APPENDIX K
San Diego Bay Watershed Management Area Water Quality Improvement Plan
—
Monitoring and Assessment Program

Submitted to the

San Diego Regional Water Quality Control Board

by the San Diego Bay Responsible Parties

January 2015

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Acronyms and Abbreviations

Acronym or Abbreviation	Definition
%	percent
<	less than
µg/L	micrograms per liter
303(d)	Clean Water Act Section 303(d) list of impaired waters
AB	(California) Assembly Bill
AB411	California Assembly Bill 411: Beach Safety Act
ABLM	Ambient Bay and Lagoon Monitoring
Airport Authority	San Diego County Regional Airport Authority
Bacteria TMDL	San Diego Regional Water Quality Control Board Resolution Number R9-2010-0001, *Revised TMDL for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek)*
Bight ’08	Southern California Bight Monitoring (2008)
Bight ’13	Southern California Bight Monitoring (2013)
BMP	best management practice
BOD	biological oxygen demand
Caltrans	California Department of Transportation
CDFW	California Department of Fish and Wildlife
CEDEN	California Environmental Data Exchange Network
CLRP	Comprehensive Load Reduction Plan
Copermittee	Operator of a municipal separate storm sewer system in San Diego County that is party to the Municipal Permit.
CRAM	California Rapid Assessment Method
CTR	California Toxics Rule
CWA	Clean Water Act
DEH	San Diego County Department of Environmental Health

Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
FIB	fecal indicator bacteria
Focused Priority Condition	Focused Priority Water Quality Condition
FY	fiscal year
HA	Hydrologic Area
Highest Priority Condition	Highest Priority Water Quality Condition
HMP	Hydromodification Management Plan
HSA	Hydrologic Sub-Area
HU	Hydrologic Unit
IBI	Index of Biological Integrity
IC/ID	illicit connection and/or illicit discharge
IDDE	illicit discharge detection and elimination
IGP	Industrial General Permit
ILACSD	I Love a Clean San Diego
JRMP	Jurisdictional Runoff Management Program (2013 Municipal Permit)
JURMP	Jurisdictional Urban Runoff Management Program (2007 Municipal Permit)
LID	Low-Impact Development
MBAS	methylene blue active substance
MLS	mass loading station
MS4	municipal separate storm sewer system
MST	microbial source tracking

Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
Municipal 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*
NA	not applicable
NAL	non-storm water action level
NPDES	National Pollutant Discharge Elimination System
O&G	oil and grease
OPP	Office of Pesticide Programs
PGA	pollutant-generating activity
pH	measure of hydrogen ion
POSD	Unified Port of San Diego
PWQC	Priority Water Quality Condition
QA/QC	quality assurance and quality control
QAPP	Quality Assurance Project Plan
REC-1	Contact Water Recreation (beneficial use)
Regional Board	San Diego Regional Water Quality Control Board
RHMP	Regional Harbor Monitoring Program
RP	Responsible Party. Responsible Parties include parties subject to the Bacteria TMDL and participating in this Water Quality Improvement Plan Monitoring and Assessment Program, specifically the Copermittees in the San Diego Bay WMA.
SAL	storm water action level
SCCWRP	Southern California Coastal Water Research Project
SHELL	Shellfish Harvesting (beneficial use)

Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
SISP	Shelter Island Shoreline Park
SIYB	Shelter Island Yacht Basin
SMC	Southern California Stormwater Monitoring Coalition
SQO	California Sediment Quality Objective
SR-MLS	Sweetwater River Mass Loading Station
SSID	stressor/source identification
State	State of California
State Board	State Water Resources Control Board
SWAMP	Surface Water Ambient Monitoring Program
TBD	to be determined
TMDL	total maximum daily load
TWAS	temporary watershed assessment station
USEPA	United States Environmental Protection Agency
WER	Water Effect Ratio
WLA	Waste Load Allocation
WMA	Watershed Management Area
WQBEL	water quality-based effluent limits
WQO	water quality objective
WURMP	Watershed Urban Runoff Management Program

1 Introduction

The San Diego Regional Water Quality Control Board (Regional Board) develops and enforces water quality objectives and implements plans to protect the area's waters. On May 8, 2013, the Regional Board adopted a new Municipal Permit[1] to regulate discharges from Municipal Separate Storm Sewer Systems (MS4s) (Regional Board, 2013). The Municipal Permit established a new, watershed-based approach by which the Copermittees plan and implement storm water programs. The new approach requires that jurisdictions' storm water programs address the priority receiving water conditions, focusing efforts toward measureable improvements in receiving water quality. The Municipal Permit requires that a Water Quality Improvement Plan be developed for the San Diego Bay Watershed Management Area (WMA). Provision D of the Municipal Permit requires that a Monitoring and Assessment Program be developed as part of the Water Quality Improvement Plan and implemented to assess impacts of MS4 discharges on receiving water conditions.

Collection and assessment of monitoring data guide future implementation of management actions by Responsible Parties (RPs) (described in Section 1.3) as part of the Water Quality Improvement Plan process. Monitoring during wet and dry weather is conducted to collect observational and analytical data. This data are used to help RPs determine whether receiving water conditions are improving, degrading, or staying the same.

Monitoring data collection and assessment provide the vehicle for determination of whether intended outcomes are being realized or whether adaptations of RPs' programs are necessary to achieve the intended outcomes. RPs assess the data, in combination with their management actions, to determine what actions are improving receiving water conditions and where additional actions are necessary to improve conditions. The Municipal Permit supports this outcome-based approach, as implemented and adapted through the Water Quality Improvement Plan process.

1.1 Purpose of the Monitoring and Assessment Program

The Monitoring and Assessment Program incorporates requirements of Provision D of the Municipal Permit along with the specific monitoring and assessment requirements for applicable Total Maximum Daily Loads (TMDLs) listed in Attachment E of the Municipal Permit and specific monitoring for focused priority conditions.

[1] *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* (Municipal Permit) (Order Number R9-2013-0001, Regional Board, 2013).

As stated in Provision D of the Municipal Permit:

> *"The purpose of this provision is for the Copermittees to monitor and assess the impact on the conditions of receiving waters caused by discharges from the Copermittees' MS4s under wet weather and dry weather conditions. The goal of the Monitoring and Assessment Program is to inform the Copermittees 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 MS4s, pollutant sources and/or stressors, and effectiveness of the water quality improvement strategies implemented as part of the Water Quality Improvement Plans."*

Based on the requirements of the Municipal Permit, the RPs in the San Diego Bay WMA have developed an integrated Monitoring and Assessment Program that:

(1) Measures the progress toward addressing the Highest Priority Conditions and Focused Priority Conditions;

(2) Assesses the progress toward achieving the Water Quality Improvement Plans numeric goals and schedules; and

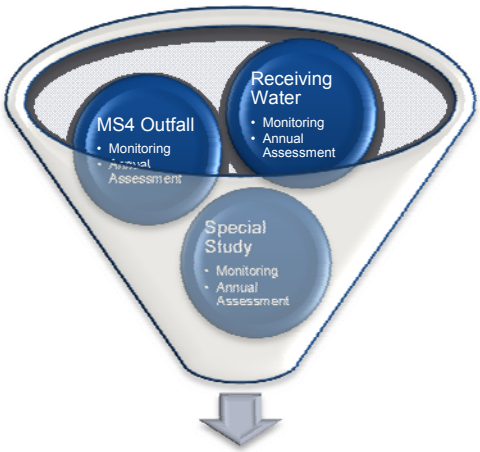
(3) Evaluates each RP's overall efforts to implement the Water Quality Improvement Plan.

The Monitoring and Assessment Program for the San Diego Bay WMA includes three major monitoring components:

(1) Receiving water monitoring, which measures the long-term health of the watershed;

(2) MS4 outfall monitoring, which promotes the elimination of dry weather flows from MS4 outfalls and investigates the improvement of the quality of the flows that exit the MS4 outfalls during rain events; and

(3) Special studies, which are designed to research regional issues as well as answer questions specific to Highest and Focused Priority Conditions.



Integrated Assessment and Iterative Review Process

Each of these components has elements that are applicable to the Highest and Focused Priority Conditions in the WMA. The Assessment Program includes an annual analysis of the monitoring data and an integrated analysis that combines all previously performed evaluations at the end of the Municipal Permit term. The program also reviews metrics collected through programmatic assessments and strategic implementation.

1.2 Watershed Background

The San Diego Bay WMA encompasses a 444-square-mile area (approximately 284,500 acres) that extends eastward from the San Diego Bay for more than 50 miles to the Laguna Mountains. The WMA ranges in elevation from sea level at San Diego Bay to a maximum elevation of approximately 6,000 feet above sea level at the eastern boundary. Most of the WMA land area lies north of the Tijuana River WMA, south of the San Diego River WMA, west of the Anza Borrego WMA, and east of the Pacific Ocean. The Municipal Permit defines the San Diego Bay WMA as containing three hydrologic units (HUs): (1) the Pueblo San Diego (Pueblo) HU 908, (2) the Sweetwater River (Sweetwater) HU 909, and (3) the Otay River (Otay) HU 910.

Previous efforts through the Watershed Urban Runoff Management Program (WURMP) focused on watershed collaboration to identify and address high and focused priority water quality problems in the WMA, and to develop and implement activities that include pollutant load reduction and abatement, educational activities, and public participation.

The Municipal Permit continues the watershed-based approach to water quality management by focusing on providing consistent implementation, improving interagency communication and collaboration, and establishing requirements that focus on attaining water quality improvement goals. The emphasis is on watershed quality outcomes as opposed to fulfillment of prescriptive activities. This approach assesses the WMA in its entirety, as well as at the subwatershed and jurisdictional level. The outcome-based adaptive management process supports the use of scientific tools to answer management questions that lead to implementation actions in the WMA. The goal of the Water Quality Improvement Plan is to reduce pollutants and other stressors from the RPs' MS4 discharges to support the Clean Water Act's objective to protect, preserve, enhance, and restore the water quality and designated beneficial uses of waters of the state.

Figure 1-1 presents the San Diego Bay WMA, along with Highest and Focused Priorities.

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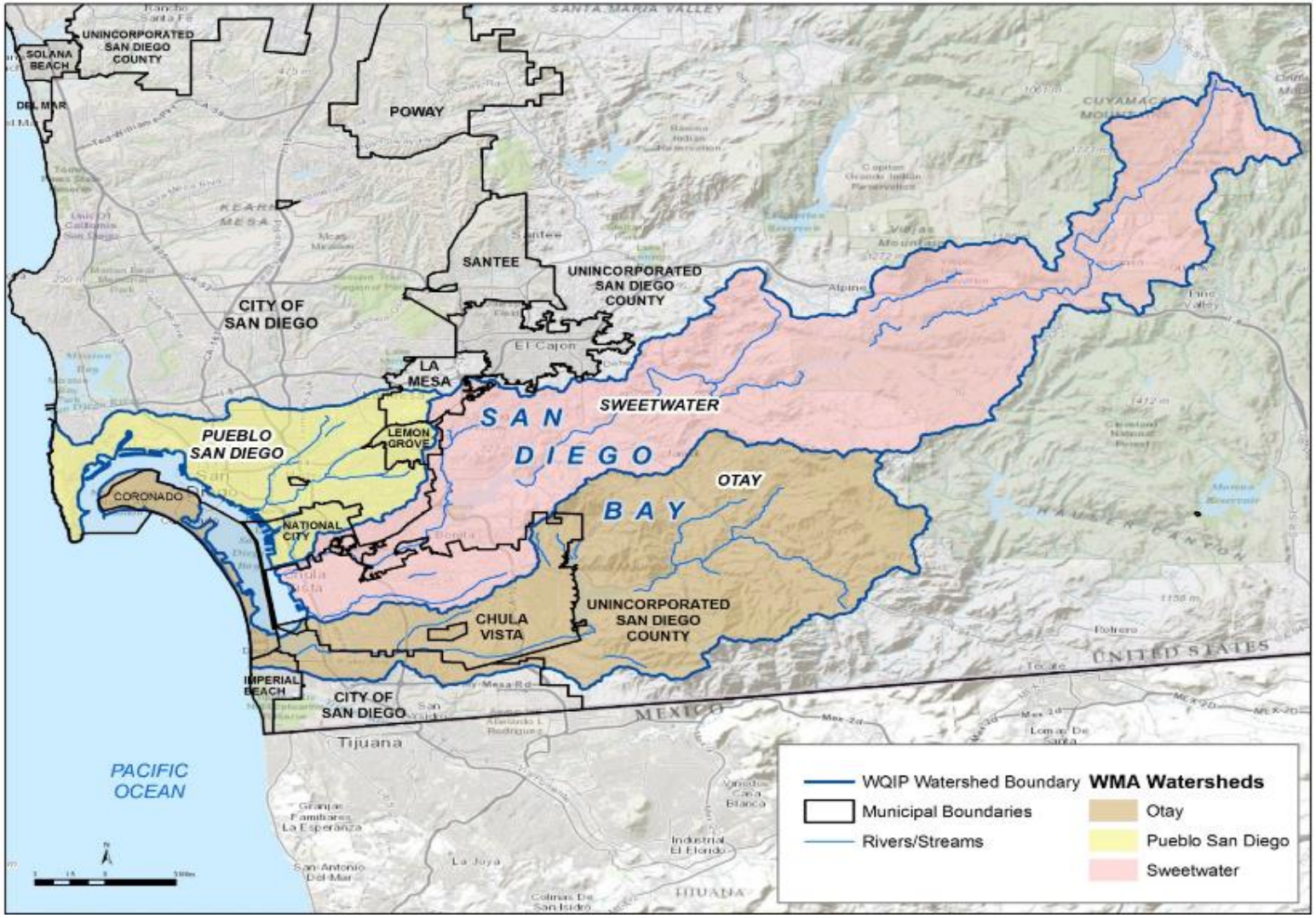
Figure 1-1
San Diego Bay WMA



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1.3 Responsible Parties

Water Quality Improvement Plan development and implementation is a collaborative effort by all of the RPs. The RPs in the San Diego Bay WMA include the County of San Diego, the Port of San Diego, the San Diego County Regional Airport Authority (Airport Authority), and the Cities of Chula Vista, Coronado, Imperial Beach, La Mesa, Lemon Grove, National City, and San Diego. The Copermittees within the San Diego Bay WMA are collectively referred to throughout this document as RPs.

Table 1-1 provides an overview of the three HUs and the jurisdictions within the watershed.

Table 1-1
San Diego Bay WMA Jurisdictional Breakdown (by Hydrologic Area [HA])

RP	San Diego Bay WMA								
	Pueblo			Sweetwater River			Otay River		
	908.1	908.2	908.3	909.1	909.2	909.3	910.1	910.2	910.3
Airport Authority		✓							
Chula Vista				✓				✓	✓
County		✓		✓	✓	✓		✓	✓
Coronado							✓		
Imperial Beach							✓	✓	
La Mesa		✓		✓					
Lemon Grove		✓		✓					
National City			✓	✓					
Port of San Diego	✓	✓	✓	✓			✓		
San Diego	✓	✓	✓	✓				✓	

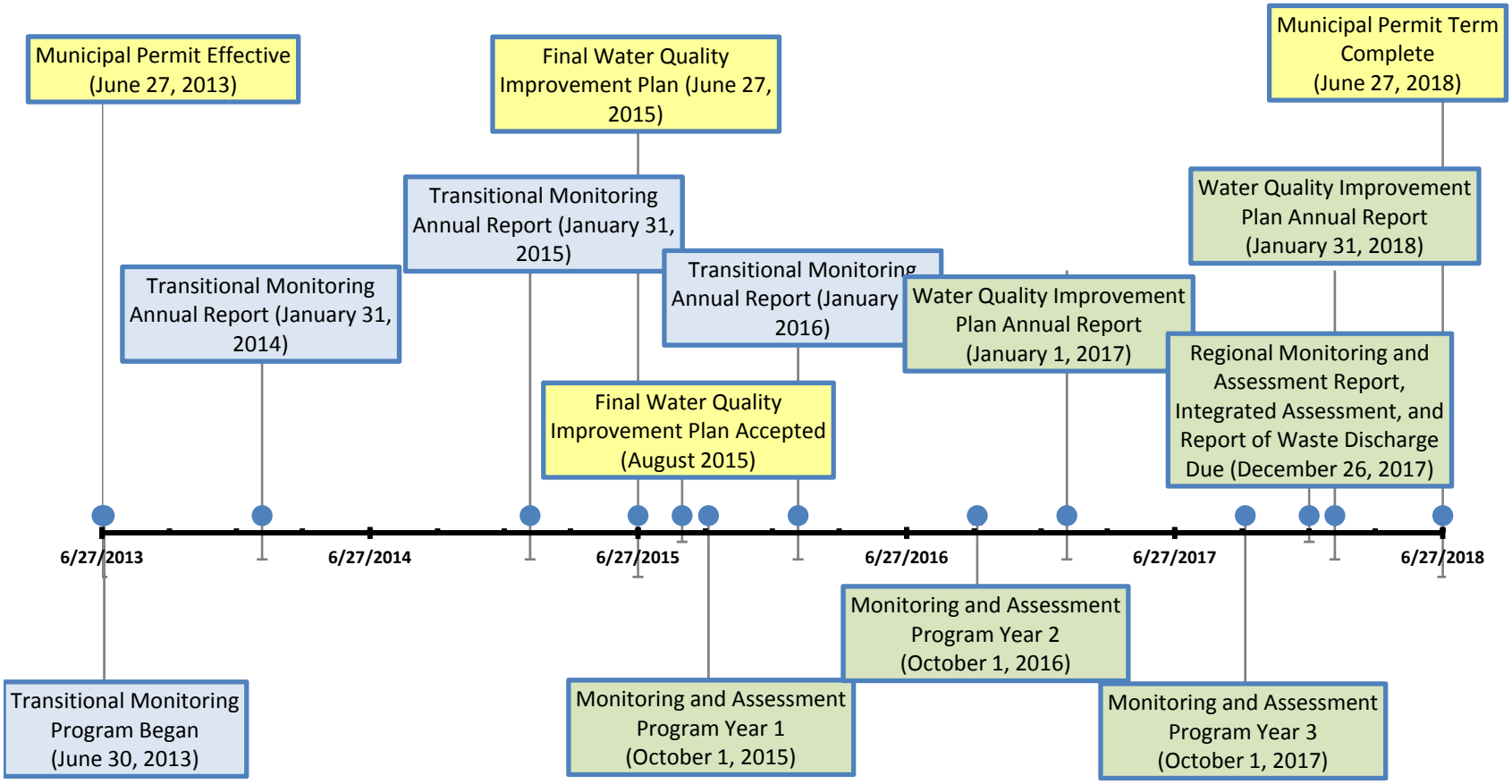
1.4 Monitoring and Assessment Program Schedule

The Municipal Permit was adopted in June 2013. Since adoption of the Municipal Permit, the RPs have implemented a regional transitional monitoring program. Per the Municipal Permit, the transitional monitoring program remains in place until Regional Board approval of the Final Water Quality Improvement Plan, which includes a 30-day public comment period. When the Final Water Quality Improvement Plan is approved by the Regional Board, RPs implement the Monitoring and Assessment Program jurisdictionally, on a watershed-wide basis, and regionally, as applicable. Approval of the Final Water Quality Improvement Plan is anticipated in summer 2015. The transitional monitoring program is anticipated to continue until the end of the monitoring year (September 30, 2015). The RPs expect to implement the Monitoring and Assessment Program beginning October 1, 2015.

Annual monitoring assessments are to be included as part of the Water Quality Improvement Plan Annual Report. Six months prior to the end of the Municipal Permit term, the RPs are to submit a regional monitoring and assessment report in collaboration with other Copermitees in the San Diego Region. At the same time, the RPs also submit the Report of Waste Discharge, which includes an integrated assessment of both this Monitoring and Assessment Program and RPs respective Jurisdictional Runoff Management Programs (JRMPs).

Figure 1-2 presents the general program timeline for Monitoring and Assessment, including reporting.

Figure 1-2
Monitoring and Assessment Program Timeline



Note: Yellow boxes indicate general permit milestones. Blue Boxes indicate transitional monitoring milestones. Green Boxes indicate milestones included as part of this Monitoring and Assessment Program.

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2 Monitoring Approach

2.1 General Information on Types of Monitoring

The San Diego Bay Water Quality Improvement Plan Monitoring Program has three major components:

- General permit-required monitoring (monitoring requirements prescribed in Provision D of the Municipal Permit),
- Highest and Focused Priority Condition monitoring (monitoring intended to inform programs and assess progress toward the goals outlined in the Water Quality Improvement Plan Second Interim Deliverable), and
- Additional monitoring (TMDL monitoring, where the TMDL is not a Highest or Focused Priority Condition, and special studies).

Each program component may include various types of monitoring elements, from visual observations used to identify illicit discharges, to flow-weighted composite sample collection. While monitoring may include water sample collection, it may also include other sampling types such as counting the number of trash pieces on a stream bank, collecting sediment or algae grab samples, or measuring physical changes in channel width and depth.

Table 2-1 presents an overview of planned monitoring activities for the San Diego Bay WMA, including key monitoring elements, sampling types, monitoring locations, and monitoring frequency by program. Figure 2-1 presents an overview of the San Diego Bay WMA's various monitoring programs and station locations including the Long-Term Receiving Water Monitoring, the MS4 Outfall Monitoring, the Highest and Focused Priority Condition programs, and Additional Monitoring Programs.

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Table 2-1
Water Quality Improvement Plan Monitoring Overview

Monitoring Programs			Weather (Wet or Dry)	Monitoring Elements	Sample Type(s)	Highest or Focused Priority Condition Addressed or Contributed to by Monitoring Program					Permit Schedule[1]				
						Chollas Creek Bacteria/Metals	Airport Metals	Riparian	Physical Aesthetics	Swimmable Waters	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
General Permit-Required Monitoring															
Receiving Water Monitoring	Long-Term Receiving Water Monitoring	Long-Term Receiving Water	Dry	Chemistry, FIB, toxicity (chronic), visual observations, field measurements	Time-weighted water composite, water grab, visual observations, *in-situ* measurements	–	–	–	–	–	●	–	–	–	–
				Trash Assessment	Visual observations, *in-situ* measurements	–	–	–	✓	–	●	–	–	–	–
				Hydromodification (channel conditions, discharge points, habitat integrity, evidence and estimate of erosion and habitat impacts)	Visual observations, *in-situ* measurements	–	–	–	–	–	●	–	–	–	–
				Bioassessment (BMI taxonomy, algae taxonomy, physical habitat characteristics)	Per SWAMP protocols	–	–	✓	–	–	●	–	–	–	–
			Wet	General: chemistry, FIB, toxicity (chronic), field measurements	Flow-weighted water composite	–	–	–	–	–	●	–	–	–	–
				Trash Assessment	Visual observations, *in-situ* measurements	–	–	–	✓	–	●	–	–	–	–
	Regional Monitoring	Southern California Bight Monitoring (Bight '13)	Dry	Chemistry, toxicity, bioassessment	Sediment grab, per SWAMP protocols	✓	–	✓	✓	✓	●	–	–	–	–
		Stormwater Monitoring Coalition (SMC)	Dry	TBD (year 1 was under SMC bioassessment)	Per SMC Protocols	–	–	✓	✓	–	●	TBD	TBD	TBD	TBD

Notes:
AB411 = Assembly Bill 411; BOD = biological oxygen demand; CRAM = California Rapid Assessment Method; FIB = fecal indicator bacteria; HMP = Hydromodification Monitoring Program; IBI = Index of Biological Integrity;
IC/ID = illicit connection and/or illicit discharge; MST = microbial source tracking; NA = not applicable; O&G = oil and grease; PWQC = Priority Water Quality Condition; RHMP = Regional Harbor Monitoring Program; SMC = Southern California Stormwater Monitoring Coalition; TBD = to be determined
● Monitoring has been or will be conducted.
– Monitoring will not be conducted
1. Cells marked as TBD will be determined before the submittal of the full Water Quality Improvement Plan. The TBD has been assigned if the program has not been developed or monitoring plans are not complete.
2. The California Assembly Bill 411 (AB411) program monitoring is conducted by the County of San Diego Department of Environmental Health will be tracked and incorporated into bacteria-related receiving water assessments. Monitoring under AB411 is not required under Provision D of the Municipal Permit, but bacteria monitoring is required as part of the Bacteria TMDL (Municipal Permit Attachment E.6). AB411 monitoring may be used to augment RP monitoring and will be reviewed as part of the data assessment.
3. Conducted under the Ambient Bay and Lagoon Monitoring (ABLM) Program, as part of Bight '13.
4. If <125 outfalls, 80% must be monitored twice annually.
5. Airport monitoring for metals will be conducted as part of the Industrial General Permit monitoring. Additional constituents are monitored under that program, but only metals is included here because that is the focused priority condition.
6. Monitoring is paired. Receiving Water and MS4 Outfall will be monitored the same day.

Table 2-1 (continued)
Water Quality Improvement Plan Monitoring Overview

Monitoring Programs			Weather (Wet or Dry)	Monitoring Elements	Sample Type(s)	Highest or Focused Priority Condition Addressed or Contributed to by Monitoring Program					Permit Schedule[1]				
						Chollas Creek Bacteria/Metals	Airport Metals	Riparian	Physical Aesthetics	Swimmable Waters	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Receiving Water Monitoring (cont.)	Regional Monitoring (cont.)	Hydromodification Monitoring Program (HMP)	Wet	Rain gauge analysis; stream gauge analysis; channel assessments; flow monitoring; sediment transport monitoring	Visual observations, *in-situ* measurements	–	–	✓	–	–	●	●	●	TBD	TBD
		Beach Water Quality (AB411)[2]	Dry	FIB	Water grab	–	–	–	–	✓	●	●	●	●	●
	Sediment Quality Monitoring	Sediment Quality Monitoring	Dry	Chemistry, toxicity, bioassessment	Sediment grab, visual observations, *in-situ* measurements	–	–	✓	–	–	●[3]	●	●	●	●
		Regional Harbor Monitoring Program (RHMP)	Dry	Field parameters, chemistry, toxicity, bioassessment, trash assessment	Water grab, sediment grab, visual observations, *in-situ* measurements	✓	–	–	✓	✓	●	–	–	–	–
MS4 Monitoring	MS4 Outfall	MS4 Field Screening	Dry	Visual: flow condition/estimation, trash, IC/IDs, Station condition descriptions (see Municipal Permit Table D-5)	Visual observations[3]	✓	✓	✓	✓	✓	●	●	●	●	●
		MS4 Outfall	Dry	Chemistry, FIB, toxicity (chronic), visual observations, field measurements	Water grab, visual observations, *in-situ* measurements	✓	✓	✓	✓	✓	●	●	●	●	●
		MS4 Outfall	Wet	Chemistry, FIB, toxicity (chronic), visual observations, field measurements	Time-weighted or flow-weighted water composite, water grab, visual observations, *in-situ* measurements	✓	✓	✓	✓	✓	●	●	●	●	●

Notes:
AB411 = Assembly Bill 411; BOD = biological oxygen demand; CRAM = California Rapid Assessment Method; FIB = fecal indicator bacteria; HMP = Hydromodification Monitoring Program; IBI = Index of Biological Integrity;
IC/ID = illicit connection and/or illicit discharge; MST = microbial source tracking; NA = not applicable; O&G = oil and grease; PWQC = Priority Water Quality Condition; RHMP = Regional Harbor Monitoring Program; SMC = Southern California Stormwater Monitoring Coalition; TBD = to be determined
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4. If <125 outfalls, 80% must be monitored twice annually.
5. Airport monitoring for metals will be conducted as part of the Industrial General Permit monitoring. Additional constituents are monitored under that program, but only metals is included here because that is the focused priority condition.
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Table 2-1 (continued)
Water Quality Improvement Plan Monitoring Overview

Monitoring Programs			Weather (Wet or Dry)	Monitoring Elements	Sample Type(s)	Highest or Focused Priority Condition Addressed or Contributed to by Monitoring Program					Permit Schedule[1]				
						Chollas Creek Bacteria/Metals	Airport Metals	Riparian	Physical Aesthetics	Swimmable Waters	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Highest and Focused Priority Condition Monitoring															
Highest and Focused Priority Condition Monitoring	Highest Priority	Chollas Creek Metals TMDL	Wet	Metals (copper, lead, and zinc), pesticides, FIB	Flow-weighted water composite	✓	–	–	–	–	●	●	●	●	●
Highest and Focused Priority Condition Monitoring	Highest Priority	Chollas Creek Bacteria TMDL (part of the 20 Beaches and Creeks TMDL)	Dry	FIB, visual observations, field measurements (optional)	Water grab, visual observations, *in-situ* measurements	✓	–	–	–	–	●	●	●	●	●
Highest and Focused Priority Condition Monitoring	Highest Priority	Chollas Creek Bacteria TMDL (part of the 20 Beaches and Creeks TMDL)	Wet	FIB, visual observations, field measurements (optional)	Water grab, visual observations, *in-situ* measurements	✓	–	–	–	–	●	●	●	●	●
Highest and Focused Priority Condition Monitoring	Focused Priority	Airport Metals	Dry	Metals (total and dissolved)	Water grab	–	✓	–	–	–	●	●	●	●	●
Highest and Focused Priority Condition Monitoring	Focused Priority	Airport Metals	Wet	Metals (total and dissolved)	Flow-weighted water composite, water grab	–	✓	–	–	–	●	●	●	●	●
Highest and Focused Priority Condition Monitoring	Focused Priority	Riparian Area Monitoring – Paradise Creek	Dry	Bioassessment (CRAM)	Water grab, Physical Habitat (pHab), So Cal IBI	–	–	✓	–	–	–	TBD	●	●	●
Highest and Focused Priority Condition Monitoring	Focused Priority	Physical Aesthetics Monitoring – Sweetwater and Otay[6]	Dry	Trash Assessment	Visual observations, *in-situ* measurements	–	–	–	✓	–	–	–	●	●	●
Highest and Focused Priority Condition Monitoring	Focused Priority	Physical Aesthetics Monitoring – Sweetwater and Otay[6]	Wet (Post-storm)	Trash Assessment	Visual observations, *in-situ* measurements	–	–	–	✓	–	–	–	●	●	●

Notes:
AB411 = Assembly Bill 411; BOD = biological oxygen demand; CRAM = California Rapid Assessment Method; FIB = fecal indicator bacteria; HMP = Hydromodification Monitoring Program; IBI = Index of Biological Integrity;
IC/ID = illicit connection and/or illicit discharge; MST = microbial source tracking; NA = not applicable; O&G = oil and grease; PWQC = Priority Water Quality Condition; RHMP = Regional Harbor Monitoring Program; SMC = Southern California Stormwater Monitoring Coalition; TBD = to be determined
● Monitoring has been or will be conducted.
– Monitoring will not be conducted
1. Cells marked as TBD will be determined before the submittal of the full Water Quality Improvement Plan. The TBD has been assigned if the program has not been developed or monitoring plans are not complete.
2. The California Assembly Bill 411 (AB411) program monitoring is conducted by the County of San Diego Department of Environmental Health will be tracked and incorporated into bacteria-related receiving water assessments. Monitoring under AB411 is not required under Provision D of the Municipal Permit, but bacteria monitoring is required as part of the Bacteria TMDL (Municipal Permit Attachment E.6). AB411 monitoring may be used to augment RP monitoring and will be reviewed as part of the data assessment.
3. Conducted under the Ambient Bay and Lagoon Monitoring (ABLM) Program, as part of Bight '13.
4. If <125 outfalls, 80% must be monitored twice annually.
5. Airport monitoring for metals will be conducted as part of the Industrial General Permit monitoring. Additional constituents are monitored under that program, but only metals is included here because that is the focused priority condition.
6. Monitoring is paired. Receiving Water and MS4 Outfall will be monitored the same day.

