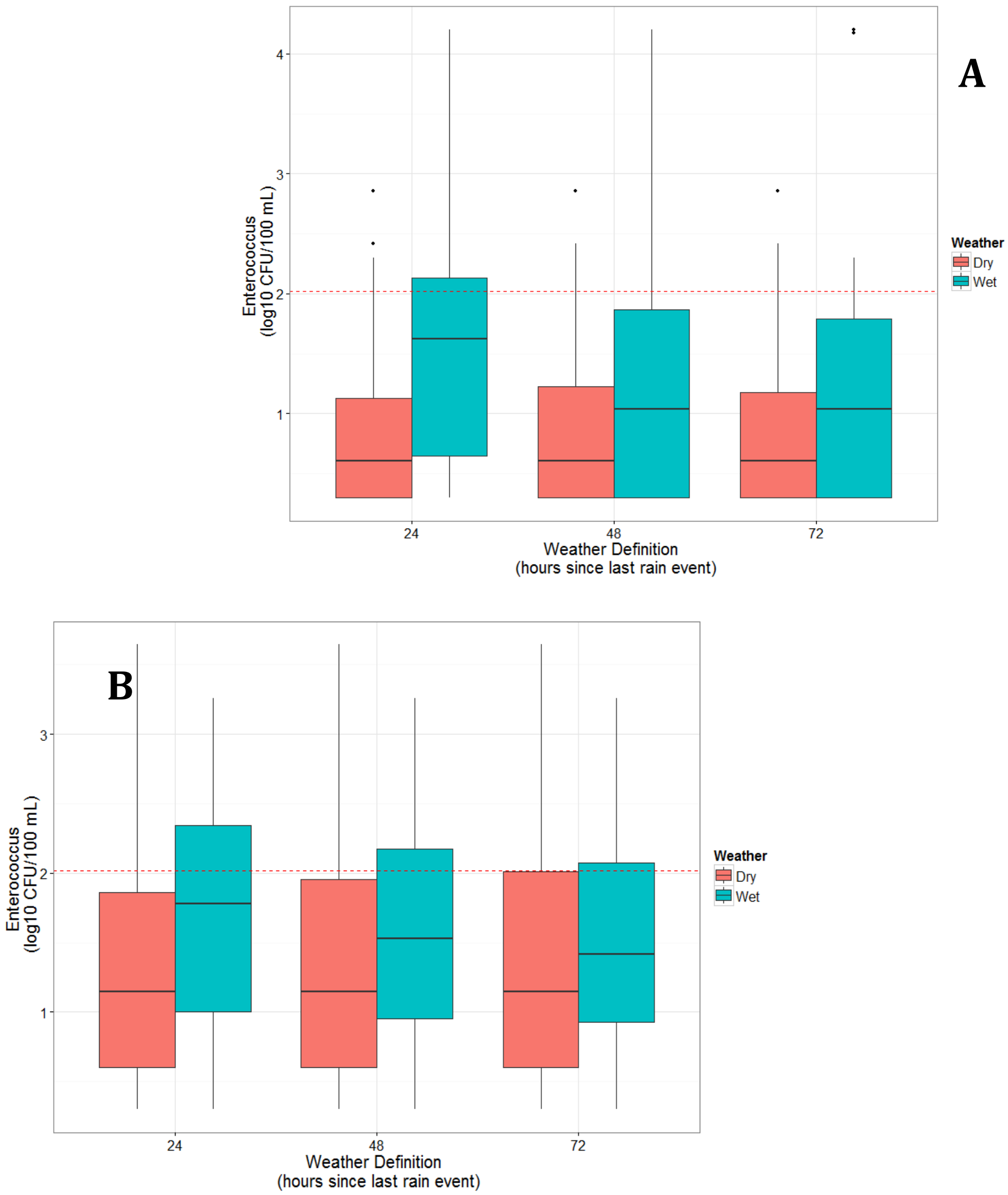


Figure 9. Enterococcus (log) concentration in wet vs dry weather at all Tourmaline Surfing Park (A) and Ocean Beach (B) beach sites.

Communication Strategy

Communication during any epidemiology study is crucial because of the significant public health implications. The Study also provides the opportunity to test and evaluate our communication strategy. Our Study communication strategy has three elements: 1) pre-survey announcements; 2) in-survey information resources, and; 3) post-survey statements. Pre-survey announcements are meant only to announce our presence on the beach so the local community is informed, which will avoid confusion, potential fears, and potential bias for the study. We will use several mechanisms to announce the onset of the study including outreach to lifeguards, police, parks and recreation department, local surf shops, and local surfing organizations (i.e., San Diego Surfrider Chapter, local surfing teams and clubs, etc.). We will not pursue a press release, but are glad to support the City or County if they choose to use the press. The in-survey information resources are perhaps the most important from a bias perspective. Once surfers are approached, they will naturally be curious about the water quality. Our intent is to provide several venues for additional information that will include signage, study brochures with frequently asked questions, a web site with the study description, and an email and telephone hotline. These materials will also be distributed to the outreach stakeholders in the first element and available to the public, particularly the surfers that we will be enrolling into the study. The post-survey communication elements will remain small and mostly directed at the Advisory Committee, who will be the primary end-users of the information. Keeping this element small and directed is also beneficial because we will likely have insufficient information for public health decision making until the full study is completed.

References

1. Pruss A (1998) Review of epidemiological studies on health effects from exposure to recreational water. IJE 27: 1–9.
2. Wade TJ, Pai N, Eisenberg JNS, Colford JM (2003) Do U.S. Environmental Protection Agency water quality guidelines for recreational waters prevent gastrointestinal illness? A systematic review and meta-analysis. Env Heal Perspect 111: 1102–1109.
3. Wade TJ, Calderon RL, Sams E, Beach M, Brenner KP, et al. (2006) Rapidly measured indicators of recreational water quality are predictive of swimming-associated gastrointestinal illness. Environ Health Perspect 114: 24.
4. Wade TJ, Calderon RL, Brenner KP, Sams E, Beach M, et al. (2008) High sensitivity of children to swimming-associated gastrointestinal illness: results using a rapid assay of recreational water quality. Epidemiol Camb Mass 19: 375–383. doi:10.1097/EDE.0b013e318169cc87.
5. Wade TJ, Sams E, Brenner KP, Haugland R, Chern E, et al. (2010) Rapidly measured indicators of recreational water quality and swimming-associated illness at marine beaches: a prospective cohort study. Env Heal 9: 66. doi:10.1186/1476-069X-9-66.
6. Haile RW, Witte JS, Gold M, Cressey R, McGee C, et al. (1999) The health effects of swimming in ocean water contaminated by storm drain runoff. Epidemiology 10: 355–363.

7. Colford JM, Wade TJ, Schiff KC, Wright CC, Griffith JF, et al. (2007) Water Quality Indicators and the Risk of Illness at Beaches With Nonpoint Sources of Fecal Contamination. Epidemiology 18: 27–35. doi:10.1097/01.ede.0000249425.32990.b9.
8. Colford JM, Schiff KC, Griffith JF, Yau V, Arnold BF, et al. (2012) Using rapid indicators for Enterococcus to assess the risk of illness after exposure to urban runoff contaminated marine water. Water Res 46: 2176–2186.
9. Arnold BF, Schiff KC, Griffith JF, Gruber JS, Yau V, et al. (2013) Swimmer illness associated with marine water exposure and water quality indicators: impact of widely used assumptions. Epidemiology 24: 845–853. doi:10.1097/01.ede.0000434431.06765.4a.
10. Kay D, Fleisher JM, Salmon RL, Jones F, Wyer MD, et al. (1994) Predicting likelihood of gastroenteritis from sea bathing: results from randomised exposure. Lancet 344: 905–909.
11. Fleisher JM, Kay D, Salmon RL, Jones F, Wyer MD, et al. (1996) Marine waters contaminated with domestic sewage: nonenteric illnesses associated with bather exposure in the United Kingdom. Am J Public Health 86: 1228–1234.
12. Fleisher JM, Kay D, Wyer MD, Godfree AF (1998) Estimates of the severity of illnesses associated with bathing in marine recreational waters contaminated with domestic sewage. Int J Epidemiol 27: 722–726.
13. Dorevitch S, Pratap P, Wroblewski M, Hryhorczuk DO, Li H, et al. (2012) Health risks of limited-contact water recreation. Env Heal Perspect 120: 192–197. doi:10.1289/ehp.1103934.
14. Fleisher JM, Fleming LE, Solo-Gabriele HM, Kish JK, Sinigalliano CD, et al. (2010) The BEACHES Study: health effects and exposures from non-point source microbial contaminants in subtropical recreational marine waters. Int J Epidemiol 39: 1291–1298. doi:10.1093/ije/dyq084.
15. Soller JA, Schoen ME, Bartrand T, Ravenscroft JE, Ashbolt NJ (2010) Estimated human health risks from exposure to recreational waters impacted by human and non-human sources of faecal contamination. Water Res 44: 4674–4691. doi:10.1016/j.watres.2010.06.049.
16. Schoen ME, Ashbolt NJ (2010) Assessing pathogen risk to swimmers at non-sewage impacted recreational beaches. Env Sci Technol 44: 2286–2291. doi:10.1021/es903523q.
17. USEPA (2012) Recreational Water Quality Criteria. United States Environmental Protection Agency Office of Water, Report 820-F-12-058.
18. Noble RT, Weisberg SB, Leecaster MK, McGee CD, Dorsey JH, et al. (2003) Storm effects on regional beach water quality along the southern California shoreline. J Water Heal 1: 23–31.
19. Stone DL, Harding AK, Hope BK, Slaughter-Mason S (2008) Exposure assessment and risk of gastrointestinal illness among surfers. J Toxicol Env Heal 71: 1603–1615. doi:10.1080/15287390802414406.
20. Tseng LY, Jiang SC (2012) Comparison of recreational health risks associated with surfing and swimming in dry weather and post-storm conditions at Southern California beaches using quantitative microbial risk assessment (QMRA). Mar Pollut Bull 64: 912–918. doi:10.1016/j.marpolbul.2012.03.009.
21. Turbow DJ, Kent EE, Jiang SC (2008) Web-based investigation of water associated illness in marine bathers. Env Res 106: 101–109. doi:10.1016/j.envres.2007.06.006.

22. Boehm AB, Van De Werfhorst LC, Griffith JF, Holden PA, Jay JA, et al. (2013) Performance of forty-one microbial source tracking methods: A twenty-seven lab evaluation study. Water Res. Available: http://dx.doi.org/10.1016/j.watres.2012.12.046.
23. Colford JM, Hilton JF, Wright CC, Arnold BF, Saha S, et al. (2009) The Sonoma Water Evaluation Trial: A Randomized Drinking Water Intervention Trial to Reduce Gastrointestinal Illness in Older Adults. Am J Public Heal 99: 1988–1995. doi:10.2105/AJPH.2008.153619.
24. Nezlin NP, DiGiacomo PM, Diehl DW, Jones BH, Johnson SC, et al. (2008) Stormwater plume detection by MODIS imagery in the southern California coastal ocean. Estuar Coast Shelf Sci 80: 141–152.
25. Soller JA, Bartrand T, Ashbolt NJ, Ravenscroft J, Wade TJ (2010) Estimating the primary etiologic agents in recreational freshwaters impacted by human sources of faecal contamination. Water Res 44: 4736–4747. doi:10.1016/j.watres.2010.07.064.
26. McNutt L-A, Wu C, Xue X, Hafner JP (2003) Estimating the relative risk in cohort studies and clinical trials of common outcomes. Am J Epidemiol 157: 940–943.
27. Lipsitch M, Tchetgen ET, Cohen T (2010) Negative controls: a tool for detecting confounding and bias in observational studies. Epidemiology 21: 383–388. doi:10.1097/EDE.0b013e3181d61eeb.
28. Brookes ST, Whitely E, Egger M, Smith GD, Mulheran PA, et al. (2004) Subgroup analyses in randomized trials: risks of subgroup-specific analyses; power and sample size for the interaction test. J Clin Epidemiol 57: 229–236.
29. Baqui, A. H.; Black, R. E.; Yunus, M.; et al. 1991. Methodological issues in diarrhoeal diseases epidemiology: definition of diarrhoeal episodes. *Int J Epidemiol, 20*, 1057-1063.