Table 2-1 (continued)
Water Quality Improvement Plan Monitoring Overview

Monitoring Programs		Weather (Wet or Dry)	Monitoring Elements	Sample Type(s)	Highest or Focused Priority Condition Addressed or Contributed to by Monitoring Program					Permit Schedule[1]				
					Chollas Creek Bacteria/Metals	Airport Metals	Riparian	Physical Aesthetics	Swimmable Waters	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
	Swimmable Waters Monitoring – Beaches (Otay River)[6]	Dry	FIB	Water grab	–	–	–	–	✓	●	●	●	●	●
		Wet	FIB	Water grab	–	–	–	–	✓	–	–	●	●	●
Additional Monitoring Programs														
Additional TMDL Monitoring	Shelter Island Copper TMDL – Receiving Water Monitoring	See Regional Board Investigative Order No. No. R9-2011-0036.												
	Shelter Island Copper TMDL – MS4 Outfall Monitoring	See Regional Board Investigative Order No. No. R9-2011-0036.												
	Shelter Island Shoreline Park Bacteria TMDL	Dry	FIB	Water grab	–	–	–	–	✓	●	●	●	●	●
		Wet	FIB	Water grab	–	–	–	–	✓					

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AB411 = Assembly Bill 411; BOD = biological oxygen demand; CRAM = California Rapid Assessment Method; FIB = fecal indicator bacteria; HMP = Hydromodification Monitoring Program; IBI = Index of Biological Integrity;
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Table 2-1 (continued)
Water Quality Improvement Plan Monitoring Overview

Monitoring Programs			Weather (Wet or Dry)	Monitoring Elements	Sample Type(s)	Highest or Focused Priority Condition Addressed or Contributed to by Monitoring Program					Permit Schedule[1]				
						Chollas Creek Bacteria/Metals	Airport Metals	Riparian	Physical Aesthetics	Swimmable Waters	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Special Study Monitoring	Regional Special Study	San Diego Regional Reference Streams and Beaches	Dry	Chemistry, FIB, instantaneous flow (streams only), Bioassessment	Water grab, Per SWAMP protocols	✓	–	✓	–	✓	●	–	–	–	–
			Wet	Chemistry, FIB, field measurements, flow and precipitation (duration of storm), Toxicity	Pollutograph water grabs	✓	–	✓	–	✓	●	●	TBD	–	–
	WMA Special Study	San Diego Bay Debris Study	Dry	Trash Assessment, pHab	Grab, Visual Observation	✓	–	✓	✓	✓	TBD	TBD	TBD	TBD	TBD
Special Study Monitoring (cont.)	Focused Priority Special Study	Pueblo-San Diego Hydrologic Unit: Creek Refuse Assessment Program	Dry	Trash Assessment	Grab, Visual Observation	✓	–	✓	✓	✓	●	●	●	●	●
	Highest Priority Special Study	Chollas Jurisdictional Boundary Study	Wet	Metals, Pesticides, FIB	Flow-weighted water composites, water grabs	✓	–	–	–	–	●	●	TBD	TBD	TBD
	Focused Priority Special Study	Riparian Area Special Study	Dry	Metals (selenium)	Water grab	–	–	✓	–	–	●	●	TBD	TBD	TBD
			Wet												

Notes:
AB411 = Assembly Bill 411; BOD = biological oxygen demand; CRAM = California Rapid Assessment Method; FIB = fecal indicator bacteria; HMP = Hydromodification Monitoring Program; IBI = Index of Biological Integrity;
IC/ID = illicit connection and/or illicit discharge; MST = microbial source tracking; NA = not applicable; O&G = oil and grease; PWQC = Priority Water Quality Condition; RHMP = Regional Harbor Monitoring Program; SMC = Southern California Stormwater Monitoring Coalition; TBD = to be determined

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3. Conducted under the Ambient Bay and Lagoon Monitoring (ABLM) Program, as part of Bight '13.
4. If <125 outfalls, 80% must be monitored twice annually.
5. Airport monitoring for metals will be conducted as part of the Industrial General Permit monitoring. Additional constituents are monitored under that program, but only metals is included here because that is the focused priority condition.
6. Monitoring is paired. Receiving Water and MS4 Outfall will be monitored the same day.

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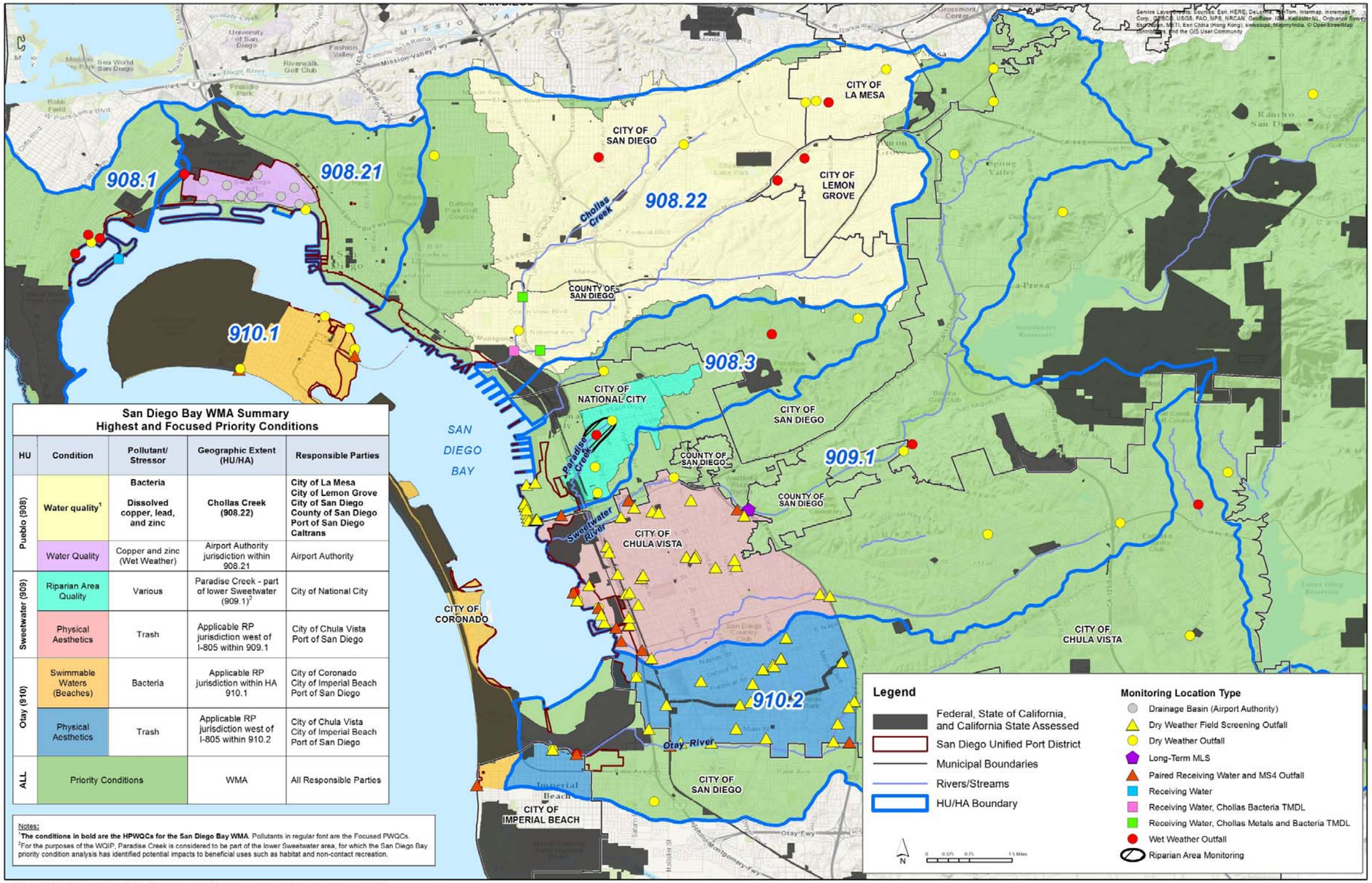
Figure 2-1
Summary Map of Monitoring Location



San Diego Bay WMA Summary
Highest and Focused Priority Conditions

HU	Condition	Pollutant/ Stressor	Geographic Extent (HU/HA)	Responsible Parties
Pueblo (908)	Water quality[1]	**Bacteria** **Dissolved copper, lead, and zinc**	**Chollas Creek (908.22)**	**City of La Mesa** **City of Lemon Grove** **City of San Diego** **County of San Diego** **Port of San Diego** **Caltrans**
Pueblo (908)	Water Quality	Copper and zinc (Wet Weather)	Airport Authority jurisdiction within 908.21	Airport Authority
Sweetwater (909)	Riparian Area Quality	Various	Paradise Creek - part of lower Sweetwater (909.1)[2]	City of National City
Sweetwater (909)	Physical Aesthetics	Trash	Applicable RP jurisdiction west of I-805 within 909.1	City of Chula Vista Port of San Diego
Otay (910)	Swimmable Waters (Beaches)	Bacteria	Applicable RP jurisdiction within HA 910.1	City of Coronado City of Imperial Beach Port of San Diego
Otay (910)	Physical Aesthetics	Trash	Applicable RP jurisdiction west of I-805 within 910.2	City of Chula Vista City of Imperial Beach Port of San Diego
ALL	Priority Conditions		WMA	All Responsible Parties

Notes:
[1]**The conditions in bold are the HPWQCs for the San Diego Bay WMA**. Pollutants in regular font are the Focused PWQCs.
[2]For the purposes of the WQIP, Paradise Creek is considered to be part of the lower Sweetwater area, for which the San Diego Bay priority condition analysis has identified potential impacts to beneficial uses such as habitat and non-contact recreation.

Note: Sediment monitoring sites have not been finalized at this time. See Section 3.1.3 for more details.

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2.2 General Permit-Required Monitoring

The Municipal Permit includes general monitoring requirements that are not directly related to RPs' selected Highest and Focused Priority Conditions. General Municipal Permit-required monitoring is applicable to all Copermittees, regardless of watershed or effective TMDLs. Where overlap is available, general monitoring requirements may be used to fulfill monitoring elements for Highest and Focused Priority Conditions. Upon completion of the transitional monitoring program, which is being implemented until the Water Quality Improvement Plan is approved by the Regional Board, general monitoring requirements applicable to the San Diego Bay WMA include:

- Long-Term Receiving Water Monitoring;
- Regional Monitoring Program Participation, including:
  - Southern California Stormwater Monitoring Coalition (SMC) Regional Monitoring;
  - Southern California Bight Monitoring (Bight '13);
  - Hydromodification Regional Monitoring Program; and
  - San Diego County Beach Water Quality (Assembly Bill [AB]411) Monitoring;
- Sediment Quality Monitoring; and
- MS4 Outfall Monitoring.

Additional information about each monitoring component is provided in Section 3.

2.3 Highest and Focused Priority Condition Monitoring

Monitoring is designed to answer management questions regarding Highest and Focused Priority Conditions. In addition to general permit-required monitoring, RPs monitor receiving waters and the MS4, where applicable, to provide data for assessment of progress toward the goals selected by RPs. Highest and Focused Priority Conditions include:

- Chollas Creek Metals and Bacteria TMDLs (Highest);
- Airport Metals (Focused);
- Riparian Area (Focused);
- Physical Aesthetics –Trash (Focused); and
- Swimmable Waters – Bacteria (Focused).

Additional information about each monitoring component is provided in Section 4.

2.4 Additional Monitoring Program Components: Other TMDLs and Special Studies

Additional monitoring programs include TMDL compliance monitoring, per Attachment E of the Municipal Permit, and monitoring selected by RPs to collect data for special studies. Additional monitoring addresses both WMA-specific and regional goals, and include:

- San Diego Regional Reference Streams and Beaches Studies (Regional);
- San Diego Bay Debris Special Study (WMA);
- Jurisdictional Boundary Special Study for Metals, Pesticides, and Bacteria (WMA); and
- Riparian Area Special Study (WMA).

Additional information about each monitoring component is provided in Section 5.

3 General Permit-Required Monitoring

This section provides an overview of general monitoring requirements per Provision D of the Municipal Permit. General permit-required monitoring incorporates receiving water and MS4 monitoring, which are monitoring elements common to all Copermittees under the Municipal Permit and, at the same time, may be watershed and jurisdiction specific. The San Diego Bay WMA RPs are required to implement receiving water monitoring at one long-term monitoring station and to participate in certain regional monitoring programs, including, but not limited to, the Bight '13 monitoring. Each Copermittee is also required to monitor MS4 outfalls within its jurisdiction in each WMA. This section includes receiving water monitoring and MS4 monitoring required under the Municipal Permit for the San Diego Bay WMA.

3.1 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. This program is designed to meet the requirements set forth in Provision D.1 of the Municipal 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 is part of the continued participation in a regional monitoring program. The Municipal Permit (Attachment E) also stipulates how TMDL monitoring requirements are to be incorporated into the receiving water monitoring program. Receiving water monitoring comprises several types of data collection activities for the San Diego Bay WMA:

(1) Long-Term Receiving Water Monitoring: includes a broad set of monitoring activities designed to characterize receiving water quality during dry and wet weather at one representative "mass loading station" over an extended (multi-year) time frame.

(2) Regional Monitoring Participation: includes continuing participation in regional monitoring programs that are applicable to the San Diego Bay WMA, including the Bight '13 program and SMC Regional Monitoring.

(3) Sediment Quality Monitoring: involves monitoring of sediments from receiving waters, including San Diego Bay, which is named in the state's Sediment Control Plan for enclosed bays and estuaries.

The monitoring approach for each of these data collection activities is described below.

3.1.1 Long-Term Receiving Water Monitoring

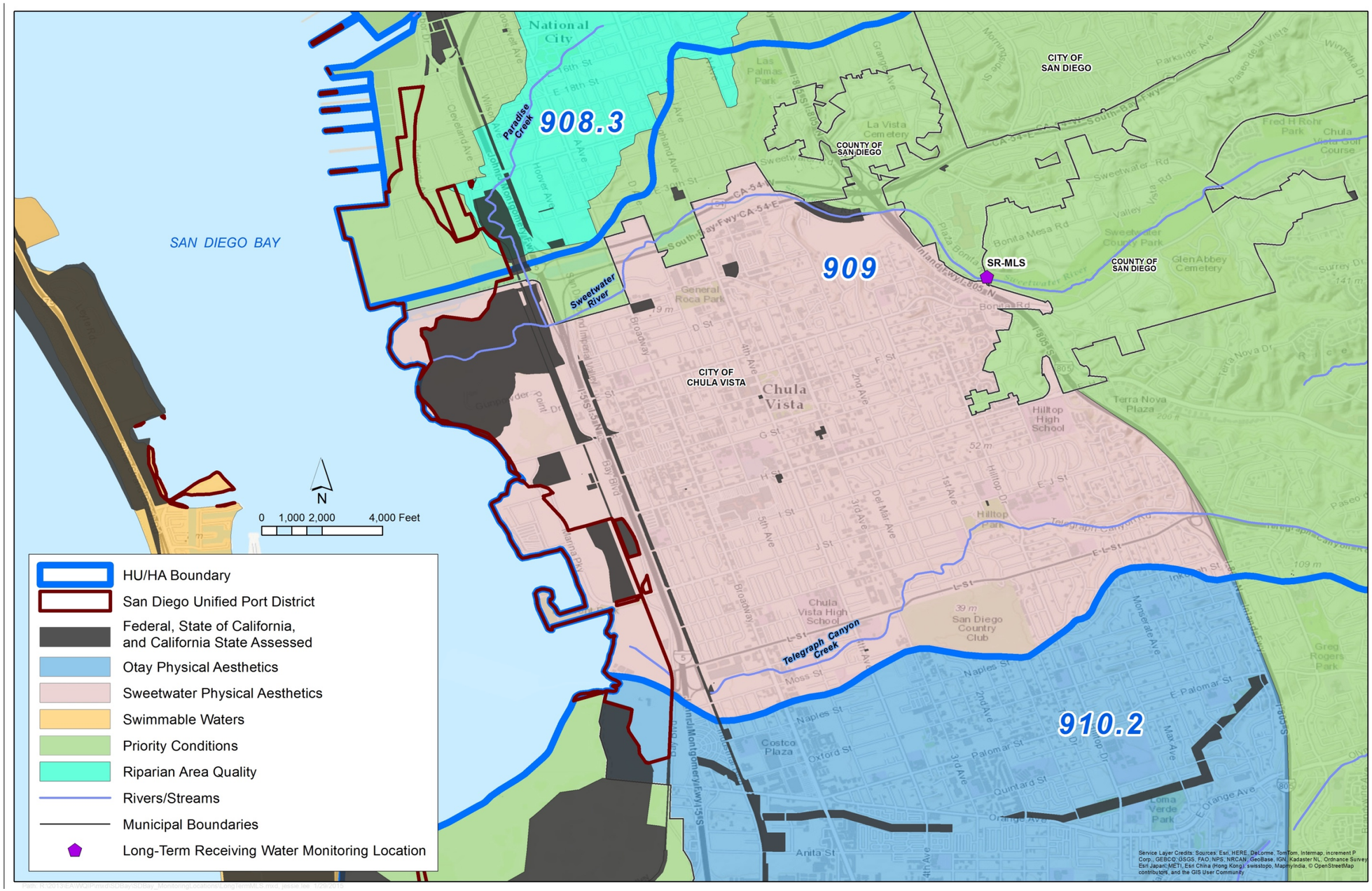
Dry and wet weather monitoring was performed at the Sweetwater River Mass Loading Station (SR-MLS) under the Transitional Monitoring Program to fulfill the permit requirements for long-term receiving water monitoring in the San Diego Bay WMA. Copermittees have monitored SR-MLS since 2001. The SR-MLS was selected as the long-term receiving water monitoring station because it is a developing HU and limited data are available, signifying the need for additional data in the Sweetwater HU. Long-

term receiving water monitoring tracks the overall health of the receiving water and is designed to answer 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?

SR-MLS was monitored three times during dry weather and three times during wet weather during the current permit cycle. Figure 3-1 below presents the location of the SR-MLS monitoring station.

Figure 3-1
Sweetwater MLS Long-Term Receiving Water Station



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3.1.1.1 Dry Weather Receiving Water Monitoring (Municipal Permit Provision D.1.c)

Dry weather monitoring at the SR-MLS comprises three field events per permit term. The dry weather events are spread throughout one year during the Municipal Permit term to the maximum extent practicable as follows:

- Event 1—During dry season (May 1 through September 30)
- Event 2—During wet season (October 1 through April 30)[2]
- Event 3—At-large dry weather event

Dry weather sampling occurred on dry weather days when there was measureable flow at the location. During the wet season, samples were collected after an antecedent dry period of at least 72 hours with less than 0.1 inch of rainfall.

Data collection for each of the three dry weather events included:

- Field observations (as listed in Municipal Permit Table D-1)
- Field measurements (as listed in Municipal Permit Table D-2)
- Laboratory analytical chemistry (constituents relating to Highest Priority Conditions, Clean Water Act Section 303(d) listings (303(d) list), TMDL Load Reduction Plans, Permit non-storm water action levels (NALs), and constituents listed in Municipal Permit Table D-3)
- Toxicity testing (chronic testing for three freshwater species for fresh waters and one marine species for salt waters, as listed in Municipal Permit Table D-4)

In addition to water quality monitoring, bioassessment and hydromodification monitoring were also performed at the SR-MLS once each during the Municipal Permit term:

- Bioassessment, including benthic macroinvertebrate taxonomy and calculation of Index of Biological Integrity (IBI), algae taxonomy and calculation of IBI, and physical habitat characterization
- Hydromodification Monitoring, including observations regarding channel characteristics, discharge points, and habitat integrity, photo documentation of erosion or habitat impacts, measurements of erosion, and identification of known or suspected causes of erosion or habitat impacts

Appendix A details the monitoring methods, including constituent lists and quality assurance practices for long-term receiving water monitoring.

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[2] Dry weather sample must be preceded by a ≥72-hour antecedent dry period following a rainfall event of >0.1 inch and must occur after the first wet weather event of the season.

3.1.1.2 Wet Weather Receiving Water Monitoring (Municipal Permit Provision D.1.d)

Wet weather monitoring has been conducted at the Sweetwater Mass Loading Station (MLS) monitoring location during three storm events during one wet season (October 1 to April 30). Storms resulting in greater than 0.1 inch of precipitation are targeted for analysis. The storm events during the permit term are spread throughout the wet season to the maximum extent practicable as follows:

- Event 1—First wet weather event of wet season (October 1—April 30)
- Event 2—Event occurring after February 1
- Event 3—Additional wet weather event

Wet weather sampling occurs on wet weather days when there is measureable flow at the location. Samples are to be collected after an antecedent dry period of 72 hours with greater than 0.1 inch of rainfall.

Data collection for each of the three wet weather events includes:

- Field Observations, including description of monitoring station, rainfall parameters, field conditions, flow rates, and presence/assessment of trash
- Field Measurements (as listed in Permit Table D-2)
- Laboratory Analytical Chemistry (constituents relating to Highest Priority Conditions, 303(d) listings, TMDL Load Reduction Plans, Permit storm water action lists (SALs), and constituents listed in Permit Table D-3)
- Toxicity Testing (chronic testing for three freshwater species for fresh waters and one marine species for salt waters, as listed in Permit Table D-4)

During wet weather events, water samples are analyzed for conventional constituents, nutrients, metals, pesticides, bacteria, field parameters, and toxicity, when applicable are collected by flow-weighted composite samples. A flow-weighted composite sample consists of a mixture of constant-volume aliquots collected at variable time intervals. The resulting composite represents the average concentration throughout the hydrograph. Chronic toxicity can be collected by a composite sample or a grab sample, as determined by each jurisdiction.

During each wet weather monitoring event, field observations, including presence/absence of trash and station conditions, are recorded consistently with Table D-2 of the Municipal Permit.

For further details on monitoring methods, please refer to Appendix A.

3.1.2 Regional Monitoring Participation

Regional monitoring includes several separate studies to evaluate various aspects of receiving water health on a regional scale. The data may be used by RPs to answer 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?

RPs have and/or will participate in the following regional programs:

- Bight '13

  The Bight '13 program is a multi-agency collaborative effort conducted by SCCWRP to assess the ecological condition of the Southern California Bight from a cross-regional perspective. The core program consists of monitoring of sediment chemistry, sediment toxicity, benthic infauna, demersal fish, and epibenthic invertebrates. The goal of the Bight '13 program is to answer three primary questions:

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

- Regional Harbor Monitoring Program (RHMP)

  The Regional Harbor Monitoring Program (RHMP) was developed by the Port of San Diego, the City of San Diego, the City of Oceanside, and the County of Orange (RHMP Agencies) in response to a July 24, 2003, request by the San Diego Regional Water Quality Control Board (SDRWQCB) under §13225 of the California Water Code. The RHMP is a comprehensive effort to survey the general water and sediment quality and condition of aquatic life and to determine whether beneficial uses are being protected and attained in Dana Point Harbor, Oceanside Harbor, Mission Bay, and San Diego Bay. The program is composed of a core monitoring program supplemented by focused special studies warranted by the chemical, biological and toxicological results of this core monitoring. Compliance with the RHMP goals is accomplished in part through participation in the region-wide Bight '13 monitoring program managed by the Southern California Coastal Water Research Project (SCCWRP).

  The RHMP is a monitoring coalition that includes the Port of San Diego, City of San Diego, City of Oceanside, and County of Orange. During Bight '13, 75 sites were monitored for sediment and water quality in San Diego Bay, Mission Bay,

Oceanside Harbor, and Dana Point Harbor. The harbors are partitioned into five strata, composed of freshwater-influenced, shallow, deep, industrial/port, and marina areas. Freshwater-influenced areas in San Diego Bay are located at the mouths of major watersheds, including Sweetwater Channel, the mouth of Chollas Creek, and Otay River. The RHMP is coordinated and conducted in association with the Bight '13 program. As described in Section 3.1.3, RHMP sediment monitoring data are used to fulfill part of the sediment monitoring requirements of the Municipal Permit and to evaluate locations for continued monitoring.

- SMC Regional Monitoring

  The Stormwater Monitoring Coalition Stream Survey is a collaborative effort of leading storm water and multiple state, federal, and local regulatory agencies in southern California. In 2009, the SMC began assessing the health of streams in these watersheds by monitoring stream conditions using multiple indicators of ecological health. The initial five-year study documented the condition of perennial wadeable streams in the region and set a baseline for monitoring regional trends.

  The Southern California Stream Survey is designed to generate the data to answer three key management questions:

  (1) What is the condition of streams in southern California?

  (2) What stressors are associated with poor condition?

  (3) Are conditions changing over time?

  In 2015, a new five-year program extends the initial survey to answer key management questions about the impacts of storm water on stream conditions. The objective is to create a comprehensive monitoring design that integrates many elements of the individualized monitoring programs that currently exist within the region. Through re-allocation of Municipal Permit-required monitoring efforts, this survey is intended to provide valuable data about regional conditions in a cost-effective way. This integrated regional monitoring program is designed to be collaborative, so that each individual program can assess its local geography, and then contribute its portion to the whole region to address large-scale management needs and provide answers to the public about the health of southern California's streams and rivers.

- 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 caused by an increase in runoff discharge rates and volume from all Priority Development Projects (County of San Diego, 2011). Monitoring consists of channel sediment transport assessments, and continuous flow monitoring of pre-project, post-project, and reference conditions.