Appendix C Surfer Health Survey Questionnaire

Overview

Surfer Health Study
Questionnaire
Module 0: Overview
Version 8 (5 Sep 2014)

This document provides an overview of the survey modules used for the Surfer Health Study.

The enrollment survey should take around 10-15 minutes to complete (not including consent), and the follow-up survey should take 10 minutes or less.

Below is a list of modules included in the enrollment survey and a summary of when they will be administered to study participants. We will administer the surveys both through in-person interviews on the beach and through self-enrollment, web-based surveys. The follow-up and exit surveys will only be web-based (or app based). We are tracking differences in dialog or any question wording / administration in the modules by including web-based dialog / questions in blue text if it differs from the beach interview.

Module	Description	Status, updated	Enroll.	Follow-up	Exit
1	Eligibility and enrollment	V7, 2 Jan 2014	X		
2	History	V7, 25 Nov 2013	X		
3	Recent ocean exposure	V7, 2 Jan 2014	X	X	
4	Recent health symptoms	V7, 23 Sep 2013	X	X	
5	Demographic information	V7, 23 Sep 2013	X		
6	Study exit survey	not started			X

* First time that a participant logs on to the study's web or mobile app.

Each question has a corresponding question number with numbering nested within module. In the database, it would be helpful to use an alphabetic prefix before each number since many statistical software programs do not allow variable names to start with a number. So, for example, we could use the prefix "q" before each question number in the database. Then module 1, question 1.1 would be named "q11" in the database, module 2, question 2.4 would be "q24", etc.

Example question	Question type	Suggested variable name(s) and formats

1.1	Single code (e.g., 1=yes, 2=no)	q11 with byte storage of 1 or 2
2.6	Mark all that apply, with 12 options	q26_1 – q26_12 each with a byte storage of 1 if marked and 2 if not marked (default)
2.8.a	Numeric (real) (e.g., number of days)	q28a with integer storage and a range restriction on plausible values

Eligibility and Enrollment

Surfer Health Study
Questionnaire
Module 1: Eligibility and enrollment

Version 8 (5 Sep 2014) [updated 5 Sep 2014]

NOTE: All surveys will be web and app-based beginning in December 2014

Welcome to the Surfer Health Study enrollment website. The Surfer Health Study is a research project in San Diego County led by investigators at the Southern California Coastal Water Research Project (www.sccwrp.org), the School of Public Health at the University of California at Berkeley (www.sph.berkeley.edu), and the Surfrider Foundation (www.surfrider.org). The objective of the study is to determine whether surfers are at risk of illness from ocean exposure on the California coast. The study will collect information about surf activity and illness over the next 4 months by having surfers report information each week through a website or smartphone app. If you are interested in participating, then please answer the following eligibility questions. If you are eligible, then you can read more details about the study, the benefits of participating, and then you can decide whether you are willing to participate. If you decide to participate, you'll need to complete an enrollment survey that will require about 10 minutes.

Eligibility questions

		Yes	No
1.1	Do you speak English?		
1.2	Are you 18 years or older?		
1.3	Do you plan to surf in California in the next 4 months?		
1.4	Do you have internet access with a computer or a smartphone?		

If "No" to any question in 1.1 – 1.4: We're sorry, but we are only enrolling surfers who
[speak English] [are 18 years or older]
[plan to surf in California in the next 4 months]

[have internet access, because the study will rely on reporting through the web]

If "Yes" to all questions 1.1 – 1.4: Great! You are eligible to participate in the study. Please continue to the next page, which will describe the details of what the study will involve, the benefits of participating, and will ask you for informed consent should you decide to participate.

[Go to web page that includes consent form]

1.5 [Internal (not seen by participants)]
Signed consent obtained?
1 Yes
2 No **--> END refused**

1.6
Please enter your primary phone number and email address where we can reach you (mobile phone preferred). This information remains completely confidential. We collect this information only so we can contact you if needed during the study. We will never share this information with anybody and will destroy this information at the end of the study.

1.6.a Please enter your phone number
[default 999-999-9999 if there is no phone number]
(_ _ _) _ _ _ - _ _ _ _

1.6.b Please re-enter your phone number (to confirm)
(_ _ _) _ _ _ - _ _ _ _

1.6.c Please enter your email address ____________________

1.6.d Please re-enter your email address (to confirm) ____________________

1.7
The study will send you a weekly reminder to fill out a quick, 10-minute survey of your surf activity and health. Would you prefer that the study contact you primarily by phone through text messages (SMS) or by email?
1 Phone / text / SMS
2 Email

1.8
How did you hear about the study?
1 Surfrider Foundation website
2 Surfrider Foundation email announcement
3 Flier posted at the beach
4 Flier posted at my local surf shop
5 Talked with a study representative on the beach

6 Friends / word of mouth
88 Other _________

1.9
What is your Zip Code?

— — — — —

History

Surfer Health Study
Questionnaire
Module 2: History

Version 8 (5 Sep 2014) [updated 10 Sep 2014]

This page includes a series of questions about your general surf activity. Please answer all of the questions to the extent that you can.

2.1
How many years have you surfed?

____ ____ Years [*record "0 0" for less than 1 year*]

2.6
Thinking back over the past year, in which months did you surf in California?
mark all that apply
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
[coded 1 – 12]

[if 2.6 = 1, 2, 3, 11, 12] ask 2.2, else skip to 2.3
2.2
About how often do you surf during the wet season (November – March)?
[enter "0 0" if less than once per month]
___ ___
2.2.units [select one]
1 per week
2 per month

[if 2.6 = 4, 5, 6, 7, 8, 9, 10] ask 2.3, else skip to 2.4
2.3
About how often do you surf during the dry season (April – October)?
[enter "0 0" if less than once per month]

___ ___

2.3.units [select one]

1 per week
2 per month

2.4

How long is the board that you usually ride?

1 Short board (< 7 feet)
2 Fun board (7 – 9 feet)
3 Long board (> 9 feet)

2.5

Do you usually wear earplugs when you surf?

1 Yes
2 No

2.7

If it rains, do you ever wait to go in the ocean?

1 Yes, always wait
2 Yes, sometimes wait
3 No

[If answer to 2.7 is 1 or 2]

2.7.a How long do you typically wait?

___ ___

2.7.b (units)

1 Days
2 Hours

2.8

During the winter season (November – March), which beach do you consider your "home" beach (where you surf most often)?

mark one

[will include an auto-populated beach list]

2.11

Do you regularly go into the ocean for activities other than surfing?

1 Yes
2 No

2.11.a

(If yes, answer 1), *mark all that apply*

1 swimming
2 body surfing
3 body boarding
4 stand-up paddle boarding

5 wind surfing or kite boarding
6 free diving or scuba diving
88 Other (specify) ________

2.12
Do you have any of the following long-term health conditions?
mark all that apply

1 Allergies, other than drug allergies?
2 Surfer's ear?
3 Chronic sinus problems?
4 Chronic gastrointestinal problems such as Crohn's disease or irritable bowel syndrome?
5 Chronic respiratory disease such as asthma or emphysema?
6 Chronic skin problems such as psoriasis or eczema?

Recent Ocean Exposure

Surfer Health Study
Questionnaire
Module 3: Recent Ocean Exposure

Version 8 (5 Sep 2014) [updated 5 Sep 2014]

Think about your ocean activities since this day last week. Only report information for the last 7 days.

3.1
Did you enter the ocean on any days in the past week?

mark all that apply
[auto populate days of the week, depending on the day of the interview]
1 [Today]
2 [Yesterday]
3 [Day before yesterday]
4 ... 5 ... 6 ... 7 ...

For each day selected in 3.1, the software will ask the following questions (complete for each day) [question numbering 3.2.1, 3.2.2, 3.2.3... 3.2.7, 3.3.1, 3.3.2, ... 3.3.7, etc.]

Recall Day [1=Today]:	1	2	3	4	5	6	7
3.2 What beach did you go to? [will include a add beach list]							
3.3							

Recall Day [1=Today]:	1	2	3	4	5	6	7
What was your main activity while in the ocean on [*day*]? 1 surfing 2 swimming 3 body surfing 4 body boarding 5 stand-up paddle boarding 6 wind surfing or kite boarding 7 free diving or scuba diving 8 other (specify ________)							
3.4 Did you immerse your head in the water on [*day*]? 1 Yes 2 No							
3.5 Did you swallow any water on [*day*]? 1 Yes 2 No							
3.6 Did you wear earplugs? 1 Yes 2 No							
3.7 Did you wear a wetsuit? 1 Full suit (full legs and arms) 2 Shorty (short sleeves and short legs) 3 Long john (covers torso and legs) 4 Rash guard only 88 No wetsuit							
Approximately when did you enter the ocean and exit the ocean? **3.8.a** Entered ___ ___ : ___ ____ [HH : MM] **3.8.b** Exited ___ ___ : ___ ____ [HH : MM]							

3.9
Were there any days in the past week that you would have gone into the ocean but didn't because of wet weather or bad weather?
mark all that apply [auto populate days of the week, depending on the day of the interview]
[include a logic check / dialog to make sure the entries do not contradict 3.1.1]

1 [Today]
2 [Yesterday]
3 [Day before yesterday]

4 … 5 … 6 … 7 …

Recent Health Symptoms

Surfer Health Study
Questionnaire
Module 4: Recent health symptoms

Version 8 (5 Sep 2014) [updated 5 Sep 2014]

Think about your ocean activities since this day last week. Only report information for the last 7 days.

[question numbering: 4.1, 4.1.a, 4.1.b, …, 4.1.g, 4.2, 4.2.a, 4.2.b, … etc.]
[in software, would be great to auto-populate the day of the week names for each day of recall. For both the beach interview and the web-based survey, it would be helpful to show only one symptom at a time to avoid confusion.]

		a	**b**	**c**	**d**	**e**	**f**	**g**
	Day of Recall [1=Today]:	1	2	3	4	5	6	7
	In the past 7 days (since this day last week), have you had: *[Web: If Yes, have a dialog that requests the user to mark each day that they had the symptom]* *If No, skip to the next symptom.*							
4.1	Fever 1 Yes **-->** 2 No							
4.2	Diarrhea (3 or more loose/watery stools in 24 hours) 1 Yes **-->** 2 No							
4.3	Stomach cramps 1 Yes **-->** 2 No							
4.4	Vomiting 1 Yes **-->** 2 No							
4.5	Nausea 1 Yes **-->** 2 No							
4.6	Sinus pain or sinus infection 1 Yes **-->** 2 No							

		a	b	c	d	e	f	g
	Day of Recall [1=Today]:	1	2	3	4	5	6	7
	In the past 7 days (since this day last week), have you had: *[Web: If Yes, have a dialog that requests the user to mark each day that they had the symptom]* *If No, skip to the next symptom.*							
4.7	Earache, ear infection, or runny ears 1 Yes **-->** 2 No							
4.8	Eye infection 1 Yes **-->** 2 No							
4.9	Negative control 1 1 Yes **-->** 2 No							
4.10	Negative control 2 1 Yes **-->** 2 No							
4.11	Infected cut 1 Yes **-->** 2 No							
4.12	Skin rash, itchy skin, or skin infection 1 Yes **-->** 2 No							
4.13	Cough 1 Yes **-->** 2 No							
4.14	Sore throat 1 Yes **-->** 2 No							
4.15	Runny nose / congestion 1 Yes **-->** 2 No							

If Yes to any symptom in 4.1 – 4.15, then ask 4.16 – 4.21. Otherwise skip to 4.22.