- San Diego County Beach Water Quality (AB411) Monitoring

  In 1997, the California State Assembly passed a resolution to amend the state's Health and Safety Code Section 115880. The amendment, known as Assembly Bill 411 (AB411), required the testing of the ocean receiving waters adjacent to all public beaches for microbiological contamination, including total coliform, fecal coliform, and *Enterococcus* bacteria. AB411 criteria established a monitoring program whereby receiving waters at public beaches were required to be sampled weekly from April 1 through October 31 within a given calendar year.

  San Diego County Department of Environmental Health (DEH) implements the Beach and Bay Water Quality Monitoring Program to support the statewide program funded by the AB411. 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 posts a health advisory notice or closes a beach when fecal indicator bacteria (FIB) results are above contact water recreational use (REC-1) water quality standards. There are four AB411 beach monitoring stations in the San Diego Bay WMA.

3.1.3 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 Water Board's Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality (Sediment Control Plan) (State Water Board, 2009). Sediment quality monitoring will be performed in compliance with Permit Provision D.1.e.(2), The Sediment Control Plan Section VII.D requires NPDES Phase I storm water dischargers to conduct monitoring at least twice per permit term, unless monitoring stations are shown to consistently be unimpacted. Section VII.E provides general guidelines for conducting sediment monitoring, and refers to the specific monitoring parameters and assessments that are required per Sediment Control Plan Section V.

Sediment quality monitoring are performed as part of the Water Quality Improvement Plan in compliance with Municipal Permit Provision D.1.e.(2), which requires preparation of a Sediment Monitoring Plan that satisfies the requirements of the state's Sediment Control Plan, including the following elements:

(1) The elements required under Sections VII.D and VII.E of the Sediment Control Plan,

(2) A Quality Assurance Project Plan (QAPP), and

(3) A schedule for completion of sample collection, analysis, and reporting.

These elements, as well as the details for sediment monitoring methods and protocols, are largely covered in the Sediment Monitoring Plan that was prepared for this purpose by the San Diego Copermittees (Appendix B).

Sediment quality monitoring will employ the following general approach to meet the requirements of the Permit:

(1) 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.

(2) 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 MS4), 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:

    (a) 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 MS4 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.

    (b) 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.

    (c) 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.

(d) Stations deemed by assessment to be likely or clearly impacted by MS4 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.

(3) 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 RHMP, in coordination with the Bight ’13 program, may satisfy all or a portion of the requirements of the state's Sediment Control Plan (adopted in 2009) for monitoring of sediments in San Diego Bay.

There were a total of 60 sediment sampling sites monitored in San Diego Bay as part of the RHMP. Of those, 9 were designated as freshwater influenced locations; 8 of them in or near the Sweetwater Channel, and one site located near a storm in the Laurel Hawthorne embayment. According the Permit Provisions D.1.e(2), sediment monitoring is required to assess compliance with sediment quality receiving water limits applicable to MS4 discharges to enclosed bays and estuaries. Therefore, of the RHMP sites monitored, the freshwater-influenced sites are considered most applicable to evaluate or be representative of MS4 discharges. The San Diego Bay Responsible Agencies will determine if additional monitoring locations are needed to representative other locations areas influenced by freshwater in San Diego Bay pending the completion of the RHMP assessment and reporting (i.e., the Otay River is a major source of freshwater and sediments to south San Diego Bay, but has not been monitored as a part of the regional Bight ’08/Bight ’13/RHMP monitoring efforts). [3]

The analysis is in progress and is focused on the most recent Bight ’13/RHMP 2013 "freshwater-influenced" monitoring stations within areas from the Chollas Creek and Sweetwater watersheds. Additional sediment monitoring data are also available for these locations from prior monitoring programs, including the Southern California Bight Monitoring (2008) (Bight ’08)/RHMP efforts in 2008. The RHMP/Bight ’08 will be used in conjunction with the Bight ’13/RHMP 2013 data to assess consistency both temporally and spatially for the same “freshwater-influenced” areas, when possible. Discussions with Regional Board staff are to be held to provide the results of the analytical assessments; determine whether SSID studies should be undertaken, and identify major elements of the approach for any identified studies.

[3] Additional, more intensive investigative and TMDL-related efforts are ongoing at the mouth of Chollas Creek, one of the major sources of freshwater in San Diego Bay. Additional monitoring of this site through the MS4 Program may be duplicative and thus not warranted depending on the timing of future activities.

The Sediment Monitoring Plan (Appendix B) is considered to be the template from which modifications will be made as the assessment and analytical steps described above are completed. Additions include specifications for monitoring stations and methods reflecting the results of the analytical assessments.

Final quality assurance and quality control (QA/QC) and analysis of the data collected for RHMP in 2013 are currently underway, and thus are not currently available for decision-making purposes. A draft RHMP report containing these results is due to be submitted to the RHMP agencies in the summer of 2015, this report will not satisfy the requirements for the Sediment Monitoring Program. The schedule of implementation shown in the Sediment Monitoring Plan (Appendix B) reflects the pending data and will be amended upon completion of the analytical assessments described above to include the planned follow-up monitoring.

3.2 MS4 Outfall Monitoring

Section 3.1 described Permit requirements for long-term receiving water monitoring. This section describes Permit requirements for MS4 outfall monitoring. The purpose of the MS4 outfall monitoring program is to evaluate the potential contribution from MS4 discharges to the receiving water quality. This program is designed to meet requirements set forth in Provision D.2 of the Municipal Permit. The MS4 outfall monitoring program has both dry and wet weather monitoring components.

The outfall monitoring program seeks to answer the question:

- Do non-storm water or storm water discharges from the MS4 cause or contribute to receiving water quality problems?

The MS4 Outfall Discharge Monitoring component involves the following types of data collection activities for the San Diego Bay WMA:

- Dry Weather MS4 Outfall Field Screening: involves inspection of major outfalls during dry weather conditions to identify and prioritize persistently flowing outfalls.
- MS4 Outfall Dry Weather Monitoring: monitors up to five persistently flowing outfalls semi-annually by each jurisdiction during dry weather.
- MS4 Outfall Wet Weather Monitoring: monitors one wet weather MS4 outfall discharge monitoring station that is representative of storm water discharges from land uses in the San Diego Bay WMA for each Copermittee annually during the wet season.

The monitoring approach for each of these data collection activities is described below.

Table 3-1 provides the number of major outfalls to be monitored under each component of the MS4 Outfall Monitoring Program by Copermittee. Additional information is available in Appendix A.

Table 3-1
Number of MS4 Outfalls per Jurisdiction

Jurisdiction	Number of Outfalls		
	Total Major Outfalls for Dry Weather Field Screening	Dry Weather Monitoring (Persistently Flowing Outfalls)[3]	Wet Weather Monitoring
Airport Authority[4]	0[2]	0(0)	0
Chula Vista	186[1]	5(5)	1
Coronado	7[2]	5(1)	1
Imperial Beach	2[2]	2(2)	1
La Mesa	5[2]	5(5)	1
Lemon Grove	4[2]	1(1)	1
National City	5[2]	5(5)	1
City of San Diego	502[5]	5(5)	1
County of San Diego	57[2]	5(5)	1
Port of San Diego	65[2]	5(2)	1

Notes:

1. For Responsible Agencies with fewer than 500 but more than 125 major MS4 outfalls in the watershed, 100% of major outfalls must be screened once per year.
2. For Copermittees with fewer than 125 major outfalls in the WMA, 80% of total major outfalls presented in the table must be screened twice per year.
3. Parenthesis indicates the number of persistent flowing outfalls monitored under this program. Jurisdictions with less than five persistently plowing outfalls may still monitor five outfalls during dry weather for additional data collection.
4. The Airport Authority has two major outfalls that are tidally influenced and cannot be safely screened or monitored. The nearest safe upstream access points will be screened/monitored as a proxy.
5. The City of San Diego has 502 outfalls within the City jurisdiction. The City of San Diego in accordance with 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.

3.2.1 Dry Weather MS4 Outfall Field Screening

The purpose of the MS4 Outfall Dry Weather Monitoring Program is to evaluate the potential contribution from MS4 discharges to receiving water quality during dry weather conditions and to effectively eliminate non-storm water discharges. The dry weather MS4 outfall monitoring component has two phases. For the first phase, each RP performs a field screening of a certain number of outfalls, based on the total number of outfalls in its jurisdiction. Using this outfall review, the RPs prioritize the persistently flowing outfalls on the basis of their potential to impact receiving water quality. For the second phase, the highest priority dry weather MS4 outfalls are then monitored, using more in-depth methods than those used in the field screening program.

Dry Weather Field Screening

Field screening consists of visual monitoring of all MS4 outfalls to identify and eliminate sources of persistently flowing non-storm water discharges. Dry weather MS4 outfall discharge field screening is designed to answer the following questions:

- Which non-storm water discharges are transient and which are persistent?
- Which discharges should be investigated as potential illicit connection/illicit 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 to identify and possibly 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.

The frequency of field screening is determined on a jurisdictional basis and is dependent on the number of major outfalls. Provision D.2.b(1) of the Municipal Permit outlines three categories as the basis for frequency, as described below:

- For 0-125 major outfalls, 80 percent of major outfalls 2 times per year
- For 125-500 major outfalls, all major outfalls 1 time per year
- For 500+ major outfalls, at least 500 major outfalls 1 time per year

Field screening activities are conducted during dry weather with an antecedent dry period of at least 72 hours with less than 0.1 inch of rainfall. Field observations include flow condition (pooled, ponded, flowing, or no flow), an estimate of flow, characteristics of flow and water, likely source(s), the presence of trash, or evidence or signs of illicit connections or illegal dumping. Follow-up investigations are employed on the basis of jurisdictional illicit connection and/or illicit discharge (IC/ID) programs.

The dry weather outfall screening involves two sets of activities:

- Conduct field inspections
- Identify/prioritize persistent non-storm water discharges

Field Inspections

Based on the jurisdictional inventory of major outfalls, each Copermittee may inspect up to 500 outfalls annually within its jurisdiction, and 80 percent of major outfalls in the San Diego Bay WMA twice a year.

Inspections are performed during dry weather conditions (defined as having an antecedent dry period of at least 72 hours following any storm event producing measurable rainfall greater than 0.1 inch). Visual observations (as listed in Municipal Permit Table D-5) are recorded during inspections.

Identification/Prioritization of Persistent Discharges

Persistent discharges are defined as those with evidence of flow present during three consecutive dry weather inspections.

Persistently flowing discharges are assigned a priority "according to potential threat to receiving water quality" (per Municipal Permit Provision D.4.b.(1)(c)) based on the following criteria:

- Persistent flow (defined as evidence of flow in each of three most recent inspections)
- Representative of discharges to Highest or Focused Priority Condition receiving waters
- Connectivity/proximity to receiving water
- Representativeness of urban land uses (commercial, industrial, residential, mixed use)
- Prior water quality data (especially if NALs are exceeded)

The prioritized list of persistently flowing outfalls (Table 3-3) is maintained and adjusted as needed on the basis of subsequent inspections and on the results of the dry weather outfall monitoring as described below.

3.2.2 MS4 Outfall Dry Weather Monitoring

Each jurisdiction ranked its outfalls independently on the basis of its Highest or Focused Priority Conditions, pollutant-generating activities (PGAs), and available resources. RPs considered the following factors to prioritize persistently flowing outfalls:

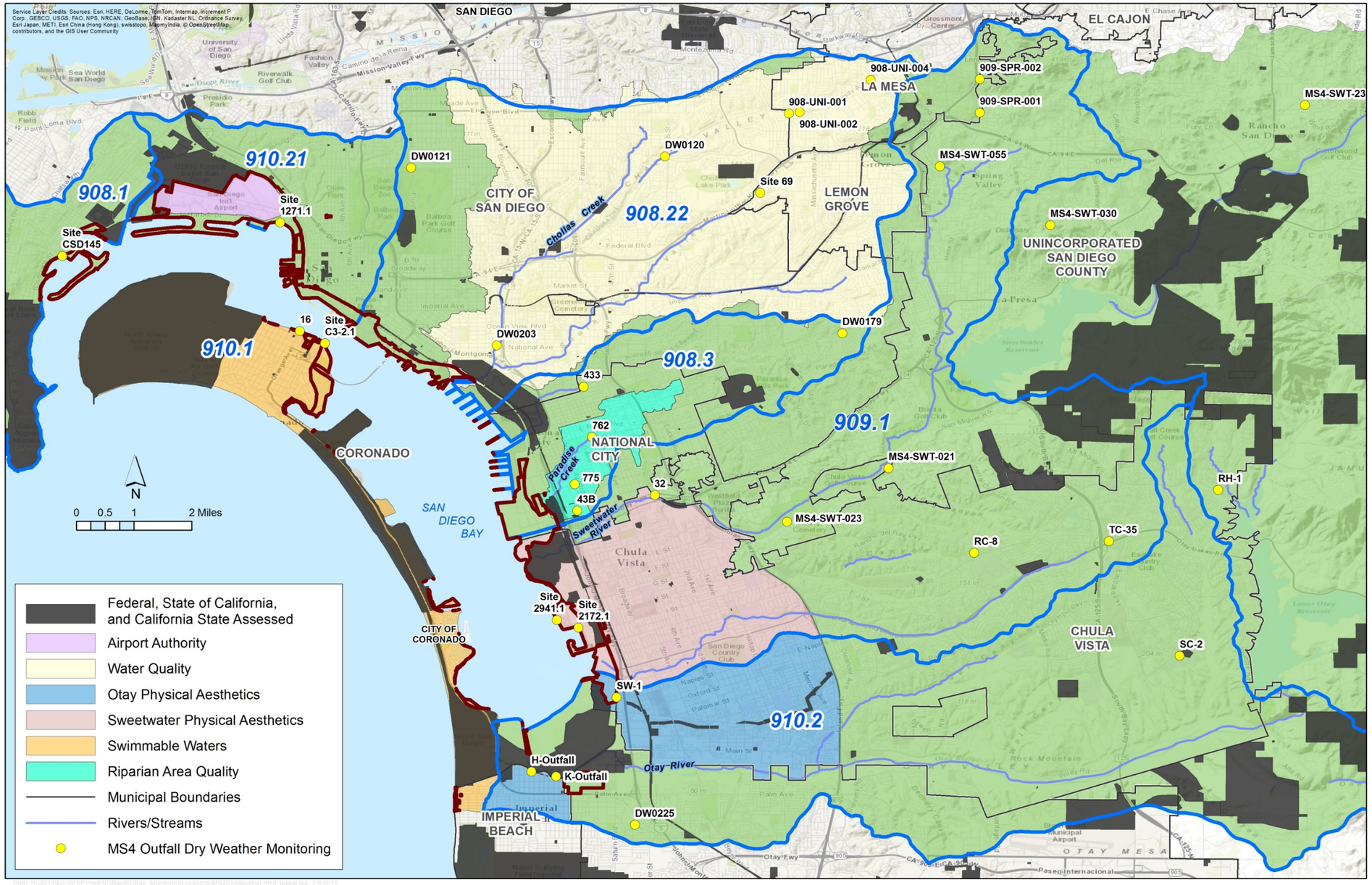
- Potential to contribute to a Highest or Focused Priority Condition,
- Historical monitoring or inspection data,
- Controllability,
- Surrounding land uses/potential sources, and
- Flow rate.

Up to five major outfalls are selected from the prioritized lists of persistent non-storm water discharges generated by each jurisdiction for major outfalls within the San Diego Bay WMA. Where a jurisdiction identifies less than five persistently flowing dry weather stations, all of the persistently flowing stations are monitored. Sites to be monitored during dry weather are mapped in Figure 3-2.

Using this prioritized list, Participating Agencies will focus resources on abating identified sources to mitigate flow at the highest priority locations. Monitoring is performed semi-annually and consist of the following elements:

- Field observations,
- Field measurements, and
- Laboratory analytical chemistry.

Figure 3-2
MS4 Outfall Dry Weather (Persistent) Monitoring Stations



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3.2.3 MS4 Outfall Wet Weather Monitoring

The purpose of this program is to identify pollutants in storm water discharges from the MS4s, guide pollutant source identification efforts, and track progress in achieving the Water Quality Improvement Plan goals. The RPs' locations for the wet weather MS4 outfall discharge monitoring component are chosen to be representative of the residential, commercial, industrial, and mixed-use land uses within the San Diego Bay WMA. These locations are monitored during one storm event annually. The wet weather MS4 outfall discharge monitoring is designed to answer the following questions:

- Do wet weather discharge concentrations at MS4 outfalls meet Municipal Permit action levels?
- What is the relative contribution of MS4 outfalls to priority water quality conditions during wet weather?
- How do representative MS4 outfalls discharge concentrations, loads, and flows change over time?

A total of 10 outfalls are monitored once per year during a storm event with greater than 0.1 inch of rainfall. During each event, observational and hydrologic data are recorded, including duration of the storm, rainfall estimates, and estimated or measured flow rates and volumes. Grab samples are 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 Highest or Focused Priority Conditions, 303(d) list impairments, TMDLs, and SALs. When historical data demonstrates or justifies that analysis of a constituent is not necessary for a particular waterbody or outfall, then it will be removed from the constituent list.

Wet weather MS4 outfall monitoring stations are selected that are representative of storm water discharges from land uses in the San Diego Bay WMA, including at least one wet weather MS4 outfall discharge monitoring station for each RP within the WMA. Sites to be monitored during wet weather are mapped in Figure 3-3.

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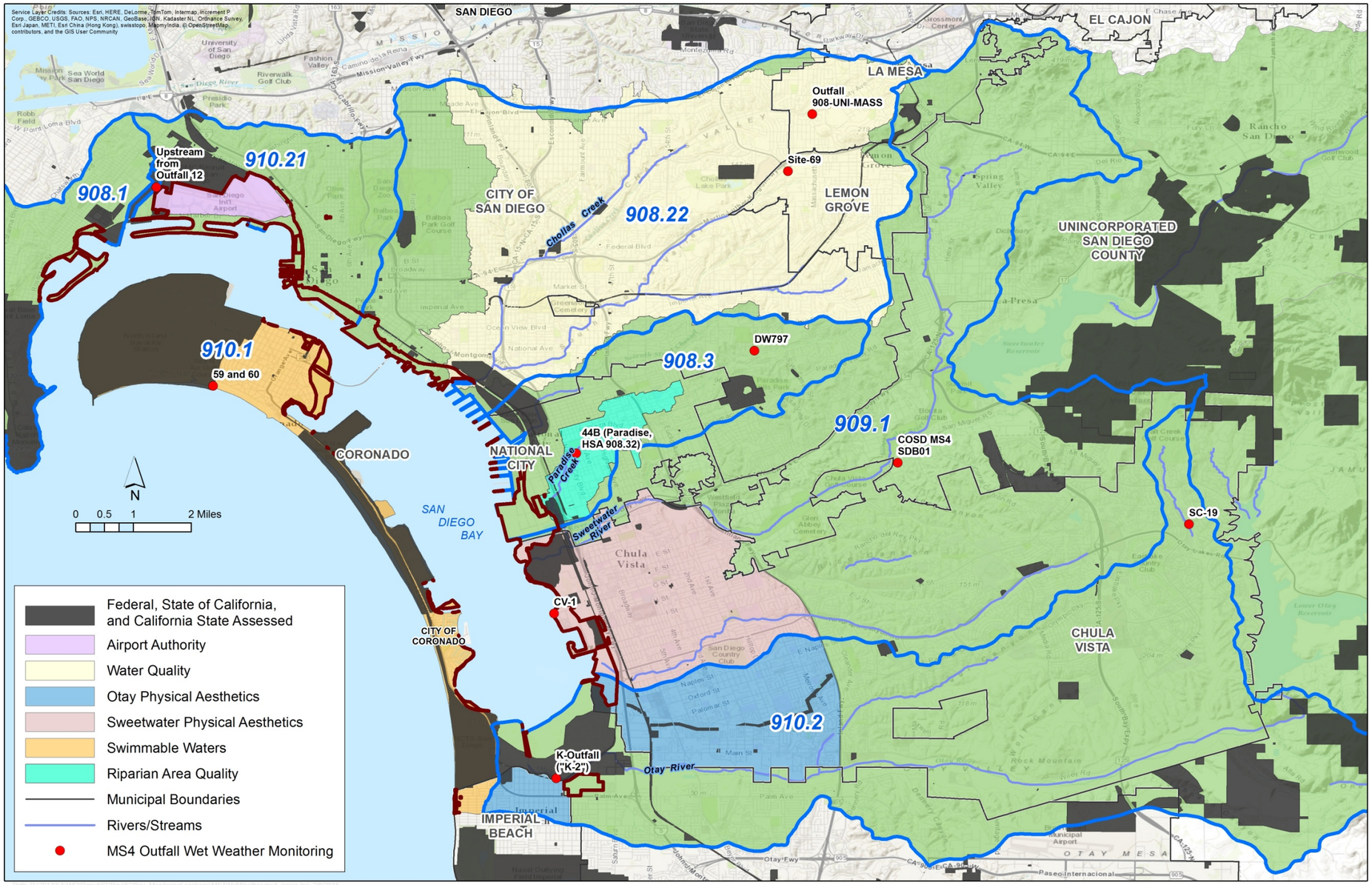
Figure 3-3
MS4 Outfalls Wet Weather Discharge Monitoring Stations



Note: Outfalls 59 and 60 are co-located in the same headwall.

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One monitoring event per year is performed during the wet season (October 1–April 30). The following monitoring elements will be included for each site:

- Field observations,
- Field measurements,and
- Laboratory analytical chemistry.

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4 Highest and Focused Priority Condition-Specific Monitoring

Receiving water monitoring is planned to address Highest and Focused Priority Conditions in the following areas:

- Water quality monitoring for the Highest Priority Condition in accordance with the Chollas Creek TMDLs for metals and bacteria;
- Monitoring for metals at the San Diego International Airport;
- Monitoring to characterize riparian area quality in Paradise Creek, via the California Rapid Assessment Method (CRAM);
- Trash monitoring for physical aesthetics in the Sweetwater and Otay HUs; and
- Bacteria monitoring of swimmable waters in Otay HU.

The monitoring approach for each of these Highest and Focused Priority Conditions is described below.

4.1 Chollas Creek Metals and Bacteria TMDLs

The Chollas Creek Metals TMDL is intended to identify and reduce dissolved copper, lead, and zinc in Chollas Creek. The Bacteria TMDL is intended to address levels of indicator bacteria in Chollas Creek. Final TMDL compliance requirements of both TMDLs are intended to be protective of beneficial uses in Chollas Creek. Water quality composite samples are collected for dissolved metals during wet weather at the Chollas Creek MLSs. Water quality grab samples are collected for indicator bacteria during wet and dry weather at the Chollas Creek MLSs and one tidal location. Receiving water and major outfall monitoring locations are mapped below in Figure 4-1.

4.1.1 Chollas Bacteria TMDL Receiving Water Monitoring

Dry weather bacteria monitoring occurs weekly during the dry season (April 1 through September 30) and monthly during the wet season at the Chollas Creek MLSs and one tidal location, provided in Table 4-1. Wet weather monitoring is conducted at the Chollas Creek MLSs and one tidal location during up to three storm events of each wet season.

Additional Information is available in Chollas Creek TMDL Monitoring Plan (Appendix C).

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Figure 4-1
Chollas Creek TMDL Monitoring Locations

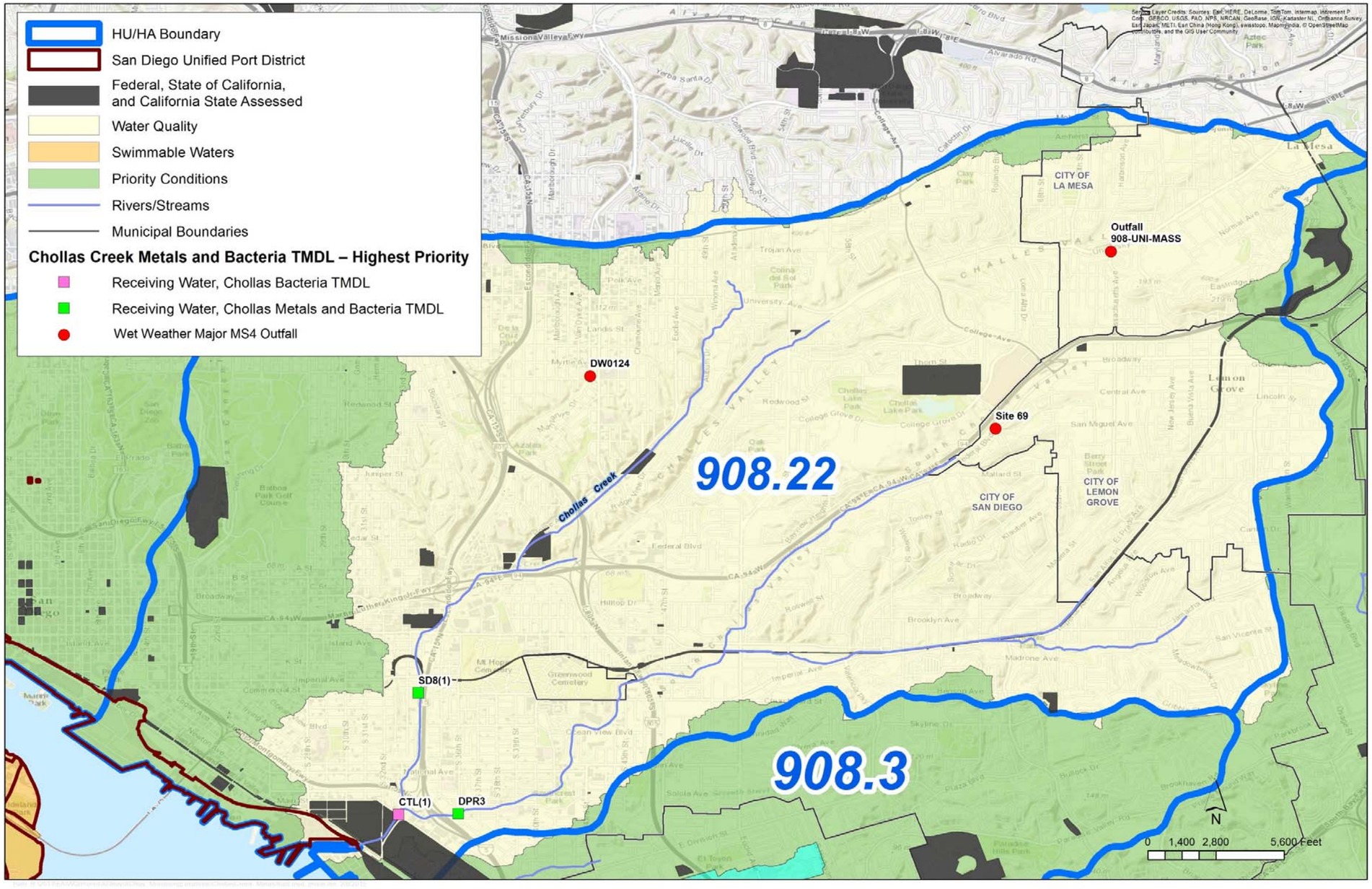

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Table 4-1
Bacteria TMDL Receiving Water Monitoring Stations

Station Name	Station Type	Waterbody	HU	Latitude	Longitude
SD8(1)	North Chollas Creek MLS	Chollas Creek	Pueblo (908)	32.70493	-117.12132
DPR3	South Chollas Creek MLS	Chollas Creek	Pueblo (908)	32.69130	-117.11682
CTL(1)	Chollas Tidal	Chollas Creek	Pueblo (908)	32.69120	-117.12354

4.1.2 Chollas Metals TMDL Receiving Water Monitoring

Chollas Metals TMDL monitoring is conducted annually during wet weather at the Chollas Creek MLSs. Flow-weighted composite samples are collected for copper, lead, and zinc during three wet weather events each year at the Chollas Creek MLS stations provided in Table 4-2.

Table 4-2
Chollas Creek Metals TMDL Receiving Water Monitoring Stations

Station Name	Station Type	Waterbody	HU	Latitude	Longitude
SD8(1)	North Chollas Creek MLS	Chollas Creek	Pueblo (908)	32.70493	-117.12132
DPR3	South Chollas Creek MLS	Chollas Creek	Pueblo (908)	32.69130	-117.11682

Additional Information is available in the Chollas Creek TMDL Monitoring Plan (Appendix C).

4.1.3 Outfall Monitoring

The Chollas Creek Bacteria TMDL does not require outfall monitoring at this time. The Chollas Creek Metals TMDL requires outfall monitoring.

Per Municipal Permit Attachment E.4:

> *"The Responsible Copermittees (City of La Mesa, City of Lemon Grove, City of San Diego, County of San Diego, San Diego Unified Port District) must monitor the effluent of the MS4 outfalls discharging to Chollas Creek for dissolved copper, lead, and zinc, and calculate or estimate the monthly and annual…loads, in accordance with the requirements of Provisions D.2, D.4.b.(1), and D.4.b.(2) of this Order.*
>
> *…dry and wet weather discharge concentrations 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."*

Time-weighted composite samples are collected for copper, lead, and zinc during one wet weather event annually at the major outfall stations provided in Table 4-3.