4.16
Did anybody else who lives in your house come down with the same symptoms before or about the same time as you?
1 Yes
2 No

4.17
[If Yes to any symptom in 4.1 – 4.5 then ask, otherwise skip to 4.18]
Since last *[auto-populate day 7 days ago]*, do you suspect that you or anybody in your home might have had food poisoning?
1 Yes
2 No

4.18
Since last *[auto-populate day 7 days ago]*, did you miss work, school, or other daily activities because of any of the symptoms above? If so, how many days in the past week?
___ Days *Record "0" if no days are missed.*

4.19
Since last *[auto-populate day 7 days ago]*, did you seek medical care from a clinic or hospital for any of the symptoms above?
1 Yes
2 No

4.20
Since last *[auto-populate day 7 days ago]*, did you take medication such as painkillers or antibiotics for any of the symptoms above?
1 Yes
2 No

4.21
Since last *[auto-populate day 7 days ago]*, did you avoid entering the ocean because of your symptoms?
1 Yes
2 No

4.22
Since last *[auto-populate day 7 days ago]*, did you avoid entering the ocean because of any illness not covered by the symptoms above?
1 Yes
2 No

Demographic Information

Surfer Health Study
Questionnaire
Module 5: Demographic information

Version 8 (5 Sep 2014) [updated 5 Sep 2014]

You are almost finished! After answering these questions, you will be taken to a final page that will remind you about future study activities and your progress toward getting a thank you gift.

5.1
What is your gender?
1 Female
2 Male

5.2
What year were you born?
__ __ __ __ Year

88 Refused
99 Don't know / not sure

5.3
What is the highest level of education that you have <u>completed</u>?
1 Less than high school
2 High school
3 Trade school, community college, or other 2-year college
4 Bachelor's degree (BA, BS, etc…)
5 Master's degree or other professional degree (MA, MS, ME, MPH, JD, etc…)
6 Doctoral degree (MD, PhD, etc…)

88 Refused
99 Don't know / not sure

5.4
Are you currently employed?
1 Yes
2 No

5.5
If you think back to your household's income in 2013, which category represents the total combined income of all members of your household reported on last year's tax return?

1 < $10,000
2 $10,000 - $15,000
3 $15,000 - $25,000
4 $25,000 - $35,000
5 $35,000 - $50,000
6 $50,000 - $75,000
7 $75,000 - $100,000
8 $100,000 - $150,000
9 > $150,000

88 Would prefer not to say / Refused
99 Don't know / not sure

Exit Survey

Surfer Health Study
Questionnaire
Module 6: Exit survey

Version 8 (5 Sep 2014) [updated 5 Sep 2014]

Thanks for participating in the Surfer Health Study. Your responses to the following questions will help us improve the way we conduct future studies of surfing and health in California.

Questions for those who dropped out early

6.1
What were your reasons for discontinuing participation in the study? Please mark all that apply.

1 It took too much time to complete the weekly surveys
2 I received too many emails/text messages about the study
3 Weekly surveys were too frequent
4 The website was difficult to use
5 The mobile app was difficult to use
6 Too busy
7 The incentives were not appealing
8 Other (specify)

If 6.1 = 7, go to 6.2. If not, go to 6.3.

6.2
Can you please give me an example of what kind of incentive you would have preferred? When would you have liked to receive it?

6.3
Would any of the following have made you want to participate in the study longer? Please mark all that apply.

1 Shorter surveys
2 Less frequent surveys
3 More reminders
4 Easier to use app
5 Guaranteed incentive (e.g. gift cards at Swell.com) for all participants instead of a drawing at the end of the study
6 Drawing for a larger/more valuable incentive at the end of the study
7 More frequent incentives (e.g. an incentive each time a questionnaire is filled out)
8 Other (specify)

Questions for everyone

6.4
How can we improve the app to make it more user friendly?

6.5
How can we improve the website to make it more user friendly?

6.6
If we were to conduct a similar study with longer follow-up starting in fall 2014, would you be interested in participating?

1 Yes
2 No
3 Not sure

6.7
Please share any other comments you have about this study.

Appendix D QMRA Study Details

Task 4a: Source Identification and Pathogen Loading

We will identify fecal contamination sources and quantify the loading of FIB and pathogens that surfers will come into with. Based on the pilot study our science team has determined that the watershed discharge can appropriately be used as a "point source". We will employ a study approach focused on quantification and confirmation.

The first step in this process is to conduct a sanitary characterization of the watersheds of interest. EPA has developed and tested a sanitary characterization approach specifically for the purpose of QMRA development. We will use the EPA sanitary characterization template for each of our sentinel beaches to identify and document the most likely sources of fecal contamination.

For quantification, we will sample wet weather discharges at the terminus of each watershed discharging to our sentinel beaches and use a spectrum of fecal bacterial indicators and markers to identify the most likely hosts and pathogen measurements for use in the exposure characterization.

We will collect flow-weighted composite storm discharge samples at Tourmaline Creek and at the San Diego River (Figure 1) for assessing inputs to our sentinel beaches. A minimum of six storm events will be targeted during the time span from December 1, 2014 through March 30, 2015. A contingency of two additional weeks, until April 15, 2015, will be utilized if insufficient rain has fallen or additional exposure weeks are necessary to meet our study targets.

Storm event mobilization will occur if there is an 80% probability of precipitation predicted to be greater than 0.1 inch by the National Weather Service. Sampling will commence when flow increases by 10% or sufficient stage exists to cover the pump intake. A 20L flow-weighted composite sampling will continue for 6 hours after the first sample is collected. A second 20L composite sample may be collected if the storm continues past 6 hours. Storm end will occur when flow returns to within 10% of baseline flow or 12 hours after sampling initiation, whichever occurs first. For up to 3 days following each storm, daily 20L grab samples will be collected once per day at Tourmaline Creek and the San Diego River between 7:00 and 9:00 AM, provided sufficient flow exists.

Composite storm discharge samples will be collected using automated equipment that relies on programmable peristaltic pumps; additional sensors and data loggers for rainfall and flow will be included. All pump tubing and sample bottles will be decontaminated and sterilized prior to each storm event. This process will be checked with an equipment blank at least once each storm. Decontamination will use a non-phosphate detergent followed by a 10% acid rinse and a triple deionized water rinse. Sterilization will require rinsing with at least 70% ethanol and allowing to dry, then being capped tightly with ethanol rinsed aluminum foil.

The 20L stormwater runoff samples will be filtered to collect protists, viruses, and bacteria, using membrane filters or hollow fiber ultrafiltration methods recently optimized with representative stormwater at SCCWRP.

Figure 1. Sampling locations for the QMRA study in Tourmaline Creek and in the San Diego River.

Each composite sample will be analyzed for FIB using traditional culturable methods and q-PCR methods. Host-specific bacterial markers for humans (e.g. HF183, HumM2), birds (e.g. Gull2, LeeSeaGull), dogs(e.g. BacCan, DogBact), cattle (e.g. BacCow, CowM2), and horses (e.g. HoF597) will be analyzed using qPCR methods. These sources and methods are consistent with the new Source Identification Project Protocol developed by SCCWRP and being promulgated by the State of California (http://www.waterboards.ca.gov/water_issues/programs/beaches/cbi_projects/docs/sipp_manual.pdf). The host-specific marker spectrum may be modified based on the results of the sanitary characterization.

Each composite sample will also be analyzed for human pathogens. Either q-PCR and/or ddPCR will be used to quantify pathogens for swimming related activities published by the Center for Disease Control (CDC) that are likely to occur in this watershed. These pathogens are comprised of human viruses (e.g. norovirus (Jothikumar et al. 2005a, Gregory et al. 2011), adenovirus: (Jothikumar et al. 2005b), and enteroviruses) , bacteria (e.g. *Salmonella sp.(*Daum et al. 2002, Novinscak et al. 2007, Malorny et al. 2004) *,* *Campylobacter sp.(*Yang et al. 2003)), and protists (e.g. *Giardia intestinalis, Cryptosporidium parvum*: (Guy et al. 2003 , Alonso et al. 2011)). All q-PCR assays will be run with negative controls to check for false positives, filter controls, and a spiked internal control to account for inhibition from the sample matrix.

In order to confirm the suspected non-human sources identified in the sanitary characterization and the storm event sampling, we will sample scats of non-human sources for FIB and pathogens (e.g. bacteria, protists). Since viruses are generally host-specific, they will not be tested. If human sources of FIB or human pathogens are not detected or only detected at low levels, this will allow potential confirmation of the suspected pathogen source(s). We will first estimate the number of scat samples required from these non-human host sources from the quantification of the non-human markers in the discharge waters, and, if necessary we will collect additional samples in order to further characterize the contributing non-human sources. The extent of sampling will then depend on host abundance, host density, proportion of host population infected with the pathogens, and host pathogen concentration in the watershed feeding Tourmaline Creek or the San Diego River. Variation in any of these parameters will ultimately require more or less samples to attain the confidence necessary for confirmation of pathogen loading. A maximum of 9 scats will be measured for any single host.

Analysis Approach

The quantitative analyses for human and non-human FIB will help demonstrate which of these sources are present in the stormwater discharge to the beaches. These, along with pathogen analyses, the beach sampling from the epidemiology study, the storm-related beach sampling, and the scat survey will inform the pathogen loading in the QMRA model. The quantitative pathogen and FIB data will directly tie in to the predictions of surfer exposure and the illness response modeling. In addition, the stormwater discharge data will provide another parameter to be used in the epidemiology study. The data product would resemble Table 3.

Table 3 Example data product for assessing the presence of human sources of fecal pollution

Site ID	Sampling Time	Human (HF183) copies/100ml	Gull copies/100ml	Norovirus copies/100ml
Tourmaline	0-6	XXX	XXX	XXX
Tourmaline	6-12	XXX	XXX	XXX
Tourmaline	24	XXX	XXX	XXX
Tourmaline	48	XXX	XXX	XXX
Ocean Beach	0-6	XXX	XXX	XXX
Ocean Beach	6-12	XXX	XXX	XXX
Ocean Beach	24	XXX	XXX	XXX
Ocean Beach	48	XXX	XXX	XXX

Task 4b: Swimmer (Surfer) exposure

Exposure is a function of water ingestion rate including the frequency and duration of swimming (or surfing), along with pathogen concentration. Together, these factors provide the estimate of "dose". This portion of the QMRA will be inextricably linked to the epidemiology study.

To estimate water ingestion, we will use the data from the epidemiology study to provide frequency and duration of exposure. These data will be used in conjunction with literature-based data on water ingestion rates to confirm that the site specific ingestion data are consistent with the data from the literature (which are commonly used in QMRA).

Estimating the pathogen concentrations at the point of exposure is likely to be one of the most challenging components that feeds into the QMRA. Therefore, we will estimate this model parameter in three different ways: 1) with no dilution or decay (i.e., full strength effluent); 2) using a simple, empirically-based statistical model, and; 3) a more complex mathematical fate and transport model. All three approaches have their positive and negative aspects, but comparisons among all three approaches will provide insight for managers (see following section, Task 4c).

In the first approach, pathogen concentrations at the point of exposure will be estimated from watershed loads measured in Tourmaline Creek and the San Diego River during storm events (Task 4a). For illness response modeling, we will assume that concentrations at the point of exposure are the same as the effluent. This approach assumes that there is no dilution and no decay as the discharge is transported down the beach. This is clearly the most conservative of the three approaches.

The Pilot Study indicated that discharge plume fate and transport played a significant role in the distribution of FIB following storm events. Therefore, our second approach will utilize a simple, statistically-based fate and transport model to account for dispersion and advection of FIB and pathogens after the discharge enters the ocean. In this approach, empirical data based on monitoring collected along the beach immediately following storm events will be used. The empirical measurements will include the flow and pathogen measurements made during and immediately following the storm (Task 4a), gradients in FIB from daily samples (i.e. sampled from the epidemiology study, Task 3b), and physical water quality parameters (i.e., temperature, salinity) measured at regular intervals upcoast and downcoast from the discharge. Simple ratios between the monitored data from the outfall and the beach sites will be derived. This type of model will provide either measured point-in-time exposure during monitored events or estimates of average conditions when combining time estimates across multiple events.

Samples of at least 50 ml for temperature and salinity will be taken in ankle deep water from no less than 5 sites spaced upcoast and downcoast from each discharge. Temperature and salinity will be measured in these samples using a hand held conductivity and temperature sensor (e.g. YSI Pro30: 0-70ppt, -5-55 deg C). Temperature and salinity will also be collected in the stormwater discharge sample.