Table 4-3
Chollas Creek Metals TMDL Major Outfall Monitoring Stations

Jurisdiction[1]	Station Name	HA or HSA	Latitude	Longitude
City of La Mesa	Outfall 908-UNI-MASS	908.22	32.754663	-117.043269
City of Lemon Grove	Site 69	908.22	32.7347	-117.05626
City of San Diego	DW0124	908.22	32.740608	-117.101952

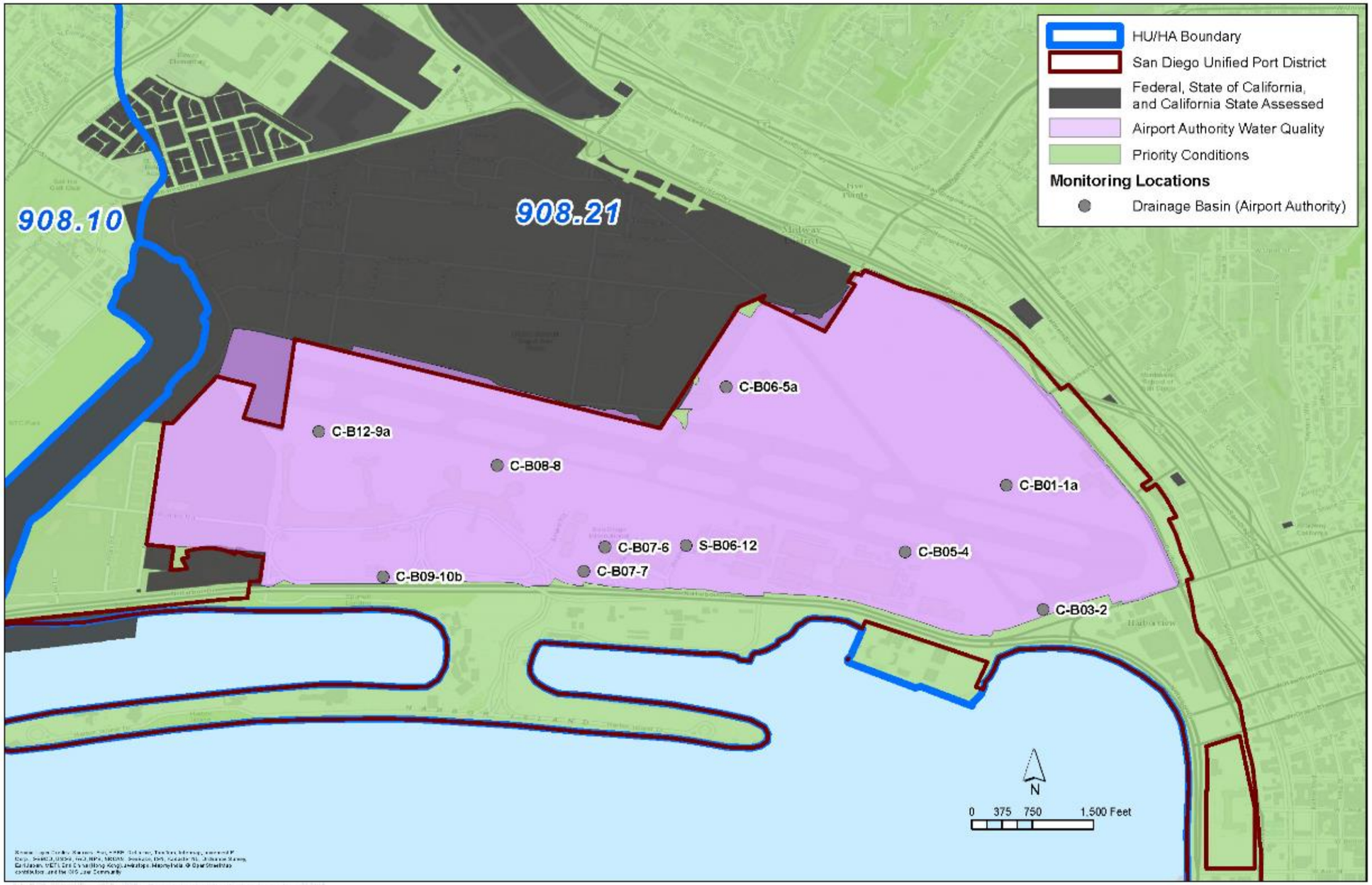
Notes:
Stations in **boldface** font are monitored under the Outfall Monitoring discussed in Section 3.2.
HA = Hydrologic Area; HSA = Hydrologic Sub-Area; TBD = to be determined
1. The Port and the County of San Diego do not have any major MS4 outfalls in the Chollas Creek HSA.

Additional Information is available in the Chollas Creek TMDL Monitoring Plan (Appendix C).

4.2 Airport Authority Metals Monitoring

Monitoring at the Airport is performed under a monitoring program that was designed to simultaneously comply with both the Industrial general permit and the Municipal Permit. Metals have been and will continue to be analyzed as part of the monitoring suite. Prior to July 2015, nine sites were monitored during two storm events each year. However, recent changes to the Industrial General Permit which take effect after July 2015 will require that four storm events are to be monitored: two between July and December, and two between January and June. The current sampling site locations are being reevaluated, but final site selection has not yet been completed. The current sample site locations are presented in Figure 4-2. Additional information is available in Appendix A.

Figure 4-2
Airport Authority Monitoring Locations



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4.3 Paradise Creek – Riparian Area Quality

Riparian area monitoring is performed by the City of National City along the reach of Paradise Creek within Kimball Park. The CRAM is used to assess riparian habitat during three dry weather events during the Municipal Permit term. A map of the monitoring location is presented in Figure 4-3.

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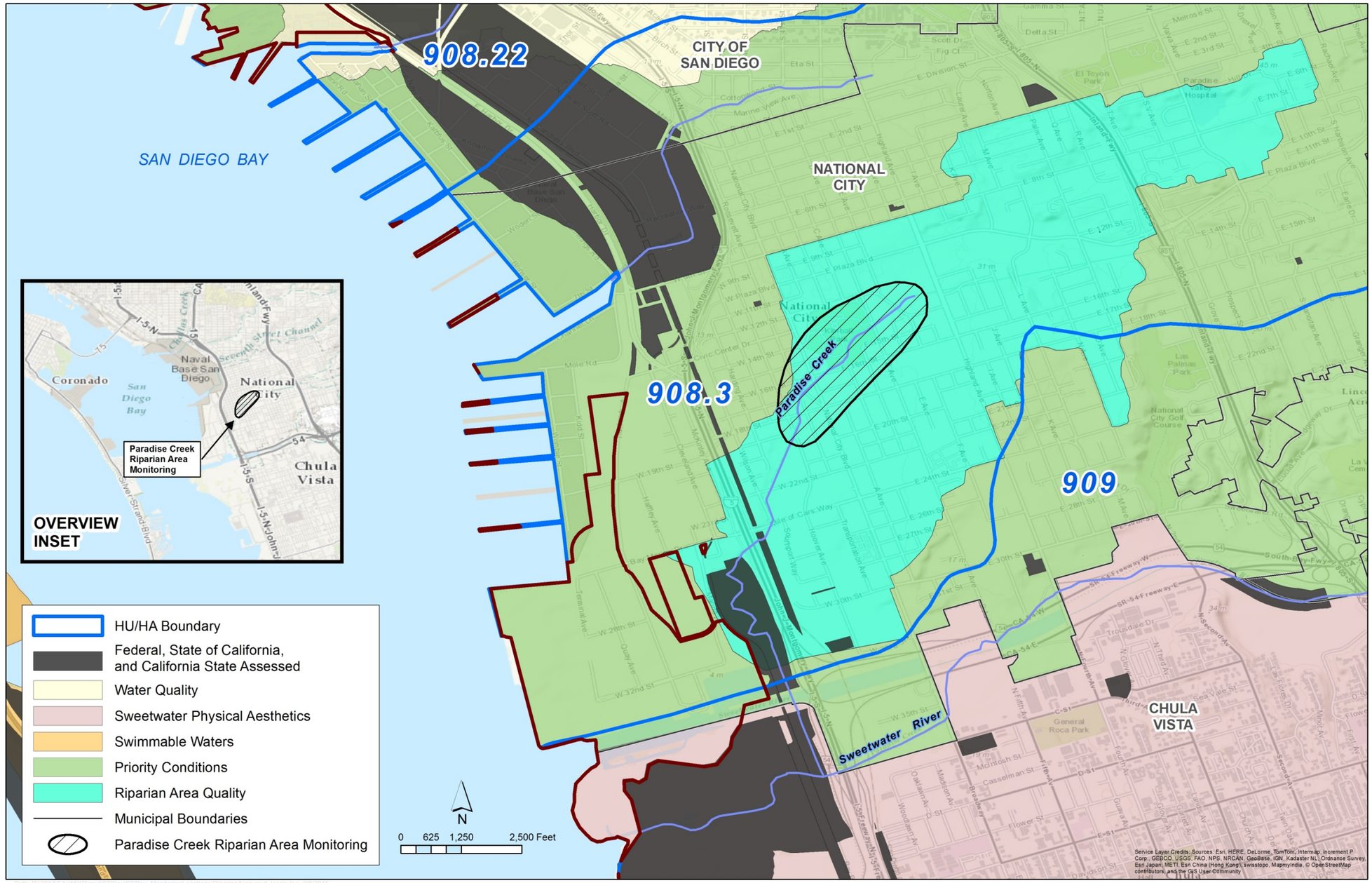
Figure 4-3
Paradise Creek – Riparian Area Monitoring Location



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4.4 Physical Aesthetics – Sweetwater and Otay Rivers

Physical aesthetics is a focused priority in the Sweetwater and Otay HUs. Since monitoring for both physical aesthetics focused priorities are similar in nature, focused priority monitoring programs for both HUs are included in this section. Nine sites are monitored for trash in the Sweetwater HU and three sites are monitored for trash in the Otay HU. Monitoring is conducted as follows:

- During two dry weather events annually: one dry season (May to September), one wet season (October to April), and
- During one "wet weather" event within three days following a storm event with at least 0.2 inch of precipitation.

Trash assessments are conducted visually, using standardized field sheets based on those developed for the San Diego Bay Debris Study and the Dry Weather Monitoring program. See Appendix A for additional details. Assessments are conducted concurrently with wet or dry weather receiving water monitoring events for receiving water and major MS4 outfalls.

The monitoring locations are receiving water locations within 2 to 25 feet of an MS4 outfall. Thus, the site is evaluated as a paired receiving water/MS4 outfall monitoring point. MS4 outfall and receiving water locations are typically distinct, in order to evaluate the contributions of MS4 outfalls to receiving water impairments. However, Physical Aesthetics monitoring locations were chosen as paired sites because of the observational nature of trash evaluation, as opposed to chemical analysis of a sample.

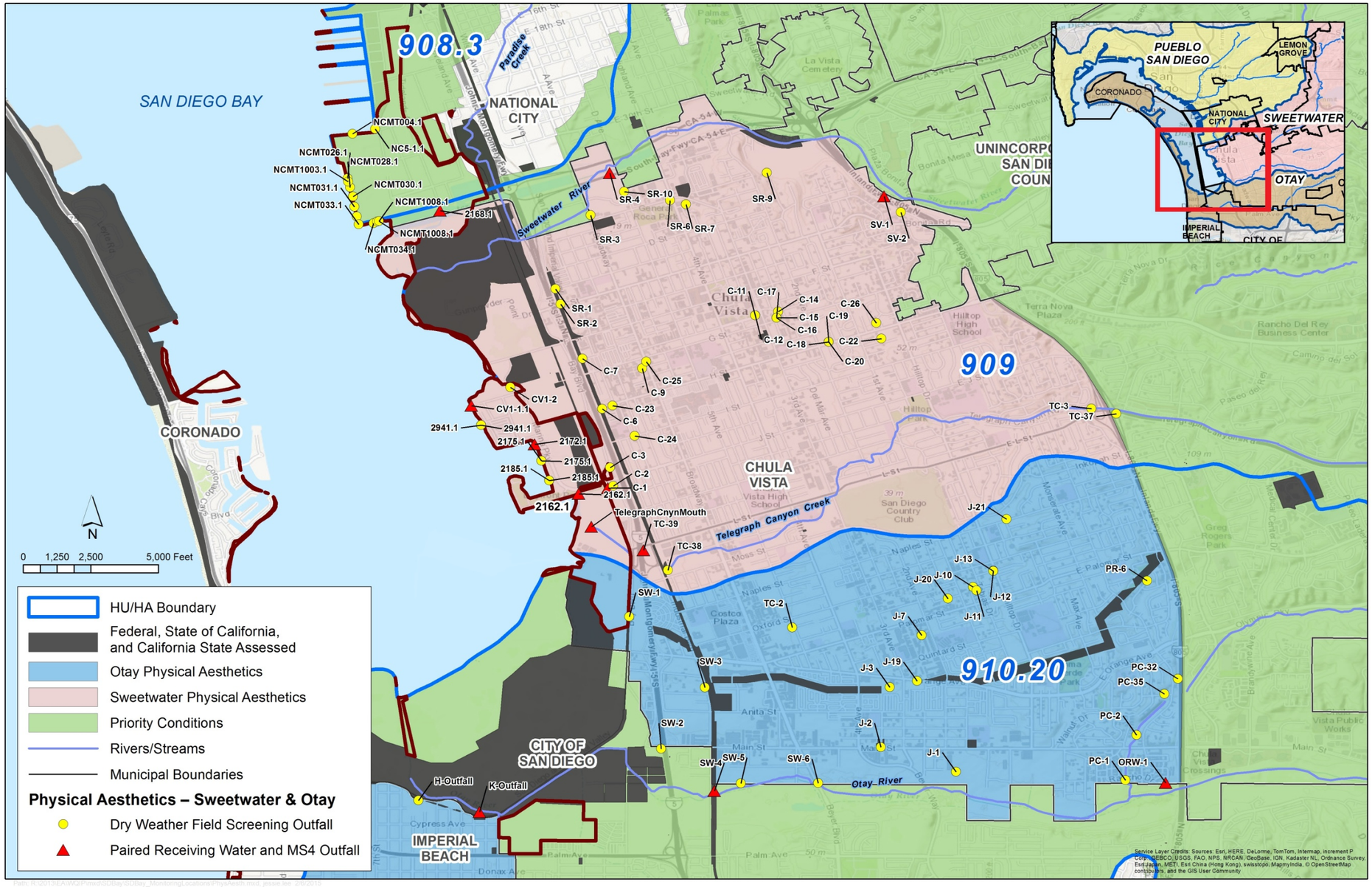
Many third-party groups, including San Diego Coastkeeper, I Love a Clean San Diego (ILACSD), and other volunteer agencies, conduct cleanup events and trash assessments in the San Diego Bay WMA. Information collected from these programs, where applicable and collected in accordance with a QAPP, may be used to augment data collected by the RPs.

Table 4-4 presents the RP monitoring requirements, frequency, and timing of physical aesthetics monitoring for the San Diego Bay WMA. Additional details are available in Appendix A. Figure 4-4 presents the locations of the monitoring sites.

Table 4-4
Physical Aesthetics (Trash) Monitoring

	Wet Weather Monitoring	Dry Weather Monitoring, Dry Season	Dry Weather Monitoring, Wet Season
RP Monitoring Approach	• Monitoring effort at 12 locations • Inspect predetermined transect of 2-25 feet (standard area) from major outfall MS4 sites. • Paired sampling – assess major outfall MS4 site when assessing receiving water	• Perform during regular MS4 inspections when possible • Inspect predetermined transect of 2-25 feet (standard area) away from major outfall MS4 sites. • Paired sampling – assess major outfall MS4 site when assessing receiving water	• Perform MS4 inspections at 12 locations • Inspect predetermined transect of 2-25 feet (standard area) away from major outfall MS4 sites. • Paired sampling – assess major outfall MS4 site when assessing receiving water
Frequency	• Annually inspect after one wet weather event during wet season at 12 locations	• Annual inspection at 12 locations	• Annual inspection at 12 locations
Timing of monitoring	• Sample within 72 hours of a storm	• During dry season (April 1st – October 31st)	• During dry periods, 72 hours or more after storm event

Figure 4-4
Physical Aesthetics – Sweetwater and Otay Monitoring Locations



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4.5 Otay Hydrologic Unit – Swimmable Waters

The following sites are monitored in HA 910.1 for bacteria indicators:

- One site is bay side: Tidelands Park, and
- Two sites are ocean side: North Beach and at IB Pier.

Monitoring are conducted each year as follows:

- Weekly during dry season (May to September)/dry weather (>72 hours with <0.1 in. of precipitation),
- Monthly during wet season (October to April)/dry weather (>72 hours with <0.1 in. of precipitation), and
- During three wet season (October to April)/wet weather (0.1 in. of precipitation within 48 hours and an antecedent dry period of >72 hours).

RPs will utilize existing monitoring conducted under the AB411 program to augment sample collection. Table 4-5 presents the RP monitoring approach, frequency, and timing of swimmable waters receiving water monitoring for the San Diego Bay WMA. A map of the monitoring locations is presented in Figure 4-5.

The Pacific Ocean shoreline of the Coronado HA 910.1 already has an established monitoring plan to assess the receiving water conditions through the South Bay Ocean Outfall Waste Discharge Requirements in Order R9-2014-0071 for the City of San Diego and Order R9-2014-0009 for the International Boundary and Water Commission. These permits establish a joint receiving water monitoring program for the South Bay Ocean Outfall and include weekly surf zone bacteria monitoring at 3 locations along the Coronado HSA 910.1. These locations include S12 Carnation Ave (Camp Surf), S8 Silver Strand State Beach, and S9 Avenida del Sol (Hotel del Coronado). In addition, the County of San Diego Department of Environmental Health performs AB 411 beach water quality monitoring from April 1 through October 31 for public health along the Pacific Ocean shoreline of the Coronado HSA 910.1. The existing beach water quality monitoring is sufficient to assess swimmable waters along the Pacific shoreline of the Coronado HSA 910.1 and the San Diego Bay WMA Copermittees utilize this data for the annual Water Quality Improvement Plan Monitoring and Assessment report.

Additional details are available in Appendix A.

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Figure 4-5
Swimmable Waters – Otay Monitoring Locations

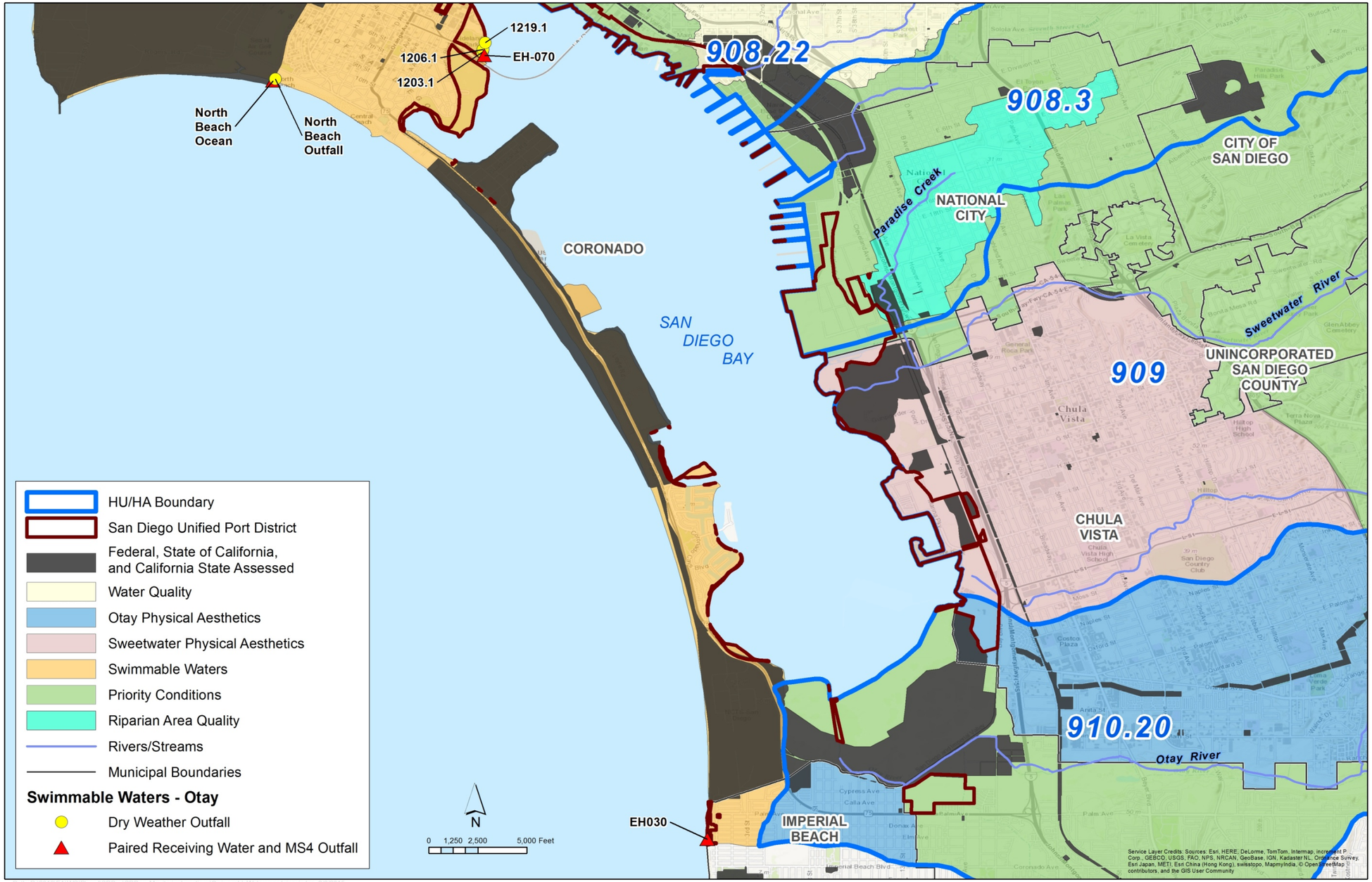

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Table 4-5
Swimmable Waters Receiving Water Monitoring

	Wet Weather Monitoring	Dry Weather Monitoring, Dry Season	Dry Weather Monitoring, Wet Season	MS4 Monitoring
RP Monitoring Approach	Monitor at Tidelands Park and North Beach sites	• Tidelands Park and South Bay Ocean Outfall* sites: Current DEH sites. (No additional monitoring to be done by RPs at these sites during this period) • North Beach: Past DEH site and City of Coronado's current transitional wet and dry monitoring location and dry weather MS4 major outfall monitoring location	• Expand DEH's dry weather monitoring to occur during the wet season. • Monitoring at Tidelands Park and North Beach sites • South Bay Ocean Outfall sites*: See note below table	Perform monitoring at all three sites
Frequency	Annually sample three wet weather events during wet season at Tidelands Park and North Beach sites	• Tidelands Park and South Bay Ocean Outfall* sites: Weekly • North Beach: Past DEH site and City of Coronado's current transitional wet and dry monitoring location and dry weather MS4 major outfall monitoring location	• Monthly at Tidelands Park and North Beach sites (November 1 – March 31) • South Bay Ocean Outfall sites*: See note below table	Inspect MS4 monthly, year round
Timing of monitoring	Sample within 72 hours of a storm (consistent with Bacteria I TMDL)	During dry season (April 1 – October 31)	During dry periods, 72 hours or more after storm event	Take sample at MS4 if there is flow/discharge

Note:
*South Bay Ocean Outfall Sites: Weekly surf zone bacteria monitoring at 3 location along the Coronado HSA 910.1. These locations include S12 Carnation Ave (Camp Surf), S8 Silver Strand State Beach, and S9 Avenida del Sol (Hotel del Coronado).

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5 Additional Monitoring Programs

Additional monitoring programs included in this section are additional TMDL monitoring programs that were not selected as the highest priority condition and Special Studies required under Municipal Permit Provision D.3.

5.1 TMDLs

The purpose of TMDL monitoring programs is to track progress toward achieving compliance with interim and final numeric targets. Compliance monitoring is designed to meet the receiving water monitoring requirements of the TMDL. TMDL provisions, schedules, and monitoring requirements are provided in Attachment E of the Municipal Permit. Compliance monitoring, including wet and dry weather sampling (as applicable), is conducted each year at the compliance monitoring locations located in the San Diego Bay WMA.

The following TMDLs are monitored in the San Diego Bay WMA as part of the Water Quality Improvement Plan:

- Highest Priority Conditions (See Section 4.1)
  - Revised Total Maximum Daily Loads for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (including Chollas Creek). Resolution No. R9-2010-0001 (Chollas Creek Bacteria TMDL);
  - Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay. Resolution No. R9-2007-0043 (Chollas Creek Metals TMDL);
- Additional TMDLs that require monitoring
  - Total Maximum Daily Load for Dissolved Copper in Shelter Island Yacht Basin, San Diego Bay. Resolution No. R9-2005-0019 (Shelter Island Copper TMDL), discussed in Section 5.1.1;
  - Total Maximum Daily Loads for Indicator Bacteria, Baby Beach in Dana Point Harbor and Shelter Island Shoreline Park (SISP) in San Diego Bay. Resolution No. R9-2002-0123 (Shelter Island Shoreline Park Bacteria TMDL or SISP Bacteria TMDL, discussed in Section 5.1.2); and
  - Total Maximum Daily Loads for Diazinon in Chollas Creek Watershed. Resolution No. R9-2002-0123. (Chollas Creek Diazinon TMDL, discussed in Section 5.2.3).

5.1.1 Shelter Island Copper TMDL

The Shelter Island Copper TMDL is intended to identify and implement actions to reduce dissolved copper loads discharging into the Shelter Island Yacht Basin. Final TMDL compliance requirements are intended to be protective of beneficial uses in the

San Diego Bay and Shelter Island Yacht Basin (SIYB). Figure 5-1 presents the MS4 Outfall monitoring locations.

Figure 5-1
Shelter Island Copper TMDL MS4 Monitoring Locations

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5.1.1.1 Receiving Water Monitoring

As stated in the "*Total Maximum Daily Load for Dissolved Copper in Shelter Island Yacht Basin, San Diego Technical Report*" (Regional Board, 2005), the primary source of copper loading to the SIYB was determined to be passive leaching from boats in the marinas and yacht clubs, and not from MS4 discharges. Receiving water stations are monitored under Investigative Order No. R9-2011-0036.

The receiving water will be monitored under Investigative Order No. R9-2011-0036 and reported in an annual report separate from the Water Quality Improvement Plan Annual Report.

5.1.1.2 Outfall Monitoring

The Shelter Island Copper TMDL is intended to identify and implement actions to reduce dissolved copper loads discharging into the Shelter Island Yacht Basin. The Shelter Island Copper TMDL requires outfall monitoring. Per Municipal Permit Attachment E.2,

> *"The Responsible Copermittee (City of San Diego) must monitor the effluent of its MS4 outfalls for dissolved copper, and calculate or estimate the monthly and annual dissolved copper loads, in accordance with the requirements of Provisions D.2, D.4.b.(1), and D.4.(b)(2)."*

Pollutograph samples are collected for copper during three storm events annually at the outfall stations provided in Table 5-1.

Table 5-1
Shelter Island Copper TMDL Outfall Monitoring Stations

Jurisdiction	Station Name	HA or HSA	Latitude	Longitude
City of San Diego	Outfall 1	908.10	32°42'57.71"N	117°14'7.80"W
City of San Diego	Outfall 2	908.10	32°43'14.89"N	117°13'55.80"W
City of San Diego	Outfall 3	908.10	32°43'11.69"N	117°13'45.22"W

Notes:
Stations in **boldface** font are monitored under the Outfall Monitoring discussed in Section 3.2.
HA = Hydrologic Area; HSA = Hydrologic Sub-Area

Flow monitoring also is conducted during wet weather at Outfall 2. Time-weighted composite samples are collected from Outfall 2 during three dry weather events. Tidal influence, jurisdictional boundaries, and lack of observed dry weather flows prevent the additional monitoring at Outfalls 1 and 3.

Figure 5-1 maps the monitoring locations. Additional Information is available in the Shelter Island Yacht Basin TMDL Monitoring Plan (Appendix D).

5.1.2 Shelter Island Shoreline Park Bacteria TMDL

The SISP Bacteria TMDL is intended to address levels of indicator bacteria at the shoreline of San Diego Bay at SISP. Final TMDL compliance requirements are intended to be protective of beneficial uses at SISP.