The third approach to fate and transport model will be a mathematical computational model such as Qual2K, available from the US EPA (http://epa.gov/athens/wwqtsc/html/qual2k.html). This model predicts shoreline FIB concentrations based on several physical parameters that drive advection and dispersion including watershed loading, wind strength and direction, wave height and direction, and pathogen decay. Watershed loading will be measured in Task 4a, wind and wave data are available from local measurements through NOAA. Calibration and validation data will be derived from the shoreline physical water parameters, surface currents from the Southern California Coastal Ocean Observing System, and FIB measurements collected as part of the epidemiology study. This model can estimate exposure for either point-in-time or average condition similar to the statistical model, but can also provide these estimates for unmeasured storm events, which will be useful if many events occur at our sentinel beaches.

Task 4c: Illness response modeling

Illness-response (QMRA) modeling predicts the illness rates in swimmers (surfers) based on exposure, ingestion, pathogen dose-response relationships, and the conditional probability of illness given infection. Exposure and ingestion will be estimated based on the results from the previous tasks (Tasks 4a and b). As is commonplace in QMRA studies worldwide, we will use peer reviewed dose response relationships for this study. EPA has established a vetted set of dose response relationships for etiologic agents of public health concern in recreational waters. We will use those dose response relationships in this work (Soller et al. 2010 a,b). EPA also has established a vetted set of conditional probabilities of illness given infection for etiologic agents of public health concern in recreational waters. We will use those probabilities of illness given infection in this study.

We will use a static stochastic (Monte Carlo simulation based) model for the illness response simulations. Previously published work indicates that for recreational water exposures, under non-outbreak conditions, the complexity of a dynamic population-based model that accounts for secondary transmission and immunity is not necessary (Soller and Eisenberg, 2008).

Model Sensitivity analysis:
One of the most important aspects of this work is sensitivity analyses. Sensitivity analysis provides information about which model parameters most strongly influence our confidence in the outcome. Therefore, we will use sensitivity analyses to evaluate the impact of numerous model parameters and/or assumptions on the QMRA output. Model parameters to be considered will include the pathogen concentrations at the discharge point, dilution of pathogens between the discharge point and the exposure point, water ingestion rates, and pathogen dose-response relationships.

Management response paradigm

One way to capture the management response to the combination of epidemiology and QMRA results is captured in Figure 2. In this paradigm, managers will make some initial decisions based on a comparison of risk estimates from the empirical epidemiology results at the beach to the modeled QMRA risk estimates of undiluted stormwater discharge at the outfall:

Figure 2. Management response based on comparisons between epidemiology study and QMRA results

	Epi at the beach indicates little to no risk	**Epi at the beach indicates risk**
QMRA at the outfall indicates little to no risk	Site specific objectives likely	Potentially unmeasured sources of pathogens. Site specific objectives unlikely
QMRA at the outfall indicates risk	QMRA may provide estimate of risk below levels sensitive enough to capture empirically. Site specific objectives likely	Apply fate and transport models to QMRA for improving risk quantifications. If unsuccessful, may use reverse QMRA. Site specific objective may be possible, depending upon level of risk and uncertainty

In the first scenario, we will assume that the epidemiological results do not detect a statistically significant increase in illness rates for surfers. In this case, we will use the illness response modeling to add context to the epidemiology study's results. We will use both types of fate and transport models and compare the results and make an assessment of the overall illness attributable to swimmers. The modeling will provide a quantitative [and likely low] estimate of risk that empirical data are not sensitive enough to provide. This scenario favors developing site specific objectives at a level that is equal to, or more protective of, current water quality objectives.

In the second scenario, we will assume that the epidemiology study does detect a statistically significant increase in illness rate and the illness response modeling without any dilution substantially underestimates the observed health risk. If this occurs, then additional investigation may be required to assess if additional sources of pathogens exist at our sentinel beaches. This scenario does not favor developing site specific objectives until the unidentified sources are remediated.

In the third scenario, we will assume that the epidemiology study does detect a statistically significant increase in illness rate and the illness response modeling without any dilution over-predicts the health risk. This would be expected if all of the major sources of pathogens and fecal indicator bacteria had been identified and quantified, but fate and transport are providing dilution and/or decay. In this scenario, we will evaluate the ability of the simple statistical vs the more complex computational model to estimate the accuracy of exposure. If the fate and transport model(s) is accurate, then the illness response model results should reasonably align with the empirical epidemiology results. If the results do not align, then additional work into the illness response modeling will occur, focusing on sensitivity in the model parameters above. Assuming that fate and transport will be one of the primary variables of concern, we will use a "reverse-QMRA", similar to the work conducted at EPA's freshwater NEEAR studies (Soller et al. 2010a). In this reverse QMRA approach, the illness estimates from the epidemiology component of this study will be used in conjunction with the results of the sanitary characterization to estimate the dilution distribution between the discharge point and the points of exposure. The reverse QMRA will assist future QMRA studies assess the level of detail necessary for fate and transport modeling at open beaches.

Figure 3 graphically illustrates QMRA results for scenario number three. For a *hypothetical* set of results, the box plots show how the QMRA results might vary depending of the type of fate and transport model employed. In this *hypothetical* example, QMRA results are shown under the assumption of no dilution from the discharge point, a constant dilution factor, a simple fate and transport model, and a more complex fate and transport model.

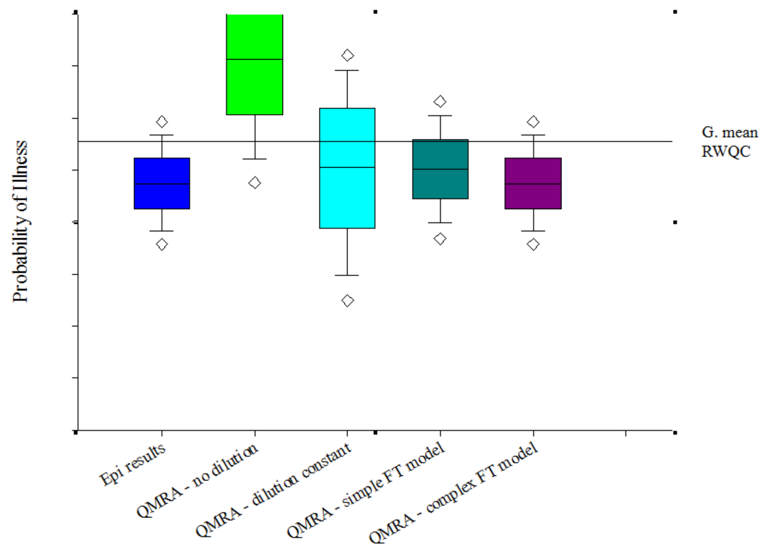


Figure 3. Hypothetical results demonstrating how the QMRA results can be utilized for making management decisions.