Analysis of bacteria monitoring results by the Port of San Diego is intended to assist with final TMDL compliance requirements and to provide support data for the removal of SISP from the 303(d) list. Receiving water monitoring is conducted weekly from April through October each year by the County of San Diego DEH under the AB411 program. Receiving water monitoring is conducted monthly by the Port of San Diego from November through March during dry weather. Three wet weather receiving water monitoring events are also conducted by the Port of San Diego. The Port analyzes the data to assess compliance with final TMDL compliance requirements and to assess trends.

In addition, monthly visual observation monitoring of outfalls within the vicinity of SISP beach is conducted during dry weather by the Port of San Diego. Outfall monitoring is conducted at low tide to identify unauthorized discharges of non-storm water to and from the MS4 that may impact receiving water quality. If non-storm water discharges are observed, samples are collected and analyzed to determine whether concentrations of indicator bacteria are elevated above water quality objectives.

Figure 5-2 maps the monitoring locations. Additional information is available in the SISP Bacteria TMDL Monitoring Plan (Appendix E).

5.2 Special Studies

Special studies, per Municipal Permit Provision D.3, are required in the San Diego Bay WMA and regionally. Special studies are selected to further investigate the Highest and Focused Priority Conditions and to meet requirements of Municipal Permit Provision D.3. The special studies include a regional special study and a special study specific to the San Diego Bay WMA, as well as additional studies applicable to the Focused Priority Conditions. RPs participating in the San Diego Bay WMA special studies are presented in Table 5-2.

Figure 5-2
Shelter Island Shoreline Park Monitoring Locations

Note: Figure leveraged from SISP Bacteria TMDL Monitoring Plan (Appendix E). Some nearby MS4 drains in the Shelter Island Shoreline Park are visually monitored for flow.

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Table 5-2
Overview of Special Studies

RP	Special Study				
	San Diego Regional Reference Streams and Beaches (Regional)	San Diego Bay Debris Study (WMA)	Pueblo-San Diego Hydrologic Unit: Creek Refuse Assessment Program (WMA)	Chollas Jurisdictional Boundary Study (WMA)	Riparian Area Special Study (WMA)
City of Chula Vista	✓	✓			✓
City of Coronado	✓	✓			✓
City of Imperial Beach	✓	✓			✓
City of La Mesa	✓	✓		✓	✓
City of Lemon Grove	✓	✓		✓	✓
City of National City	✓	✓			✓
Port of San Diego	✓	✓			✓
Airport Authority	✓	✓			✓
City of San Diego	✓	✓	✓	✓	✓
County of San Diego	✓	✓			✓

Note: RPs are required to participate in special studies, per Municipal Permit Provision D.3, in the San Diego Bay WMA and regionally.

5.2.1 San Diego Regional Reference Streams and Beaches Studies (Regional Scale)

The San Diego Regional Reference Stream Study serves as the regional special study for the San Diego Bay WMA. The study is currently being conducted by the San Diego and Orange County Copermittees and fulfills the regional special study requirement in Municipal Permit Provision D.3.(a). The goal of this project is to collect the data necessary to derive reasonable and accurate numeric targets for bacteria, nutrients, and heavy metals by referencing natural, local conditions. The study develops numeric targets that account for natural sources to establish the concentrations or loads from streams in a minimally disturbed or reference condition. This study provides a scientific basis for evaluating bacteria compliance levels in the Bacteria TMDL. The results of this study are used to support the forthcoming reopener of the recently adopted Bacteria TMDL and to support numeric targets in future TMDLs for bacteria, nutrients, and metals.

The San Diego Regional Stream Reference Study addresses the following questions (Southern California Coastal Water Research Project [SCCWRP], 2013):

- How does the Water Quality Objective (WQO) attainment vary between summer dry weather, winter dry weather, and wet weather?
- How does the WQO exceedance frequency vary by hydrologic factors, including:
  - Size of storm (wet weather only)?
  - Discharge flow rate and volume (wet and dry weather)?
  - Beginning versus end of storm season (wet weather only)?
- How does the WQO exceedance frequency vary by input factors such as:
  - Size of catchment?
  - Geology?
- How does the WQO exceedance frequency vary by biotic and abiotic factors, including:
  - Algal cover and/or biofilms?
  - Water quality (temperature, pH, conductivity, dissolved oxygen, total suspended solids concentration)?

A total of 6 locations have been selected for wet weather monitoring and up to 10 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.

5.2.2 Trash – San Diego Bay Debris Special Study (WMA Scale)

The San Diego Bay Debris Study is a comprehensive bay-wide study being conducted by SCCWRP to help managers understand the current extent and magnitude of plastic-based debris accumulation and takes into account seasonal changes to better understand the plastic debris conditions throughout San Diego Bay and its upland contributing areas. The intent of the San Diego Bay Debris Study is to quantify the abundance and amount of plastic debris in a variety of bay habitats, including:

- Open water areas throughout the bay from the north to south side of the bay;
- Enclosed area such as ports and marinas;

- Intertidal areas, including mudflats, salt marshes, sandy beaches, and the protective rip-rap shoring; and
- Upland areas in the contributing riverine habitats.

The San Diego Bay Debris Study is a multi-agency project conducted by the SCCWRP that is being leveraged in coordination with several ongoing studies, including the Regional Harbor Monitoring Program, Shallow Water Habitat Bioaccumulation Study, the Bight '13 Debris Survey, the Stormwater Monitoring Coalition Regional Watershed Monitoring Program. The study is being supported through in-kind services, project-directed contributions from stakeholders, and participation by local volunteers who all have an interest in better understanding trash issues in San Diego Bay and its contributing watersheds.

The goal of the San Diego Bay Debris Study is to develop a baseline trash assessment of the bay habitats that includes identifying the most abundant type of plastic items, evaluating where the plastic accumulates in greatest quantities, evaluating plastic items that are preferentially transported to the bay during wet weather conditions, and whether the plastics that reach the open waters of the bay affect fish communities. The general approach adopted for the San Diego Bay Debris Study follows the question-driven approach of the San Diego Region Framework for Monitoring and Assessment. Standard metrics for quantitative and qualitative assessment of trash were identified as part of the study, the anticipated transport mechanism, and potential original source. Standard field assessment methodologies are also established for consistency.

Members of the San Diego Bay Debris Study Work Group are also actively involved in outreach programs directed toward helping disadvantaged communities understand the importance of reducing trash in the environment. Through funding provided by the National Science Foundation, members of the Work Group, along with middle school and high school aged volunteer students, are contributing their time and effort to help collect data for this study..

5.2.3 Trash – Pueblo San Diego Hydrologic Unit: Creek Refuse Assessment Program Special Study (WMA Scale)

The City of San Diego is conducting a special study to improve identification of trash sources in the Chollas Creek and Paleta Creek watersheds with the intent of guiding future watershed planning efforts and implementing cost-effective best management practices (BMPs) to reduce trash (San Diego Bay Debris Study Workgroup, 2014). The special study comprises a two-tiered approach to identify sources, locate areas that disproportionately accumulated trash, and assess whether watershed locations are showing reductions in trash over time. The first stage of the special study includes a comprehensive and detailed technical evaluation of the existing storm drain based Creek Refuse Assessment Program trash data collected from 2007 to 2013. The second stage of the special study includes a comprehensive assessment of the north and south forks of Chollas Creek to locate areas that disproportionately accumulate trash and identify additional sources.

The goals of the special study are intended to:

- Identify high-priority sites that accumulate trash disproportionately.
- Prioritize management efforts to target the sources and land uses that generate the most trash.
- Communicate the successes of the ongoing assessment program and focus management planning on the remaining high-priority areas.

5.2.4 Chollas – Jurisdictional Boundary Study (WMA Scale)

The purpose of this special study is to acquire additional data to support TMDL water quality monitoring data in the lower drainages of Chollas Creek for diazinon (per the Chollas Creek Diazinon TMDL), dissolved metals (Chollas Creek Metals TMDL), and Bacteria (Chollas Creek Bacterial TMDL) TMDL compliance programs (State Water Quality Control Board [State Board] Resolution No. R9-2004-0277, Resolution No. R9-2007-004, and Resolution No. R9-2010-0001, respectively). Water quality monitoring is conducted in the north and south forks of Chollas Creek to determine whether a potential pollutant source area can be identified. The data are also used to evaluate and compare the upper drainage area (special study jurisdictional boundaries) with the lower drainage area (compliance MLSs).

As part of the Chollas Creek Comprehensive Load Reduction Plan (CLRP), the Chollas Creek Jurisdictional Boundary Study is an ongoing special study conducted in the two upper-fork drainages of the Chollas Creek HSA near the jurisdictional boundaries of the Cities of San Diego and La Mesa and Cities of San Diego and Lemon Grove. For dissolved metals (copper, lead, and zinc), flow-weighted composite samples and grab samples are collected during two storm events annually. Monitoring is conducted at the downstream jurisdictional boundaries of the City of La Mesa (LM-1) and the City of Lemon Grove (LG-1). Continuous flow data are also collected throughout the wet season. Water quality samples are analyzed for toxicity and dissolved metals, in addition to other constituents, such as diazinon and indicator bacteria. Analytical results are compared with applicable water quality criteria set forth in the approved TMDLs for the Chollas Creek HSA, pesticide criteria of the California Department of Fish and Wildlife and the United States Environmental Protection Agency (USEPA) Office of Pesticide Programs (OPP) Aquatic Life Benchmarks. The Jurisdictional Boundary Study is anticipating completion of data collection during 2014.

5.2.5 Riparian Area (WMA Scale)

Paradise Creek is listed on the 2010 Clean Water Act (CWA) 303(d) list of impaired water bodies with a selenium impairment. The Surface Water Ambient Monitoring Program (SWAMP) data collected in 2005 and 2006 indicated that selenium results exceeded the WQO of 5 micrograms per liter (µg/L) in four of four samples. Beneficial uses of Paradise Creek include warm freshwater habitat, wildlife habitat, and non-contact water recreation. Elevated selenium levels pose a threat to warm freshwater habitat. While no TMDL has been established for Paradise Creek, this water body is of

great importance to the City of National City because it runs through the center of the city, directly through Kimball Park at City Hall. Paradise Creek is one of the few urban creeks within the Pueblo San Diego Watershed that has not been completely channelized or undergrounded. Paradise Creek is also a tributary to Paradise Marsh, which is part of the Sweetwater Marsh National Wildlife Refuge.

The objective of Paradise Creek selenium monitoring is to collect additional selenium data in the portion of the creek adjacent to Kimball Park within National City that would support the removal of the selenium 303(d) listing in the future.

The sites selected for monitoring are presented in Table 5-3.

Table 5-3
Paradise Creek Monitoring Locations

Site	Location	Latitude	Longitude
KP-2	Paradise Creek, adjacent to Kimball Park, east of footbridge (approximately 175 feet), within depressed area of channel	32.67036	-117.10223
KP-2.1	Paradise Creek, adjacent to Kimball Park, upstream of Site KP-2	32.67068	-117.10220
KP-2.2	Paradise Creek, adjacent to Kimball Park, upstream of Site KP-2.1	32.66963	-117.10275
KP-3	Paradise Creek, adjacent to Kimball Park, approximately 125 feet west of D Ave parking lot	32.67128	-117.10172
KP-4	Paradise Creek, adjacent to Kimball Park, just downstream of three outlet pipes/culvert (upstream-most point of creek segment)	32.67146	-117.10133

Approximately 50 grab samples were collected by field personnel between January and June 2014, during dry and wet weather, to represent various conditions of the creek. Because four samples collected from Paradise Creek have exceeded the WQO in the past, at least 48 samples must have selenium values below the WQO to remove the Paradise Creek from the 303(d) list, according to the Regional Board's Water Quality Control Policy for Developing California's CWA Section 303(d) list.

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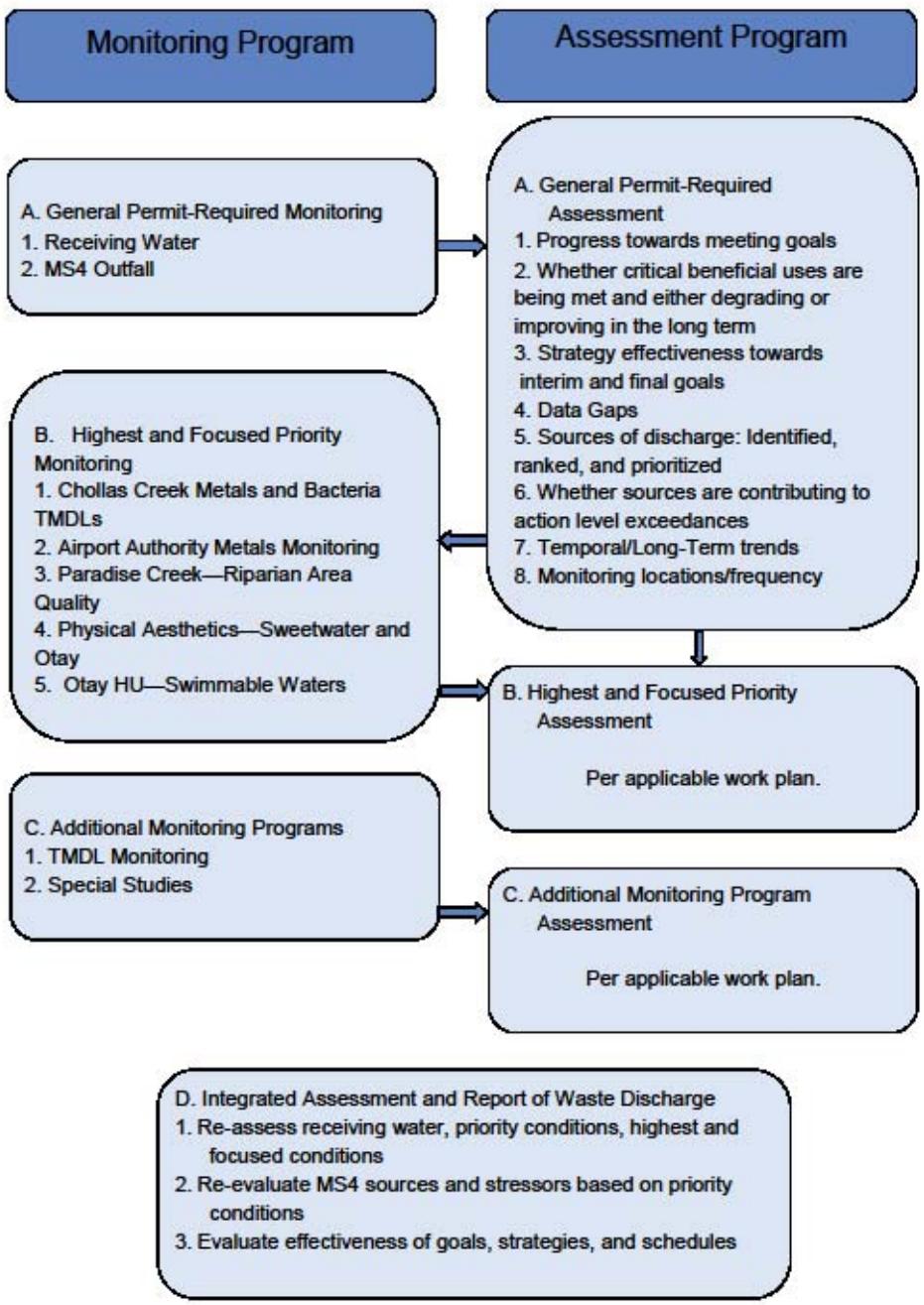
6 Assessment Process and Approach

The assessment portion of the Monitoring and Assessment Program evaluates the data collected under the monitoring programs described in Sections 3 through 5, as well as the information collected as part of the JRMP. The data collected from these programs are used to assess the progress toward achieving the Water Quality Improvement Plan numeric goals and schedules and to measure the progress toward addressing the Highest and Focused Priority Conditions. Programmatic assessment includes:

- General permit-required assessment (assessment requirements prescribed in Provision D of the Municipal Permit),
- Highest and Focused Priority Condition assessment (analysis intended to inform programs and assess progress toward the goals outlined in the Water Quality Improvement Plan Second Interim Deliverable),
- Additional assessment (assessments toward achieving the Waste Load Allocations (WLAs) outlined in applicable TMDLs, where the TMDL is not a Highest or Focused Priority Condition, and special studies assessments); and
- An integrated assessment (an assessment incorporating data collected from the assessments above, requirements as part of the JRMP program(s) under Provision E of the Municipal Permit, and additional regional assessment requirements required under Provision F of the Municipal Permit).

Figure 6-1 below presents an overview of the general approach for assessment of monitoring data.

Figure 6-1
Monitoring and Assessment Approach



7 General Permit-Required Assessment

The Municipal Permit includes general assessment requirements unrelated to Responsible Parties' selected highest and focused priority conditions. General permit-required assessment is applicable to all Copermittees, regardless of watershed or effective TMDLs. General permit-required assessment requirements applicable to the San Diego Bay WMA include:

- Receiving water assessments; and
- MS4 outfall discharge assessments.

7.1 Receiving Water Assessment

The receiving water data collected as part of this monitoring and assessment plan will be assessed in the Report of Waste Discharge. The assessment of receiving waters involves evaluating the physical, chemical, and biological conditions of the receiving waters and sediments. The RPs must assess the status and trends of receiving water quality conditions in coastal waters, enclosed bays, harbors, estuaries, and streams in the San Diego Bay WMA. This includes a review of the following common elements as appropriate for that reporting year, including receiving water monitoring data, Jurisdictional Runoff Management Program data, and other available data.

Prior to completing the assessments, each RP must compile available relevant receiving water and jurisdictional program data, as applicable, in regionally consistent formats to complete the non-storm water discharges reduction assessments including, but not limited to, the following:

Monitoring and Assessment Program Data (Watershed, Regional, and Jurisdictional)

- Wet and dry weather chemical, biological, and physical data collected under Long-term receiving water, regional monitoring, and sediment monitoring programs
- Other available and relevant wet and dry weather data at receiving water locations collected under programs such as TMDL or Special studies
- Relevant historical wet and dry weather data at receiving water locations
- Follow up field investigations of source(s) of flow based on receiving water observations and field screening (IDDE)
- Reports or notifications of illicit discharges, illicit connections, or other sources of non-storm water from hotlines or other sources
- Results of Toxicity Identification Evaluations (TIEs) or Toxicity Reduction Evaluations (TREs), if applicable

Jurisdictional Runoff Mangement Program Data (Jurisdictional)

- Reports or notifications of illicit discharges, illicit connections, or other sources of non-storm water from hotlines or other sources
- Follow up field investigations of source of flow based on complaints or inspection results
- Review of inventories or land use data
- Construction, Commercial, Industrial, Municipal, and Residential Inspections
- Outreach Programs
- Relevant historical records
- Capital Improvement Projects (CIPs)
- Results of Enforcement Response, based on Enforcement Response Plans
- Review of inventories or land use data
- Green infrastructure
- Multiuse treatment areas
- Water quality improvement BMPs
- New Jurisdictional Ordinances

Other Relevant Information

- New regulations or policies
- Basin Plan Amendments
- Publicly available data
- Scientific studies conducted by outside agencies

Once each RP's jurisdictional data is compiled in regional formats, data will be compiled for the San Diego Bay WMA for a watershed assessment. Table 7-1 presents the minimum elements to be included in the receiving water quality assessment per Provision D.4.a(2), example evaluation process and suggested output for each element.

Table 7-1
Receiving Water Assessment Evaluation Process and Suggested Outputs

Receiving Water Assessments per Provision D.4.a(2)	Example Process of Evaluation	Suggested Output(s)
Assessment 1: Determine whether or not the conditions of the receiving waters are meeting the numeric goals established Pursuant to Provision B.3.a D.4.a(2)(a)	1. Compare water quality data from TMDL compliance locations collected from current and past monitoring years to TMDL interim and final numeric goals 2. Compare MLS data to previous years	Categorize goals as met, partially met, or currently not met, or alternative categories more specific to the relevant goal(s)
Assessment 2: Identify the most critical beneficial uses that must be protected to promote the overall health of the receiving water D.4.a(2)(b)	1. Use multiple lines of evidence prioritization methodology from applicable Water Quality Improvement Plan section to evaluate current state of receiving water quality conditions using more recent and updated data, including: a. Compare water quality data from receiving water locations collected from current and past monitoring years to water quality benchmarks. b. Consider publicly available data c. Consider current regulatory drivers d. Evaluate MS4 contribution.	Status of and potential changes to Priority Conditions, High Priority Conditions, and Focused Priority Conditions

Table 7-1 (continued)
Receiving Water Assessment Evaluation Process and Suggested Outputs

Receiving Water Assessments per Provision D.4.a(2)	Example Process of Evaluation	Suggested Output(s)
Assessment 3: Evaluate whether or not the critical beneficial uses from Assessment 2 are being protected D.4.a(2)(c)	1. For Priority Water Quality Conditions and High Priority Water Quality Conditions, compare current and historical data to water quality benchmarks and calculate a frequency of exceedances. (completed as part of Assessment 2. Evaluate seasonal or temporal patterns in available water quality and flow data to determine when those critical beneficial uses are supported or impaired.	Categorize Priority Conditions, High Priority Conditions, and Focused Priority Conditions as protected, likely protected, possibly impacted, likely impacted, or clearly impacted, or alternative categories depending on type of beneficial use.
Assessment 4: Identify short-term or long-term improvements or degradation of those critical beneficial uses D.4.a(2)(d)	1. Compare current and historical data to water quality benchmarks. 2. Calculate a frequency of exceedances for each monitoring year.	Statistical analysis of trends and recommended programmatic changes or enhancements
Assessment 5: Identify data gaps in the monitoring data needed to assess the provisions above D.4.a(2)(e)	1. Review assessment methodology and determine additional data needed to improve evaluation and better characterize general health of beneficial uses.	List of potential modifications to the monitoring, Jurisdictional Runoff Management Plan activities, or strategies

Note:
Regional formats, data evaluation processes, and suggested outputs are provided as an example only and are subject to change based on program refinements and lessons learned from implementation of program elements as part of the adaptive management process.

7.2 MS4 Outfall Discharge Assessments

The second assessment to be presented in the Water Quality Improvement Plan Annual Report is the review of the MS4 outfall discharge assessments. This includes evaluating the dry weather field screening, wet and dry weather outfall monitoring data, and data collected under the Jurisdictional Runoff Management Program Illicit Discharge Detection and Elimination (IDDE) program. Details of these separate assessments are provided below. RPs will assess their MS4 monitoring programs individually and on a

watershed-wide basis annually as part of the San Diego Bay WMA Water Quality Improvement Plan Annual Report.

7.2.1 Dry Weather Outfall Assessments / Illicit Discharges

In addition to dry weather outfall field screening and monitoring, each RP must assess and report the progress of its IDDE program (required pursuant to Municipal Permit Provision E.2) toward effectively prohibiting non-storm water and illicit discharges into the MS4s within its jurisdiction. Prior to completing the assessments, each jurisdiction must compile available relevant data, as applicable, in a regionally consistent format to complete the non-storm water discharge reduction assessment including, but not limited to, the following:

Monitoring Data:

- Field screening visual observations in per Provision D.2.a(1)
- Non-storm water monitoring including water quality, observations, field measurements, and flow estimates per Provision D.2.a(2)
- Relevant historical dry weather data
- Reports or notifications of illicit discharges, illicit connections, or other sources of non-storm water from hotlines or other sources
- Follow up field investigations of source of flow
- Review of MS4 outfall inventories, drainage areas, or changes in land use

JRMP Data:

- Reports or notifications of illicit discharges, illicit connections, or other sources of non-storm water from hotlines or other sources
- Follow up field investigations of source of flow or pollutants
- Review of MS4 outfall inventories, drainage areas, or changes in land use
- Construction, Commercial, Industrial, Municipal, and Residential Inspections
- Enforcement Response actions, per the applicable Enforcement Response Plans
- Outreach Programs
- Relevant historical records
- Localized or Regional Structural BMPs contributing to discharge reductions, as applicable

Table 7-2 presents the minimum elements to be included in the non-storm water pollutant discharges reduction assessment per Provision D.4.b(1), example evaluation process and suggested output for each element.

Table 7-2
Dry Weather MS4 Outfall Assessment Evaluation Process and Suggested Outputs

Non-storm Water Assessments per Provision D.4.b(1)	Example Process of Evaluation	Suggested Output(s)
D.4.b(1)(c)(i)/ D.4.b(1)(b) Assessment 1: Progress toward effectively prohibiting non-storm water and illicit discharges into the MS4 within each jurisdiction	1. Categorize flows as dry, persistent, transient, or undetermined based on historic and current field screening data 2. For transient and persistent flows, identify the known and suspected controllable sources, as feasible, and which sources were reduced or eliminated 3. Based on two previous steps, evaluate any modifications to field screening locations or frequency necessary to identify and eliminate sources of persistent flows. Reprioritization of outfalls may occur if one of the following conditions is met: a. Non-storm water discharges have been effectively eliminated for three consecutive monitoring events or b. Source(s)s of the persistent flows have been identified as not an illicit or a source of pollutants or c. Pollutants in the persistent flow do not exceed NALs or d. The threat to water quality has been reduced by the RP	Number of sources reduced and eliminated Updated MS4 outfall inventory to reflect current flow status, outfalls removed or added from field screening program List of programmatic modifications.

Table 7-2 (continued)
Dry Weather MS4 Outfall Assessment Evaluation Process and Suggested Outputs

Non-storm Water Assessments per Provision D.4.b(1)	Example Process of Evaluation	Suggested Output(s)
Assessment 2: Rank and prioritize MS4 outfalls D.4.b(1)(c)(ii)	1. Assess threat to receiving water quality from major MS4 outfalls based on available water quality data. Compare dry weather water quality data to relevant NALs, Highest and Focused Priorities (water quality objectives, 303(d) List or ESAs), and discharge prohibitions, as applicable 2. Identify pollutants from sources or land uses known to exist within the area, drainage basin, or watershed that discharges to the portion of MS4 within its jurisdiction 3. Rank MS4 outfalls according to threat to water quality using the metrics established under the transitional monitoring program	Revised prioritized list of major MS4 outfalls List of modifications to major MS4 outfalls monitored under Provision D.2.b Revised prioritization metrics, as applicable
Assessment 3: Identify known and suspected sources contributing to numeric action limit exceedances at highest-ranked MS4 outfalls D.4.b(1)(c)(iii)	1. Compare dry weather water quality data from major outfalls to relevant NALs (completed in Assessment 2) 2. For those exceeding NALs, use visual observation, inspection data, land use data, complaints, and other reports to identify potential sources in the outfall drainage area.	List of known and suspected sources for each highest-ranked MS4 outfall Summary of NAL exceedances per HU, and applicable follow-up actions List of follow up actions and whether those actions have resulted in lower pollutant concentrations or identification of confirmed or suspected sources, if data are available Revise internal follow-up procedures, as necessary, to increase effectiveness of follow-up actions as part of adaptive management.

Table 7-2 (continued)
Dry Weather MS4 Outfall Assessment Evaluation Process and Suggested Outputs

Non-storm Water Assessments per Provision D.4.b(1)	Example Process of Evaluation	Suggested Output(s)
Assessment 4: Estimate volumes and loads of non-storm water discharges D.4.b(1)(c)(iv)	1. Compile dry weather water quality and flow data from major MS4 outfalls with persistent flow per jurisdiction. 2. Annual rainfall data representative of the watershed to define wet versus dry days for the monitored year. 3. Calculate or estimate annual non-storm water volume and pollutant loads collectively discharged from each jurisdiction's major MS4 outfalls to receiving waters 4. Estimate the percent contribution from each known source for each MS4 outfall (as identified in Assessment 3). 5. Calculate or estimate annual non-storm water volume and pollutant loads collectively discharged from non-storm water not subject to the Copermittee's legal authority	Total estimated volume or load of non-storm water discharges per jurisdiction and by HU
D.4.b(1)(c)(vi) Assessment 5: Identify data gaps	1. Review assessment methodology and determine additional data needed to improve evaluation and identify and eliminate non-storm water discharges.	List of potential modifications to the monitoring, Jurisdictional Runoff Management Program activities, or strategies

Note:
Regional formats, data evaluation processes, and suggested outputs are provided as an example only and are subject to change based on program refinements and lessons learned from implementation of program elements as part of the adaptive management process.

7.2.2 Wet Weather Outfall Assessments / Illicit Discharges

The RPs must assess and report the progress of the water quality improvement strategies implemented as part of the Water Quality Improvement Plan and the Jurisdictional Runoff Management Program toward reducing pollutants in storm water discharges from the MS4s. This is designated as the Wet Weather MS4 Outfall Discharge Monitoring Program.

Table 7-3 presents the minimum elements to be included in storm water pollutant discharges reduction assessment per Provision D.4.b(2), example process and suggested outcome for each element.