Based on the management paradigm in Figures 2 and 3, the QMRA modeling will address Q4 – "What level of *Enterococcus* corresponds to the same risk of illness as current water quality standards (WQS)?" If the epidemiology and QRMA studies find that either of the sentinel beaches are unimpacted or minimally impacted by human contamination, site specific recreational water quality criteria (that are at least as protective as the current WQS) may be worthy of consideration. Depending on the desired deviation from the benchmark risk (e.g. 0.5 to 1.0 log units), 10% to 30% human-derived ENT could serve as a potential threshold below which risk can be assumed to differ substantially from risk from exposure to pollution that is 100% human (Soller et al., 2014).

Recently published research indicates that for human/non-pathogenic, human/gull, human/pig, and human/chicken fecal mixtures with relatively low human contribution, the predicted culturable enterococci densities that correspond to the EPA benchmark risks are substantially greater than the current water quality criteria values (Soller et al., 2014) (Figure 4). Moreover, simulated ENT levels associated with illness levels of 36 GI illnesses per 1000 recreation events are driven predominantly by the proportion of the human (more potent) source. Also, the predicted median enterococci densities at any given human contribution are not widely different for the various mixtures thus far evaluated, until the proportion of human contamination is very low. For example, at a 20% human contribution to the culturable ENT, the simulated ENT densities for different mixtures vary from a low of 87 CFU 100mL^{-1} for a human / chicken mixture to 175 CFU 100mL^{-1} for a human / non-pathogenic mixture. For this investigation, we will follow the approach developed by Schoen and Ashbolt (2010) and extended by Soller et al. (2014) to derive appropriate site specific WQS recommendations that are equally protective to the 2012 RWQC recommended by US EPA (EPA, 2012).

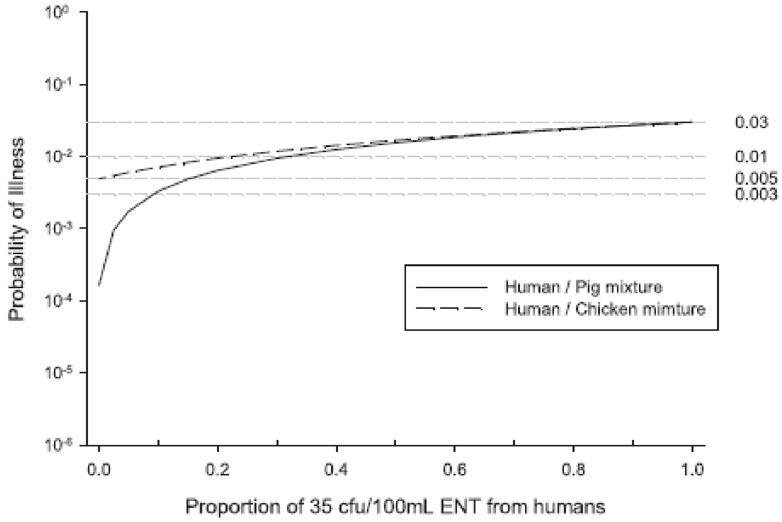


Fig. 4 – Evaluation of human/fresh pig manure and human/fresh chicken manure enterococci sources.

Figure 4. Evaluation of mixed fecal contamination source risks (From Soller et al., 2014)

References

Alonso, J. L., Amorós, I., & Cañigral, I. (2011). Development and evaluation of a real-time PCR assay for quantification of Giardia and Cryptosporidium in sewage samples. *Applied Microbiology and Biotechnology*, *89*(4), 1203–1211. doi:10.1007/s00253-010-2984-6

Guy, R. A., Payment, P., Krull, U. J., & Horgen, P. A. (2003). Real-Time PCR for Quantification of Giardia and Cryptosporidium in Environmental Water Samples and Sewage. *Applied and Environmental Microbiology*, *69*(9), 5178–5185. doi:10.1128/AEM.69.9.5178-5185.2003

Guy, R. A., Xiao, C., & Horgen, P. A. (2004). Real-time PCR assay for detection and genotype differentiation of Giardia lamblia in stool specimens. *Journal of Clinical Microbiology*.

Meynell GG and Meynell EW (1958) The growth of micro-organisms in vivo with particular reference to the relation between dose and latent period. *Epidemiology & Infection* 56(03), 323-346.

Schoen, M.E., and Ashbolt, N.J. (2010) Assessing pathogen risk to swimmers at non-sewage impacted recreational beaches. *Environ Sci Technol* **44(**7**)**: 2286-2291.

Soller, J.A., and Eisenberg, J.N.S. (2008) An evaluation of parsimony for microbial risk assessment models. *Environmetrics* **19(**1**)**: 61-78.

Soller, J.A., Bartrand, T., Ashbolt, N.J., Ravenscroft, J., and Wade, T.J. (2010) Estimating the primary etiologic agents in recreational freshwaters impacted by human sources of faecal contamination. *Water Res* **44(**16**)**: 4736-4747 doi:4710.1016/j.watres.2010.4707.4064.

Soller, J.A., Schoen, M.E., Bartrand, T., Ravenscroft, J., and Ashbolt, N.J. (2010) Estimated human health risks from exposure to recreational waters impacted by human and non-human sources of faecal contamination. *Water Res* **44(**16**)**: 4674-4691.

Soller, J.A., Schoen, M.E., Varghese, A., Ichida, A.M., Boehm, A.B., Eftim, S., Ashbolt, N.J., and Ravenscroft, J.E. (2014) Human health risk implications of multiple sources of faecal indicator bacteria in a recreational waterbody. Water research 66C(254-264.

U.S. EPA (2012) Recreational Water Quality Criteria, 820-F-12-058, Office of Water, Washington, D.C.