Prior to completing the assessments, each RP must compile available relevant data, as applicable, in a regionally consistent format to complete the storm water discharge reduction assessments including, but not limited to, the following:

Monitoring Data:	JRMP Data:
• Storm water monitoring including water quality, observations, field measurements, and flow estimates per Provisions D.2.a(3) and D.2.c • Land use data • Reports or notifications of illicit discharges, illicit connections, or other sources of non-storm water from hotlines or other sources • Follow up field investigations of source of flow • Annual WMA rainfall data, if not collected	• Reports or notifications of illicit discharges, illicit connections, or other sources of non-storm water from hotlines or other sources • Follow up field investigations of source of flow • Review of inventories or land use data • Construction, Commercial, Industrial Municipal, and Residential Inspections • Outreach Programs

Table 7-3 presents the minimum elements to be included in the storm water pollutant discharge reduction assessment per Provision D.4.b(2), example evaluation process and suggested output for each element.

Table 7-3
Wet Weather MS4 Outfall Assessment Evaluation Process and Suggested Outputs

Storm Water Assessments per Provision D.4.b(2)	Example Process of Evaluation	Suggested Output(s)
Assessment 1: Estimate volumes and loads of storm water discharges D.4.b(2)(b)/ D.4.b(2)(c)(i)	1. Compile wet weather water quality and flow data from monitored outfalls for the monitoring year. 2. Use annual rainfall data representative of the watershed to define wet versus dry days for the monitored year. 3. Calculate or estimate annual non-storm water volume and pollutant loads collectively discharged from each jurisdiction's monitored MS4 outfalls to receiving waters 4. Estimate the percent contribution from each land use type within each hydrologic subarea. 5. Evaluate modifications to wet weather MS4 monitoring locations or frequency necessary to identify pollutants in storm water discharges in the WMA	Total estimated volume or load of non-storm water discharges per jurisdiction and for the San Diego Bay WMA
D.4.b(2)(c)(ii) Assessment 2: Identify known and suspected sources contributing to SAL exceedances at highest-ranked MS4 outfalls	1. Compare wet weather water quality data from major outfalls to relevant SALs 2. For those exceeding SALs, use visual observation, inspection data, land use data, reports to identify potential sources in the outfall drainage area 3. Re-evaluate strategies and update other assumptions under the adaptive management approach	Summary of SAL exceedances per HU, and applicable follow-up actions List of known and suspected wet weather point sources for each highest-ranked MS4 outfall, as applicable List of follow up actions and whether those actions have resulted in lower pollutant concentrations or identification of confirmed or suspected sources, if data are available Revise internal follow-up procedures, as necessary, to increase effectiveness of follow-up actions as part of adaptive management.

Table 7-3 (continued)
Wet Weather MS4 Outfall Assessment Evaluation Process and Suggested Outputs

Storm Water Assessments per Provision D.4.b(2)	Example Process of Evaluation	Suggested Output(s)
D.4.b(1)(c)(vi) Assessment 5: Identify data gaps	1. Review assessment methodology and determine additional data needed to improve evaluation and identify and eliminate non-storm water discharges.	List of potential modifications to the monitoring, Jurisdictional Runoff Management Program activities and response actions, or strategies

7.2.3 ROWD Assessment Process

Table 7-4 presents the ROWD Assessment process.

Table 7-4
ROWD Assessment

ROWD Assessments (once per permit term)		Example Process of Evaluation	Suggested Output(s)
Non-storm water Assessments	Assessment 1: Identification of reductions and progress in achieving reduction in non-storm water and illicit discharges in the WMA D.4.b(1)(c)(v)[a]	1. Compile number of sources non-storm water and illicit discharges reduced and eliminated by all jurisdictions in the WMA over the permit term. 2. Assess progress by comparing to previous permit terms.	% increase or decrease in number of sources reduced or abated for the entire WMA this permit term
	Assessment 2: Assess effectiveness of strategies toward reducing or eliminating non-storm water and pollutant loads from the MS4 to receiving waters by Jurisdiction D.4.b(1)(c)(v)[b]	1. Compare data from pre- and post- project or focused area to evaluate potential effects of enhanced Water Quality Improvement Plan strategies, as available 2. If possible, estimate the pollutant load reduction attributable to specific water quality strategies.	Summary of pre-project (baseline) data and post-project data Summary of load reductions per jurisdiction by HU for highest and focused priorities List of strategies that may support pollutant load reductions and those that don't, based on data collected
	Assessment 3: Identify modifications necessary to increase the effectiveness of strategies toward reducing or eliminating non-storm water and pollutant loads from the MS4 to receiving waters by Jurisdiction D.4.b(1)(c)(v)[c]	1. Review assessment methodology and determine additional data needed to improve evaluation and identify and eliminate non-storm water discharges.	List of potential modifications to the Monitoring and Assessment Program, Jurisdictional Runoff Management Program activities, or strategies Recommendations for programmatic adjustments of strategies and schedules

Table 7-4 (continued)
ROWD Assessment

ROWD Assessments (once per permit term)		Example Process of Evaluation	Suggested Output(s)
Storm Water Assessments	Assessment 1: Identification of reductions and progress in achieving pollutant load reductions from different land uses in the WMA D.4.b(2)(c)(iii)[a]	1. Compile total estimated volume or load of non-storm water discharges by drainage area, land use, or other relevant assessment metric for the WMA over the permit term 2. Assess progress by comparing pollutant loads by land use over a period of three years to determine short-term trends over the five years of implementation.	% allocation of volume or load based on % of land use per HU and by WMA Trend analysis, if sufficient data points are available, based on % allocation of volume or load
	Assessment 2: Identify modifications necessary to increase the effectiveness of strategies toward reducing or eliminating storm water and pollutant loads from the MS4 to receiving waters in the WMA to the MEP D.4.b(2)(c)(iii)[b]	1. Compare data from pre-post project or focused area to control area in order to evaluate potential effects of enhanced Water Quality Improvement Plan strategies. 2. If possible, estimate the pollutant load reduction attributable to specific water quality strategies.	Summary of pre-project (baseline) data and post-project data Summary of load reductions per jurisdiction by HU for highest and focused priorities List of strategies that may support pollutant load reductions and those that don't, based on data collected
	Assessment 2: Identify modifications necessary to increase the effectiveness of strategies toward reducing or eliminating non-storm water and pollutant loads from the MS4 to receiving waters by Jurisdiction D.4.b(2)(c)(iii)[c]	1. Review assessment methodology and determine additional data needed to improve evaluation and identify and eliminate non-storm water discharges.	List of potential modifications to the monitoring, Jurisdictional Runoff Management Program activities, or strategies Recommendations for programmatic adjustments of strategies and schedules

8 Highest and Focused Priority Conditions Assessment

The assessment of additional receiving water and MS4 outfall monitoring data provides an indication of whether the goals associated with Highest and Focused Priority Conditions are being met. Additional monitoring includes:

- Assessment of water quality (metals and bacteria) in Chollas Creek;
- Evaluation of metals at the San Diego International Airport;
- Characterization of riparian area quality in Paradise Creek, via CRAM;
- Assessment of physical aesthetics in the Sweetwater HU and Otay HU via trash monitoring; and
- Assessment of swimmable waters in the Otay HU via bacteria monitoring.

Highest and Focused Priorities have individual assessment metrics, depending on the strategies, that are evaluated in the integrated assessment at the end of the permit term. Additional information is available in Section 10.1.

Standard assessment methods as prescribed by the CRAM and Trash Assessment Methodologies also will be used to provide a scientifically based assessment of the quantitative and qualitative data collected. The assessment of the CRAM data includes a review of the riparian buffer zone, local hydrology, physical structure, and biotic structure. The evaluation of the physical aesthetics is based on trash assessment data, and includes characterization of trash-generating areas based on land use, source identification and prioritization based on the amount and type of trash, identification of persistent pathways where trash enters creeks, and recommendations for management efforts targeted to reduce trash. The assessment of swimmable waters in the Otay HU includes the comparison of bacteria data with the appropriate water quality objectives and the beach score card metrics that are currently under development.

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9 Additional Program Assessment

9.1 TMDL Assessment

TMDL monitoring data for the five TMDLs in the San Diego Bay WMA continue to be evaluated under separate TMDL annual reports because different RPs are involved with different TMDLs. Each TMDL has its own specific assessment requirements that are detailed in the appropriate monitoring plan or Quality Assurance Project Plan.

The annual reporting schedule for the TMDLs is to be modified as needed to allow for the incorporation of the TMDL annual reports into the Water Quality Improvement Plan Annual Report. A summary of the TMDLs is incorporated into the main body of the Water Quality Improvement Plan Annual Report. The results of the TMDL monitoring are used where appropriate to assess the progress toward achievement of goals and to determine whether the critical beneficial uses are being protected. Over time, the data collected as part of the TMDL monitoring programs are analyzed to determine whether the strategies established by the Water Quality Improvement Plan are contributing to the achievement of goals. This analysis requires a number of years of data to see the impact of the Water Quality Improvement Plan strategies.

9.2 Special Studies Assessments

As part of the Water Quality Improvement Plan Annual Report, the San Diego Bay WMA RPs evaluate the results and findings from the special studies described in Appendix A. They use the resulting data to (1) assess their relevance to the RPs' characterization of receiving water conditions, (2) understand sources of pollutants and/or stressors, and (3) control and reduce the discharges of pollutants from the MS4 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 Water Quality Improvement Plan.

The San Diego Bay WMA special studies attempt to answer questions concerning the natural reference concentration of bacteria and other pollutants in the region, analyze area trash levels and jurisdictional loads in relation to the highest priority and perform stream bioassessment using the CRAM method, and evaluate selenium concentrations in the San Diego Bay WMA. The special studies help guide the implementation of the strategies for the Highest and Focused Priority Conditions. Each special study has its own assessment methods and metrics.

Future special studies related to BMP effectiveness that are implemented by the RPs in the San Diego Bay WMA are included in this assessment. RPs may select to report the results of BMP effectiveness studies that are being performed in other WMAs if they relate to the Highest or Focused Priority Conditions and if results are expected to be transferrable to strategies planned for the San Diego Bay WMA.

9.2.1 San Diego Regional Reference Streams and Beaches Studies

The Regional Reference Stream and Beach Studies are currently ongoing. The assessment of the study data helps to determine concentration or loads from minimally disturbed conditions. The information provides the basis for reasonable numeric targets that are appropriate for the San Diego region. When the results from this study are finalized and published, they will be incorporated into the Annual Water Quality Improvement Plan Annual Report as well as the Report of Waste Discharge. The reference area information provides a foundation for the analysis of regional beneficial use attainment.

9.2.2 Trash – San Diego Bay Debris Special Study

The goal of the San Diego Bay Debris Study is to develop a baseline trash assessment of the bay habitats that includes identifying the most abundant type of plastic items, evaluating where the plastic accumulates in greatest quantities, evaluating plastic items that are preferentially transported to the bay during wet weather conditions, and determining whether the plastics that reach the open waters of the bay affect fish communities. By measuring the types of debris that are present during dry weather and preferentially transported to the bay during wet weather, the San Diego Bay Debris Study provides the opportunity to better target management decisions on the most important types of plastics.

The analysis of the overall plastic debris quantities is an important component for establishing a benchmark of the most abundant types of plastic and being able to measure changes in the plastics quantities over time. The plastics data that are to be collected for the San Diego Bay Debris Study include a substantially expanded list of items beyond the data collected during previous SMC and Bight ’08 regional monitoring programs to capture a greater level of detail about the most prevalent types of plastic items.

The intent of the San Diego Bay Debris Study is to quantify the abundance and amount of plastic debris in a variety of bay habitats, including:

- Open water areas throughout the bay from the north to south side of the bay;
- Enclosed area such as ports and marinas;
- Intertidal areas, including mudflats, salt marshes, sandy beaches, and the protective rip-rap shoring; and
- Upland areas in the contributing riverine habitats.

The primary data analyses that are to be performed to answer the study questions include the following:

1) *How do the quantities and types of debris in different habitats vary during dry and wet season?*
   a) *What are the quantities and types of debris found in San Diego Bay habitats?*
   b) *What are the quantities and types of debris found in watersheds flowing to San Diego Bay?*
   c) *How do the quantities and types of trash in different San Diego Bay habitats vary by summer and winter dry season?*
   d) *What are the quantities and types of trash in San Diego Bay following the first storms of the wet season?*
2) *What types of riverine debris do wet weather flows transport to the bay?*
3) *What species caught in the bay has ingested plastic pieces?*

The general approach adopted for the San Diego Bay Debris Study follows the question-driven approach of the San Diego Region Framework for Monitoring and Assessment.

9.2.3 Trash – Pueblo San Diego HU: Creek Refuse Assessment Program Special Study

The analyses of the Pueblo San Diego Hydrologic Unit data provide an opportunity to improve the characterization of site conditions, assess land use contributions, better describe important trash sources, and evaluate the general extent to which sites are showing trash decreases over time. The results are also intended to prioritize the trash conditions to help identify the important sources and pathways of the most abundant types of trash among the land use categories that have the largest amount of trash.

The assessment approach for the trash data included six components as follows:

(1) Evaluating volumes of various types of trash (food packaging, household items, etc.) to identify the most abundant types of trash;

(2) Evaluating the overall extent of site conditions and determining the trash volumes in each condition rating category;

(3) Calculating mean trash volumes and mapping the geographic distribution of the sites to identify locations that accumulate large amounts of trash;

(4) Evaluating the overall trash volumes among various land use and demographic categories to determine association between land scale attributes and sites containing large amounts of trash;

(5) Characterizing additional sources and pathways for trash; and

(6) Evaluating which sites have trash (presence/absence) to determine the proportion of the overall number of sites that may need further management.

9.2.4 Chollas – Jurisdictional Boundary Study for Metals and Bacteria

The Chollas Jurisdictional Boundary Study has been ongoing since 2012. The study is designed to characterize the upper drainage areas (special study sites) in relation to the lower drainage areas (which comprise the Chollas Metals and Bacteria TMDL compliance sites). Results from the two drainage areas are to be compared with the California Toxics Rule (CTR) objectives for dissolved metals through application of both default and site-specific Water Effect Ratios (WERs). The study is designed to fill data gaps regarding priority water problems and potential pollutant sources in the Chollas Creek HSA. Further analysis under the Water Quality Improvement Plan monitoring program allows refinement of previous findings and helps to identify and prioritize problem drainage areas.

9.2.5 Riparian Area

The Paradise Creek Selenium Special Study is ongoing. The assessment of the study data helps to determine whether removal of selenium in Paradise Creek from the 303(d) list is appropriate. The selenium 303(d) listing is associated with an impairment to warm freshwater habitat beneficial use. The information collected in the special study will provide the required data set for a delisting analysis for selenium. When the results from this study are finalized and published, they will be incorporated into the Water Quality Improvement Plan Annual Report and the Report of Waste Discharge.

9.3 Data Gaps

During the development of the Priority Conditions, Sources, and Potential Strategies of the Water Quality Improvement Plan, the RPs identified data gaps related to the priority water quality conditions in the San Diego Bay WMA. This Monitoring and Assessment Program begins to address a number of these data gaps, as described in Table 9-1 below. The priorities of the various water quality will be re-evaluated as the data gaps are filled, and may be elevated or demoted as the data indicate.

Table 9-1
Priority Condition Data Gaps Addressed by MAP

HA/HSA	Water Body	Pollutant Category	Was it identified as a priority condition in the First Interim Deliverable?	Monitoring Program Components Addressing the Data Gap(s)
Pueblo HU				
San Diego Mesa 908.2	San Diego Bay Shoreline, between Sampson and 28th Streets	Copper	No	Yes, if the Draft TMDL is adopted during the current Permit Term, data gaps may be addressed through additional monitoring programs (Section 5).
		Mercury	Yes	
		Zinc	Yes	
	Switzer Creek	Copper	No	
		Lead	No	
		Zinc	No	
National City 908.3	Paleta Creek	Copper	No	
		Lead	No	
Otay HU				
Coronado 910.1	Pacific Ocean Shoreline at Carnation Ave and Camp Surf Jetty	Bacteria	Yes	Yes, through Swimmable Waters Focused Priority Monitoring (Section 4.5)
	Pacific Ocean Shoreline at Tidelands Park	Bacteria	Yes	

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10 Integrated Assessment

The RPs 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 evaluates the main components of the Water Quality Improvement Plan and follows the assessment process outlined in the Municipal Permit. The priority water quality conditions will be re-evaluated using the receiving water and MS4 outfall discharge assessments on the basis of the methodology presented in Appendix A. The compliance pathways that comprise the goals and schedules in the Water Quality Improvement Plan will be reviewed on the basis of the results of the receiving water and MS4 outfall discharge assessments, along with data collected as part of the JRMP. This evaluation highlights the progress in achieving the compliance goals. Finally, both water quality monitoring data and maintenance and observational data related to BMP effectiveness will be used to assess the strategies implemented by the RPs. Table 10-1 summarizes the assessment program components.

Table 10-1
Integrated Assessment Components

Water Quality Improvement Plan Components	Municipal Permit Assessment Methodology	Evaluation Assessment
Highest and Focused Priority Conditions	<u>Re-assess receiving water, priority, and Highest and Focused Priority conditions.</u> (1) Re-evaluate the receiving water conditions per methodology and any new methodology provided in Appendix A. (2) Re-evaluate the impacts of MS4 discharges on receiving waters per methodology provided in Appendix A. (3) Identify beneficial uses in receiving waters that must be protected per Receiving Water Assessment. <u>Re-evaluate MS4 sources and stressors based on potentially new Priority and Highest Priority Conditions.</u> (4) Re-evaluate the identification of MS4 sources and/or stressors performed in Section 3.	• Receiving Water Assessments • MS4 Outfall Discharge Assessments
Goals and Schedules (Compliance Pathways)	<u>Evaluate effectiveness of goals.</u> (1) Evaluate the progress toward achieving interim and final numeric goals for protecting impacted beneficial uses in receiving waters.	• Receiving Water Assessments • MS4 Outfall Discharge Assessments • JRMP Assessments

Table 10-1 (continued)
Integrated Assessment Components

Water Quality Improvement Plan Components	Municipal Permit Assessment Methodology	Evaluation Assessment
Strategies	<u>Evaluate effectiveness of strategies and actions.</u> (1) Identify the non-storm water and storm water pollutant loads from the MS4 outfalls based on the MS4 Outfall Discharge Assessment. (2) Identify the non-storm water and storm water pollutant load reductions, or other improvements that are necessary to attain the interim and final numeric goals. (3) Identify 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. (4) Evaluate the progress of the strategies toward achieving interim and final numeric goals for protecting beneficial uses in receiving waters.	• MS4 Outfall Discharge Assessments • Special Studies Assessments for BMP Effectiveness • JRMP Assessments

Strategies developed within the Water Quality Improvement Plan are incorporated into individual RP programs through implementation of their respective JRMPs. Each RP is implementing programs that are focused on addressing the Highest and Focused Priority Conditions within the San Diego Bay WMA. 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 Water Quality Improvement Plan. Over time, RPs 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 Water Quality Improvement Plan. Where new information is applicable, it may be used to modify goals, strategies, schedules, and the Monitoring and Assessment Program.

The Municipal 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 Municipal Permit cycle. Because the updates to the Water Quality Improvement Plan are required to undergo a full public participation process per Municipal Permit Provision F.2.c, including reconvening the Consultation Panel, modifications will proactively consider input from the public and the Regional Board. Adaptation of Water Quality Improvement Plan elements also considers new regulations or policies as appropriate. In the Report of Waste Discharge preparation, all elements of the Water Quality Improvement Plan are eligible for modifications through the required adaptive management processes. Elements to be evaluated include the water quality conditions (i.e., priorities), goals and accompanying schedules, strategies and accompanying schedules, and the Monitoring and Assessment Program. Of particular interest for the integrated assessment to be performed during this Municipal Permit cycle is a review of the performance-based goals. These goals are to be reviewed during the development the Report of Waste Discharge.

The process for selecting the Highest and Focused Priority Conditions is documented in the First Interim Deliverable. Given the relatively short duration of the remainder of this Municipal Permit term after expected approval of the Water Quality Improvement Plan, the priority water quality conditions selected during the development of the Water Quality Improvement Plan remain for the duration of the current permit term. They are modified only on the basis of new information assessed as part of the Report of Waste Discharge. Data collected during the Municipal Permit term are used to update the analysis of the priority water quality conditions on the basis of the methodology described in Appendix A and implemented in Section 2.

RPs will evaluate the progress toward achieving the interim and final numeric goals as part of the preparation of the Report of Waste Discharge. The Water Quality Improvement Plan interim goals identified for the current permit term are provided in Tables 10-2 through 10-6, along with the related assessment metric for each.

Table 10-2
Assessment of Goals for Chollas Creek, Current Permit Term

Jurisdiction	Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year	Assessment Method
			Current Permit Term	
PERFORMANCE MEASURES – WET AND DRY WEATHER				
	Performance Metrics		FY18	
City of La Mesa	Design, Construct, and Maintain Low-Impact Development (LID) Retrofits	Linear Feet	Approximately 4,540 linear feet of bioretention areas will replace impervious asphalt along University Avenue between La Mesa Boulevard and Harbison Avenue.	Calculate the exact number of linear of feet of bioretention areas installed.
City of San Diego	Develop green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality during wet and dry weather	Acres Baseline: 0 acres treated in 2002, the year used as baseline in the Bacteria TMDL	44.6 acres of drainage area treated through construction of 5 green infrastructure BMPs	Verify number of acres of drainage area treated from completed green infrastructure BMPs using information from final design drawings.

Table 10-2 (continued)
Assessment of Goals for Chollas Creek, Current Permit Term

Jurisdiction	Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year	Assessment Method
			Current Permit Term	
PERFORMANCE MEASURES – WET WEATHER				
	Performance Metrics		FY18	
City of Lemon Grove	Reduction in Bacteria	Restaurant Used Cooking Oil Bins Stored in Covered Areas Protected from Run-On	75 percent (%)[1]	Percent of Restaurant Used Cooking Oil Bins Stored in Covered Areas Protected from Run-On as based on the baseline to be developed during the FY16 Annual Report
	OR			
	Municipal Facility Retrofits for Reduction of Bacteria and Metals	Redirect parking lot runoff to pervious area	2 municipal facilities retrofitted (drainage area/facility TBD during site selection in FY16)	Number of facilities retrofitted and the calculated drainage area for those facilities
		Redirect Roof Downspouts to Pervious Area	2 municipal facilities retrofitted (drainage area/facility TBD during site selection in FY16)	

Table 10-2 (continued)
Assessment of Goals for Chollas Creek, Current Permit Term

Jurisdiction	Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year	Assessment Method
			Current Permit Term	
PERFORMANCE MEASURES – DRY WEATHER				
	Performance Metrics		FY18	
City of Lemon Grove	Non-Storm Water Flow Reduction Programs	Install smart irrigation systems at municipal facilities	8 Cal-Sense smart irrigation systems installed	Number of Cal-Sense smart systems installed
City of San Diego	Implement runoff reduction programs including targeted education and outreach, enhanced inspections, rebates[2], and increased enforcement	Volume Reduction Baseline: Historical dry weather monitoring data will be used to establish a baseline in the first Water Quality Improvement Plan Annual Report	10% reduction in prohibited[3] dry weather flow from baseline measured at persistently flowing outfalls in the WMA	Percent reduction in the amount of dry weather flow measured from City of San Diego dry weather monitoring locations

Notes:
1. These data have not been directly recorded in past inspection programs. The City's current BMP requirements state that bins must be kept clean but do not always require coverage. Based on discussion with inspection staff, it is estimated that about 20-30% of used oil cooking bins are stored in covered areas protected from run-on.
2. City of San Diego rebates include grass replacement, rainwater harvesting, downspout disconnect, and micro-irrigation.
3. Does not include allowable discharges as defined in Provision A and Provision E.2.a of the MS4 Permit.

% = percent; FY = fiscal year; TBD = to be determined

Table 10-3
Assessment of Goals for Water Quality (Copper and Zinc) Within Airport Authority Jurisdiction (908.21), Current Permit Term

Jurisdiction	Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year Current Permit Term FY17 or FY16 as Noted	Assessment Method
Airport Authority	MS4 Discharges Jurisdiction-wide % of Samples With Concentrations Exceeding Industrial General Permit (IGP) NALs	% of Samples	Dissolved Copper = 71% (FY17) Dissolved Zinc = 62% (FY17)	Comparison of sample results to the IGP NALs and calculation of percent exceedance
	OR			
	MS4 Discharges Sub-basins 1, 3, and 5 (total or assess individually) % Load Reduction	% Load Reduction	Dissolved Copper = 20% (FY17) Dissolved Zinc = 20% (FY17)	Review of dissolved copper and zinc loads from Sub-basins 1, 3, and 5 and a calculation of load reduction based on a baseline value set during the first Water Quality Improvement Plan Annual Report.
	OR			
	MS4 Discharges Sub-basins 1, 3, and 5 (in total) Area Treated with Street Sweeping	Acres/ Week	34 Acres/Week (Current Frequency) (FY16)	Confirmation of implementation of street sweeping frequency.
	MS4 Discharges Sub-basins 1, 3, and 5 (in total) Area Treated with Rubber Removal and/or Power Washing	Square Feet/ Week	Average of 10,000 Square Feet per Week (Current Frequency) (FY16)	Confirmation of implementation of area treated.

Table 10-4
Assessment of Goals for Riparian Area Habitat in Paradise Creek (909.1), Current Permit Term

Jurisdiction	Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year Current Permit Term FY17 or FY16 as Noted	Assessment Method
City of National City	Receiving Water Removal of 303(d) Selenium Listing	303(d) Listed Segment	Complete Selenium Water Quality Monitoring (FY16) Collect and analyze 48 samples for selenium, with zero exceedances of the water quality objective[1]	Summary of the completed monitoring program, includes sample locations, number of samples taken, and summary of results.
	Restore Native Riparian Vegetation and Wetlands	Remove Concrete Bottom from Paradise Creek	1,000 Linear Feet (FY17)	Total number of linear feet of concrete bottom removed.
		Wetland Restoration	6,000 Square Feet (FY17)	Total square feet of wetland restored.
		Native Plants Replacing Turf, Invasive Plants, or Existing Impervious Area	45,000 Square Feet (FY17)	Total square feet of native plan replacement.
		Provide Treatment for Tributary Urbanized Areas	130 Treated Acres (FY17)	Total acres of treated area.

Note:
1. These numbers are designed such that the when analyzed together with the historical data upon which the current 303(d) listing is based, the entire data set (current study data plus historical data) meets the delisting criteria in the State listing policy (State Board, 2004).

Table 10-5
Assessment of Goals for Physical Aesthetics in Lower Sweetwater HA (909.1) and Otay River HA (910.2), Current Permit Term

Jurisdiction	Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year	Assessment Method
			Current Permit Term FY18	
City of Chula Vista and Port of San Diego (909.1) City of Chula Vista, City of Imperial Beach, and Port of San Diego (910.2)	MS4 Discharges % Optimal[1] Trash Assessment Scores	MS4 Outfalls Assessed for Trash	60%	Comparison to the baseline determined in the first Annual Report that includes the RPs' cumulative number of site visits of major MS4 outfalls in the Focused Priority Condition area for dry weather and MS4 outfall monitoring during FY12 through FY14
	OR			
	MS4 Discharges % Jurisdictional High Volume Trash Drainage Area Treated for Trash[2]	Feasible Drainage Area for BMP retrofit	10%	An assessment is needed to incorporate review of all available trash and source assessment data, drainage areas, and potential locations in high-volume trash-generating areas to feasibly implement structural control BMPs to identify or verify high-volume trash areas and % area feasible to retrofit with trash BMPs

Notes:
1. Historically, an optimal score was given to sites meeting the following requirements: "On first glance, no trash visible. Little or no trash (<10 pieces) evident when evaluated area is closely examined for litter and debris." This definition may change in the future and will be noted in Water Quality Improvement Plan updates.
2. These values are based on best available information and current jurisdictional knowledge. A feasibility study is required to determine where BMP retrofits can be implemented.

Table 10-6
Assessment of Goals for Swimmable Waters (Beaches) in the Coronado HA (910.1), Current Permit Term

Jurisdiction	Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year	Assessment Method
			Current Permit Term FY18	
City of Coronado and Port of San Diego	Receiving Water Removal of 303(d) Indicator Bacteria Listings for Recreation Water Contact (REC-1 Beneficial Use)	% of Samples Exceeding WQOs San Diego Bay Shoreline, Tidelands Park	Baseline - 5%[1]	Comparison to the baseline identified in the San Diego Bay WQIP.
City of Imperial Beach	Receiving Water Removal of 303(d) Indicator Bacteria Listings for Shellfish Harvesting (SHELL Beneficial Use)	% of Samples Exceeding WQOs Pacific Ocean Shoreline, Carnation Avenue and Camp Surf Jetty	Baseline - 5%[1]	Annual Report. Baseline for dry weather calculated using a three year (Years 11-12, 12-13, 13-14) rolling average of the scores from the Heal the Bay[2] report cards for four beaches within the Coronado HA (910.1)

Note:
1. The final incremental reduction in percent exceedances of the WQO is based on the baseline value. In addition, percentage reduction (-X%) are subject to adjustments based on periodic assessment of new data collected (Baseline – X% or 15% whichever is lower).
2. www.healthebay.org

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Appendix A Monitoring Methods

APPENDIX A1. LONG-TERM RECEIVING WATER MONITORING PROGRAM – DRAFT MONITORING PLAN

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ACRONYMS AND ABBREVIATIONS

Acronym or Abbreviation	Definition
>	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
MS4 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
NPDES	National Pollutant Discharge Elimination System
PBO	piperonyl butoxide

Acronym or Abbreviation	Definition
pH	hydrogen ion concentration
PVC	polyvinyl chloride
O/E	observed to expected
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
SR-MLS	Sweetwater 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
WMA	Watershed Management Area

A.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 MS4 Permit. The goal of the San Diego Bay WMA 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 Bay WMA Water Quality Improvement Plan.

A.1.1 Program Overview

The Receiving Water Monitoring Plan includes the following monitoring to satisfy the requirements of Provision D of the MS4 Permit:

- Long-term dry and wet weather receiving water monitoring at one mass loading station (MLS) in accordance with the MS4 Permit (Provisions D.1.a, b, c, and d)
- Rapid stream bioassessment and in accordance with the MS4 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))
- Dry weather hydromodification monitoring in accordance with the MS4 Permit (Provision D.1.c.(6))
- Toxicity identification evaluation/toxicity reduction evaluation, if appropriate

The MS4 Permit identifies the Responsible Parties (RPs) for the San Diego Bay WMA. The RPs will collaborate to support the monitoring and reporting activities described in this plan are:

- Airport Authority
- City of Chula Vista
- County of San Diego
- City of Coronado
- City of Imperial Beach
- City of La Mesa
- City of Lemon Grove
- City of National City
- Port of San Diego

- City of San Diego
- Caltrans[1]

A.1.2 Monitoring Locations

The San Diego Bay WMA RPs have selected the Sweetwater River Mass Loading Station (MLS) (SR-MLS) as the long-term receiving water monitoring location. Location details are provided in Table A1-2. A map of the location is presented in Figure A1-1.

Table A1-1
List of Receiving Water Monitoring Locations for the MS4 Permit Term

Station Name	Waterbody	HU	Latitude	Longitude
SR-MLS	Sweetwater River	Sweetwater (909)	32.650720	-117.063592

[1] The California Department of Transportation (Caltrans) is not listed in the Municipal Permit as a Copermittee, but is participating voluntarily in the development of the Water Quality Improvement Plan as a Chollas Creek TMDL Responsible Party. Caltrans' participation is limited to an 864-acre area within the Chollas Creek Hydrologic Sub-Area (HSA) in the Pueblo HU.

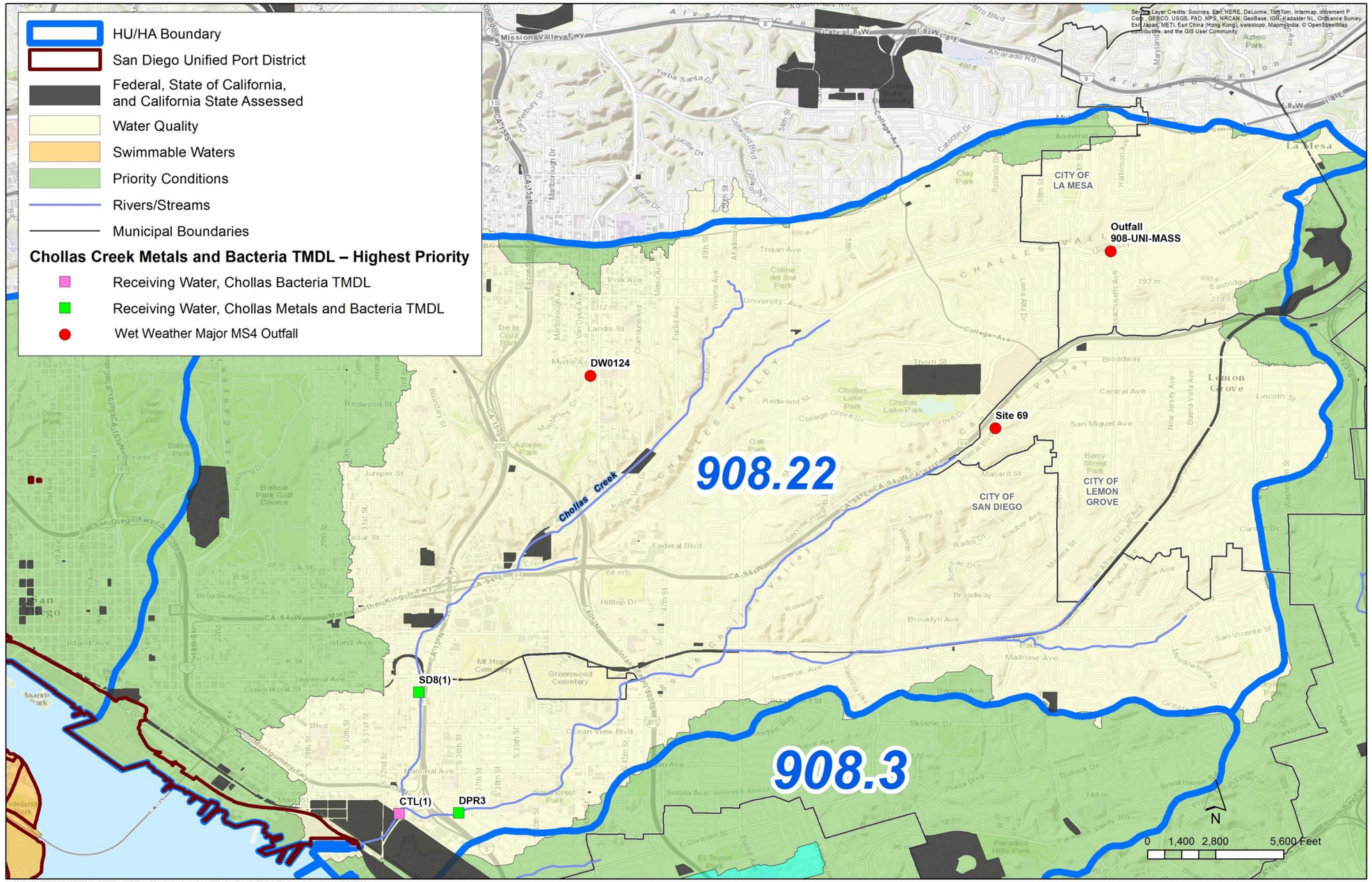

Figure A1-1
Receiving Water Monitoring Location

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A.1.3 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 Bay WMA, in accordance with the MS4 Permit (Provisions D.1.b, c, and d). Seasonal mobilization and demobilization activities will include the following:

- Equipment will be installed and maintained at SR-MLS to perform flow monitoring and sampling. The monitoring year is defined as October 1 through September 30.
- Flow monitoring data will be collected at SR-MLS throughout the monitoring season to estimate the annual watershed loads.
- Monitoring equipment at SR-MLS will be removed upon completion of the required monitoring (approximately June 30)
- Because safety and quality are integral parts of data collection, team safety meetings and quality reviews will be conducted to ensure that safe and reliable business practices are used during the implementation of this program.

A.1.3.1 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. Appendix A5 provides a complete list of constituents, methods, sample volumes, holding times, and target reporting limits for the San Diego Bay WMA Receiving Water Monitoring Program.

A.1.3.1.1 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 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 non-storm events (e.g., at least 72 hours after a storm event) if dry weather flow is observed during the wet season.

A.1.3.1.2 Wet Weather

The 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.

Storm events will be considered viable for mobilization if they are predicted to produce at least 0.10 inch of rainfall in the drainage area with at least a 70 percent chance of rainfall. Each storm of at least 0.1 inch of rainfall must be separated by a minimum of 72 hours, and the forecast storm volume within ± 50 percent of the average storm volume and duration for the region. These mobilization criteria must be met at least 24 hours prior to the anticipated onset of rainfall. For the purposes of these criteria, storm forecasts will be obtained from the National Weather Service website (http://www.wrh.noaa.gov/sgx/).

A.1.3.1.3 Flow Monitoring

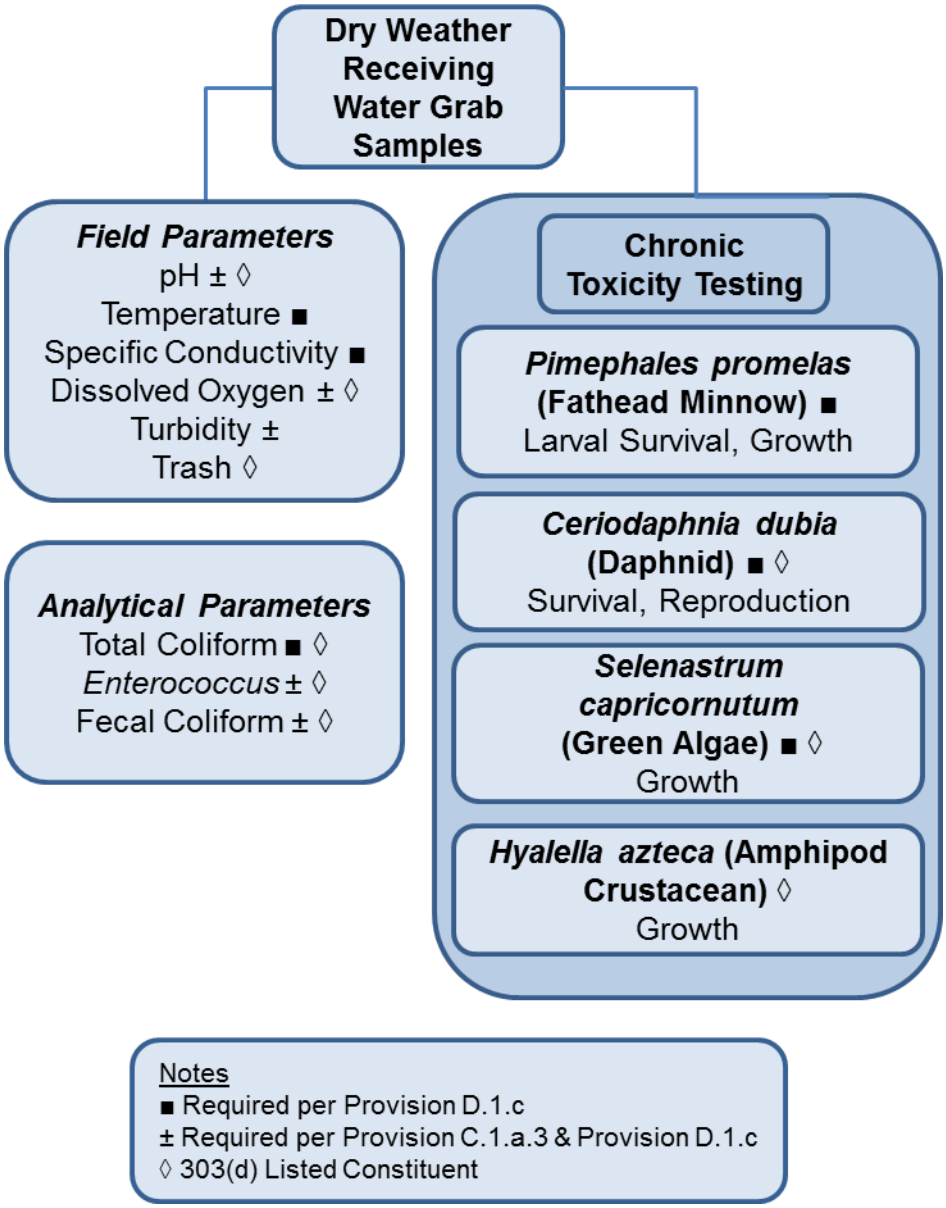
Flow rates will be monitored using American Sigma (or comparable) flowmeters with an ultrasonic sensor, bubbler, or submerged pressure transducer as the primary measuring device. The primary sensor will continuously measure stage (i.e., stream height) and relay that information to the flowmeter. The 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. 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 during the course of the monitoring year. The monitoring year is October 1 through September 30. 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 methods used for stream rating and channel surveys, are provided in Attachment A.

A.1.3.1.4 Grab Samples

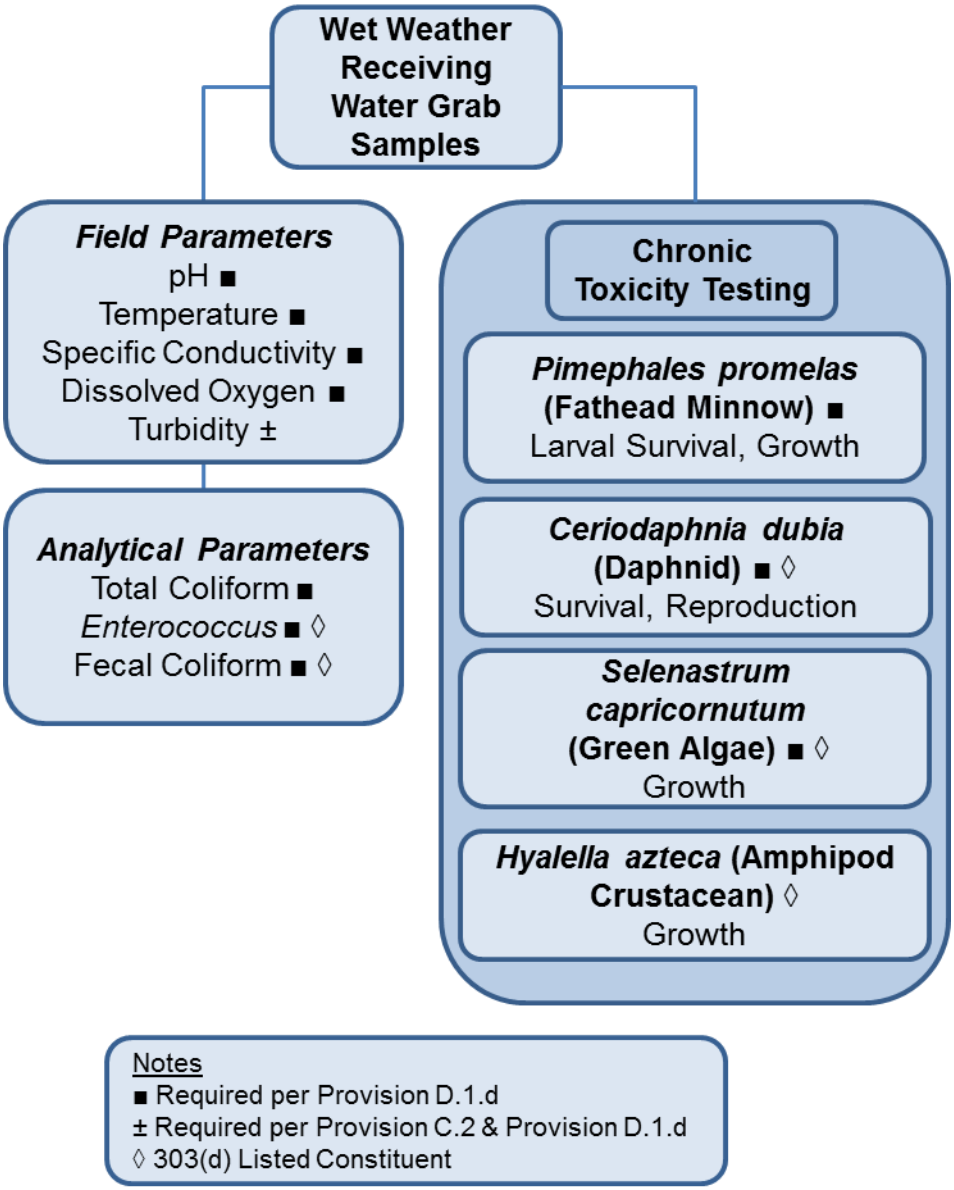
Grab samples will be collected for those constituents that are not amenable to composite sampling. Per the Permit, the constituents to be collected as grab samples are indicated in Figure A1-2 and Figure A1-3 and include:

- Temperature
- Hydrogen ion concentration (pH)
- Specific conductance
- Dissolved oxygen
- Turbidity
- Total coliform
- Fecal coliform
- *Enterococcus*



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A1-2
Dry Weather Receiving Water Monitoring Grab Samples



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A1-3
Wet Weather Receiving Water Monitoring Grab Samples

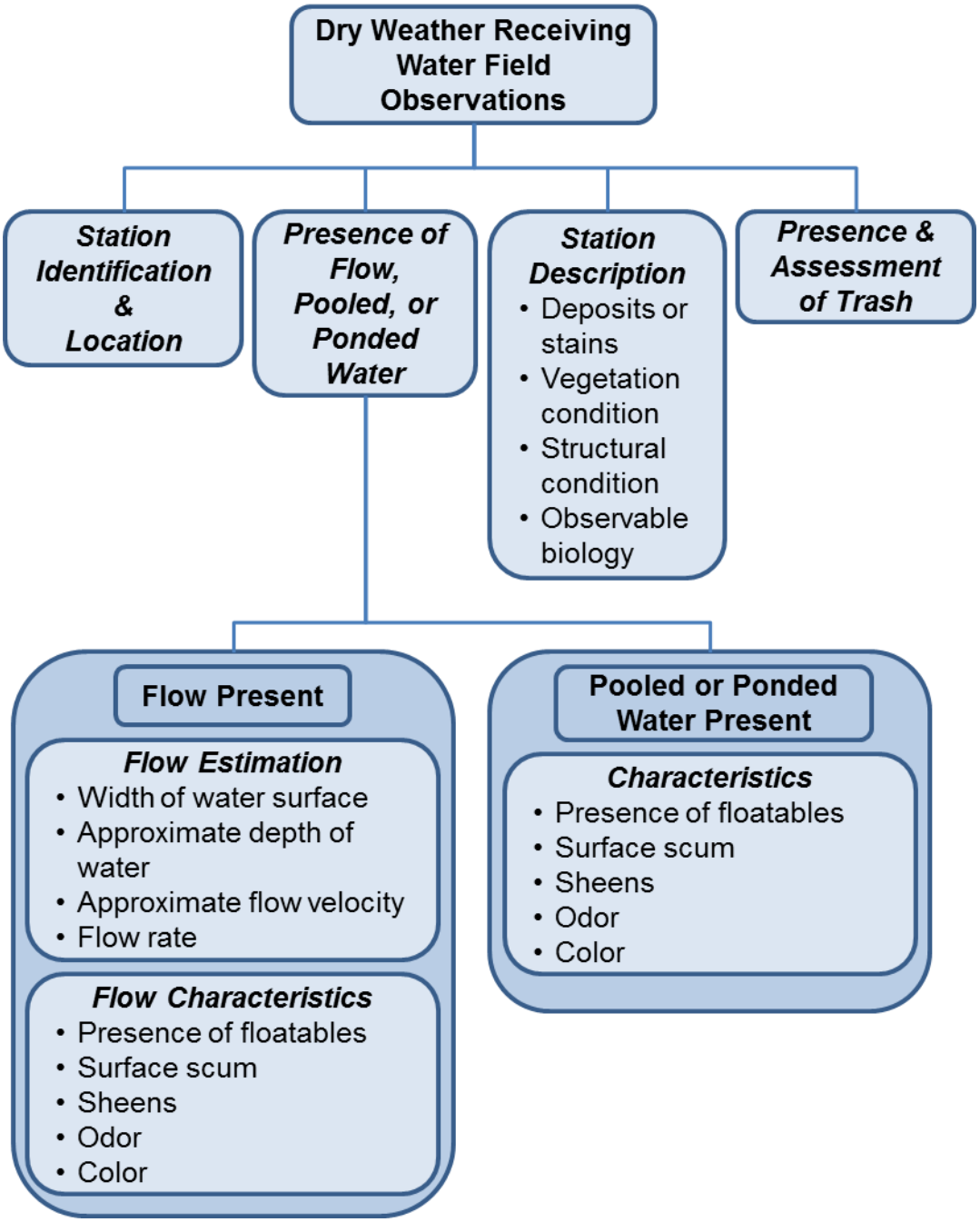
Samples will be collected from the horizontal and vertical center of the channel if possible and will be kept clear of uncharacteristic floating debris.

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).

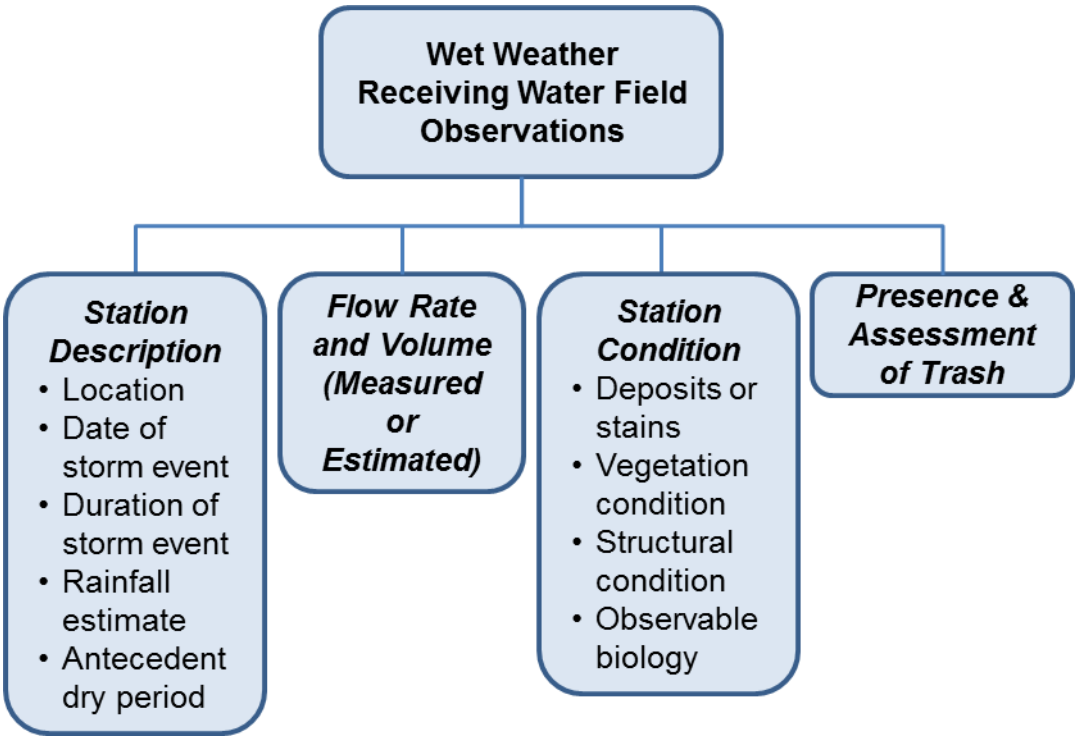
Field measurements will be performed for pH, specific conductance, temperature, dissolved oxygen, and turbidity using an YSI 6600 series water quality probe or similar device. Calibration of the instruments will be conducted prior to each sampling event in accordance with the manufacturer's specifications 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). Narrative field observation requirements are outlined in Figure A1-4 and Figure A1-5.



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A1-4
Dry Weather Receiving Water Field Observations



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A1-5
Wet Weather Receiving Water Field Observations

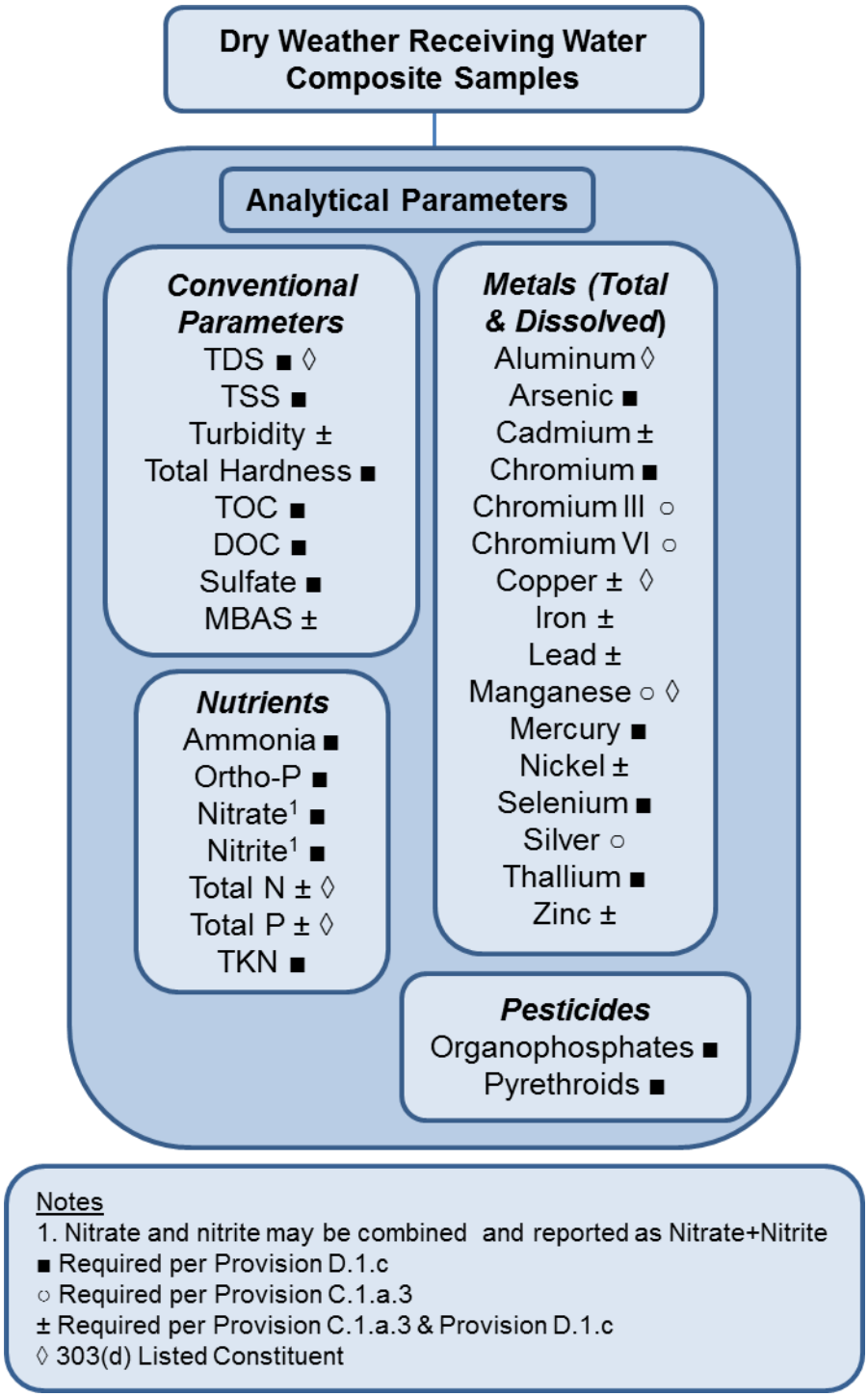
A.1.3.2 Composite Samples

A single flow-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.

Flow-weighted water samples will be collected in pre-cleaned 20-liter (L) borosilicate graduated glass bottles. Sample bottles will be properly labeled with sample identification (ID), date, and time; sealed with a pre-cleaned rubber stopper; and preserved on ice for transport to the laboratory or consultant for sample compositing.

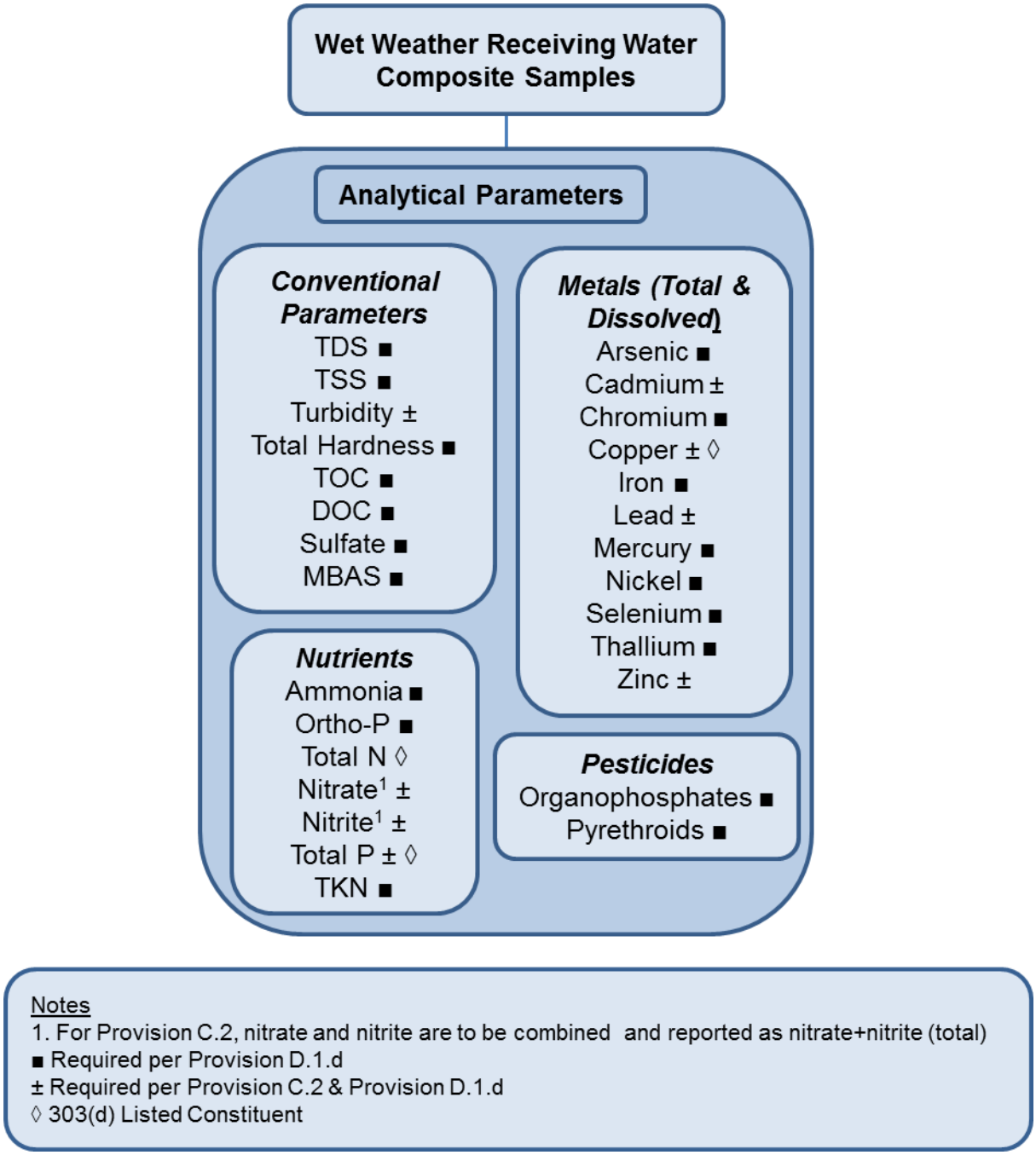
Approximately 19 L of sample water will be contained in a “full” bottle. If flow rate sampling adjustments are made during a sampling event, the volume of sample to be used in sample compositing from the various bottles will differ for a given monitoring location to ensure that the final composite sample is properly flow-weighted. To ensure that a representative sample is used, samples should be agitated and mixed prior to pouring out any liquid. A 1000-mL glass graduated cylinder will be used to measure any sample volume that will be composited if it is less than the full amount contained within a 19-L sample bottle. The mixing will be done between transfers of liquid. Samples will be agitated continuously using a pre-cleaned glass stir bar as they are poured into the large pre-cleaned containers. After all of the samples from a specific station have been added to the compositing container, subsampling may begin. Subsamples for chemical analyses will be poured into glass containers with Teflon® lids.

The flow-weighted composite samples will be analyzed for all the constituents not identified for grab sampling. Figure A1-6 and Figure A1-7 outlines the constituent requirements for composite samples. The complete list of constituents for the San Diego Bay WMA for dry weather and wet weather is provided in Appendix A5.



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A1-6
Dry Weather Receiving Water Monitoring Composite Samples



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A1-7
Wet Weather Receiving Water Monitoring Composite Samples

A.1.3.3 Sample Analysis

Samples will be analyzed for the bacteria, chemistry, toxicity, and general field parameters provided in Appendix A5. Appendix A5 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.

A.1.3.4 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.

A.1.3.4.1 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.

A.1.3.4.2 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.

A.1.3.4.3 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.

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.

A.1.3.4.4 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 an YSI 6600 series water quality probe or similar probe in accordance with the manufacturer's specifications. The YSI 6600 series water quality probe will be calibrated with calibration solutions, and it will be verified that the expiration date has not been exceeded.

A.1.3.4.5 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.

A.1.3.5 Toxicity Identification Evaluations

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 Appendix G.

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 MS4 Permit and used to determine the causative agent(s) of toxicity. The Copermittees have budgeted for three Phase I TIEs in the event that assessment under Provision D.4.a.(2) indicates the need for a TIE. 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 involves manipulating the sample(s) using the methods in Table A1-2.

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 A1-2
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)

A.1.3.6 Dry Weather Hydromodification Monitoring

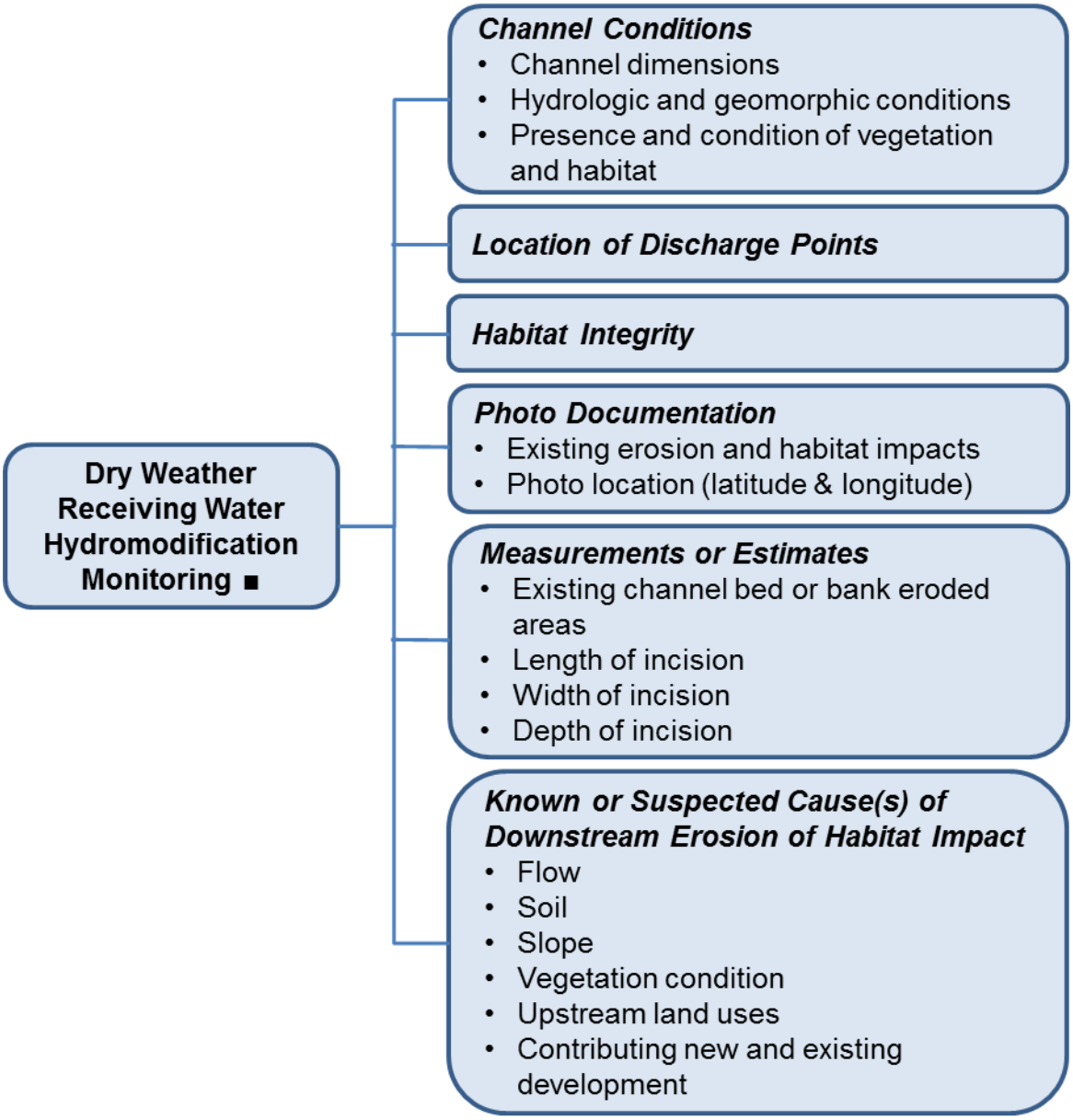
This section describes the sampling and data collection methods for the dry weather receiving water hydromodification monitoring requirements as outlined in Provision D.1.c.(6) of the MS4 Permit.

In addition to the hydromodification monitoring conducted as part of the Copermittees' Hydromodification Management Plans, hydromodification monitoring for SR-MLS is required at least once during the MS4 Permit term. The Copermittees 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.

Figure A1-8 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.



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A1-8
Dry Weather Receiving Water Hydromodification Monitoring

A.1.3.6.1 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.

A.1.3.6.2 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]).

A.1.3.6.3 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).

A.1.3.6.4 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

A.1.3.6.5 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.

A.1.3.6.6 Location of Discharge Points/Known or Suspected Causes of Erosion or Habitat Impact

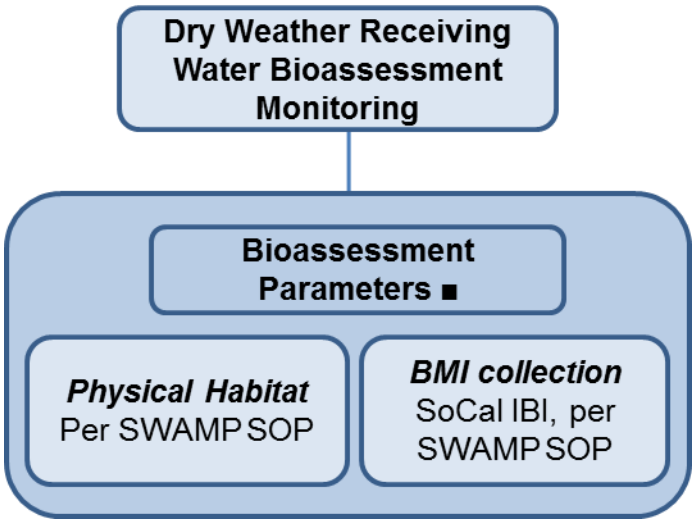
Known or suspected cause(s) of existing downstream erosion or habitat impact, including flow, soil, slope, and vegetation conditions, as well as upstream land uses and contributing new and existing development, will be assessed during a GIS desktop exercise and the SCCWRP channel assessment tool.

A.1.3.7 Dry Weather Receiving Water Bioassessment Monitoring

Dry weather receiving water bioassessment monitoring will be conducted in accordance with the MS4 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 estuarine wetlands (Collins et al., 2013).

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). Figure A1-9 provides an outline of the bioassessment monitoring requirements.



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A1-9
Dry Weather Receiving Water Bioassessment Monitoring

A.1.3.7.1 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.

A.1.3.7.2 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.

A.1.3.7.3 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.

A.1.3.7.4 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.

A.1.3.7.5 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.

A.1.3.7.6 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).

A.1.3.7.7 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.

A.1.4 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.

A.1.4.1 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.

The agency selected to conduct field efforts will review all Field Data Log Sheets for completeness, maintain the original hardcopies, and scan electronic copies (*.pdf) for storage in the project file. The field crew will retain the original Field Data Log Sheets. Summaries of sampling events will be emailed to the County of San Diego on a basis deemed appropriate by the County of San Diego.

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

In addition to providing formal results within three weeks of submittal of samples, the laboratories will report the results of indicator bacteria analyses via call or email upon completion or as soon as practical, especially if initial results indicate an exceedance of water quality objectives.

A.1.4.2 Assessment and Reporting

The assessment of receiving waters involves evaluating the physical, chemical, and biological conditions of the receiving waters and sediments. The RPs must assess the status and trends of receiving water quality conditions in coastal waters, enclosed bays, harbors, estuaries, and streams in the San Diego Bay WMA. This assessment includes evaluation of both dry weather and wet weather conditions. The receiving water assessment to be presented in the Water Quality Improvement Plan Annual Report will:

- Assess whether or not the conditions of the receiving waters are meeting the numeric goals established in Water Quality Improvement 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 Water Quality Improvement Plan contribute toward progress in achieving the interim and final numeric goals of the Water Quality Improvement Plan
- Identify data gaps in the monitoring data needed to assess the provisions above

Attachment A
Stream Rating and Channel Survey Details

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Stream Ratings

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:

$$Q = (1.486 / n) A R^{2/3} S^{1/2}$$

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.

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Attachment B
Toxicity Identification Evaluation/Toxicity Reduction Evaluation Implementation Draft Work Plan

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Toxicity Identification Evaluation / Toxicity Reduction Evaluation Implementation Draft Work Plan

Prepared for:

San Diego County Regional Copermittees

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January 16, 2015

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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

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 A-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).

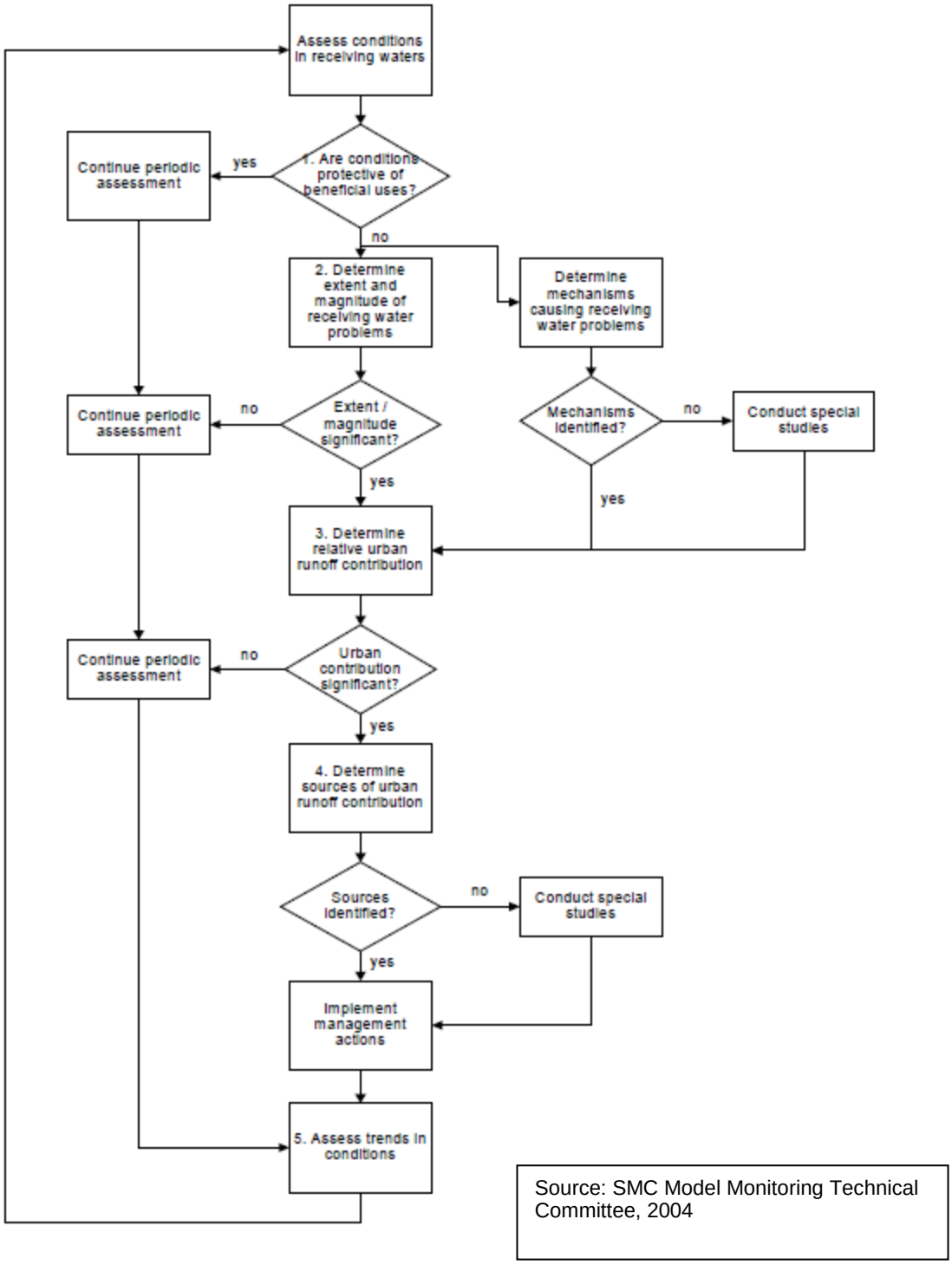

Figure A-1. Example Receiving Water Monitoring and TIE/TRE Decision Framework

• 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 A-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 A-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 ≥ 1 ppt			
Strongylocentrotus purpuratus	Chronic development	Pass/Fail	EPA-600-R-95-136

• TIE/TRE PROCESS

○ 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.

○ 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 approaych 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 A-2**.

Table A-2. 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 A-2** 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).

○ 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 A-2**.

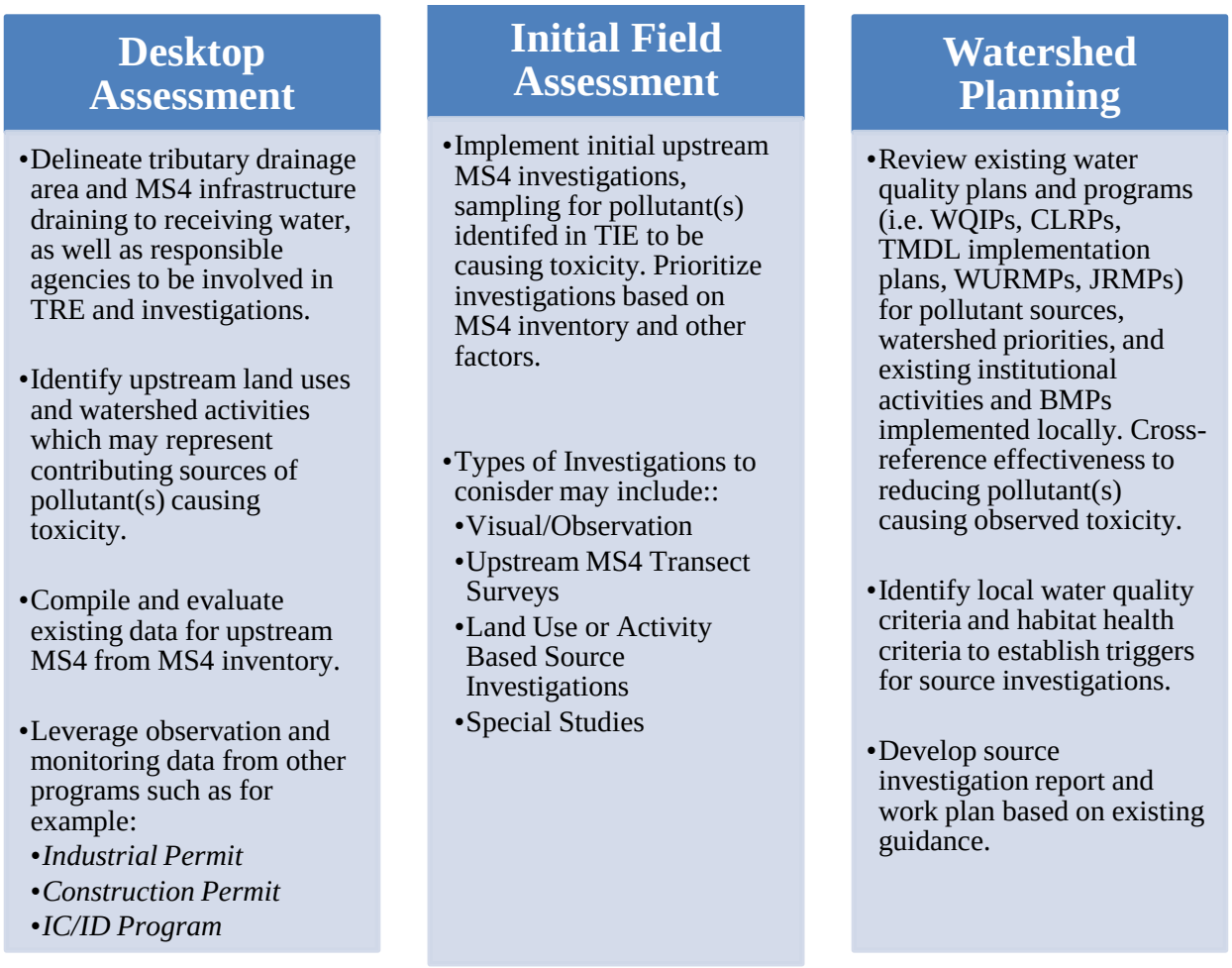

Figure A-2. The Toxicity Source Evaluation Approach

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.

○ 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 A-3**.

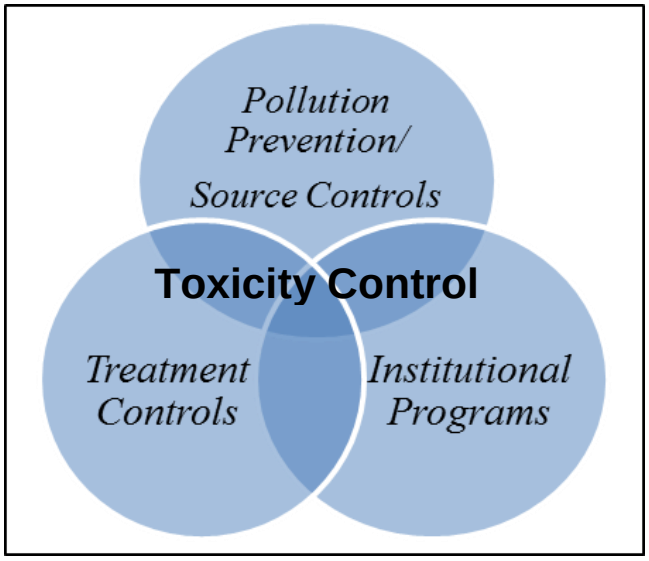

Figure A-3. Components of Toxicity Control Evaluation

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 □o).

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.

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.

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.

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APPENDIX A2 MS4 OUTFALL MONITORING PROGRAM – DRAFT MONITORING PLAN

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ACRONYMS AND ABBREVIATIONS

Acronym or Abbreviation	Definition
%	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) (RWQCB, 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
MS4	Municipal Separate Storm Sewer System
MS4 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
NAL	non-storm water action level
NPDES	National Pollutant Discharge Elimination System
PID	photoionization detector
QA	quality assurance
RCC	reinforced concrete channel
RCP	reinforced concrete pipe
RWQCB	Regional Water Quality Control Board, San Diego Region
SAL	storm water action level
SWAMP	Surface Water Ambient Monitoring Program
TBD	to be determined
TKN	total Kjeldahl nitrogen
TMDL	Total Maximum Daily Load

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym or Abbreviation	Definition
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WMA	Watershed Management Area
WQBEL	Water Quality Based Effluent Limit
Water Quality Improvement Plan	Water Quality Improvement Plan
WQO	Water Quality Objective
WURMP	Watershed Urban Runoff Management Program

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A.2 INTRODUCTION

In May 2013, the San Diego Regional Water Quality Control Board (RWQCB) 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 Watersheds Within the San Diego Region (MS4 Permit; RWQCB, 2013) was adopted, replacing RWQCB Order No. R9-2007-0001 (RWQCB, 2007), and became effective June 27, 2013. The MS4 Permit prescribes monitoring programs for the MS4 outfalls during wet and dry weather for the duration of the Permit cycle.

A.2.1 Program Overview

In the San Diego Bay Watershed Management Area (WMA), the Responsible Parties (RPs) are named under the MS4 Permit:

- Airport Authority
- City of Chula Vista
- County of San Diego
- City of Coronado
- City of Imperial Beach
- City of La Mesa
- City of Lemon Grove
- City of National City
- Port of San Diego
- City of San Diego
- Caltrans[1]

The Copermittees are required to perform MS4 outfall monitoring in accordance with Provision D of the MS4 Permit. Permit-required MS4 outfall monitoring is composed of two major components:

- Dry Weather MS4 Outfall Discharge Monitoring (Provision D.2.b; RWQCB, 2013)
- Wet Weather MS4 Outfall Discharge Monitoring (Provision D.2.c; RWQCB, 2013)

[1] The California Department of Transportation (Caltrans) is not listed in the Municipal Permit as a Copermittee, but is participating voluntarily in the development of the Water Quality Improvement Plan as a Chollas Creek TMDL Responsible Party. Caltrans' participation is limited to an 864-acre area within the Chollas Creek Hydrologic Sub-Area (HSA) in the Pueblo HU.

The purpose of this monitoring plan is to describe the monitoring and assessment requirements and procedures for the San Diego Bay WMA MS4 Outfall Discharge Monitoring Program required by the MS4 Permit.

A.2.2 Dry Weather MS4 Outfall Discharge Monitoring

This section details the dry weather MS4 outfall monitoring required to comply with the MS4 Permit. Each Copermittee is required to perform dry weather MS4 outfall prioritization and monitoring to aid in the identification of non-storm water and illicit discharges within its respective jurisdictions as required by Provision D.2.b of the MS4 Permit.

A.2.2.1 MS4 Outfall Inventory

The Copermittees have identified the known major MS4 outfalls that discharge directly to receiving waters within their respective jurisdictions within the San Diego Bay WMA. The identified major MS4 outfalls have been geo-located on respective Geographic Information System (GIS) jurisdictional map of the San Diego Bay WMA as required by Provision D.2.a.(1) of the MS4 Permit. Each Copermittee will individually maintain, confirm, and update its respective maps during annual field screening (Povision D.2.a.(2)). The respective jurisdictional MS4 maps contain the following items that, at a minimum, will be confirmed and updated during annual field screening as applicable:

- Segments of the MS4 owned, operated, and maintained by the Copermittee
- Known locations of inlets that discharge and/or collect runoff into the Copermittee's MS4
- Known locations of connections with other MS4s not owned or operated by the Copermittee
- Known locations of MS4 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 MS4 outfalls
- Locations of the MS4 outfalls within each Copermittee's respective jurisdiction
    - Latitude and longitude of MS4 outfall point of discharge
    - Watershed Management Area
    - Hydrologic subarea
    - Outlet size
    - Accessibility (i.e. safety and without disturbance of critical habitat)
    - Approximate drainage area

- Classification of whether the MS4 outfall is known to have persistent non-storm water flows, transient non-storm water flows, no non-storm water flows, or unknown non-storm water flows

- Locations of the selected non-storm water persistent flow MS4 outfall discharge monitoring stations within each Copermittee's respective jurisdiction.

Because of their size, geo-located MS4 outfall maps are not included in this monitoring plan. Table A2-1 presents the number of identified major outfalls in the San Diego Bay WMA by Copermittee.

Table A2-1
Number of Identified Major MS4 Outfalls by Copermittee

Jurisdiction	Number of Outfalls Per Year		
	Total Major Outfalls for Dry Weather Field Screening[1,2]	Dry Weather Monitoring (Persistently Flowing Outfalls)[3]	Wet Weather Monitoring
Airport Authority[2,4]	0	0(0)	0
Chula Vista[2]	5	5(5)	1
Coronado[2]	7	5(1)	1
Imperial Beach[2]	2	2(2)	1
La Mesa[2]	5	5(5)	1
Lemon Grove[2]	4	1(1)	1
National City[2]	5	5(5)	1
City of San Diego[2]	94	5(5)	1
County of San Diego[2]	57	5(5)	1
Port of San Diego[2]	65	5(2)	1

Notes:

1. These outfalls are screened twice per year.
2. For Copermittees with fewer than 125 major outfalls in the WMA, 80% of major outfalls must be screened twice per year.
3. Parenthesis indicates the number of persistent flowing outfalls monitored under this program. Jurisdictions with less than five persistently plowing outfalls may still monitor five outfalls during dry weather for additional data collection.
4. The Airport Authority has two major outfalls that are tidally influenced and cannot be safely screened or monitored. The nearest safe upstream access points will be screened/monitored as a proxy.

A.2.2.2 Field Screening

Each Copermittee is required to conduct field screening to determine which non-storm water MS4 outfall discharges are transient flows and which have persistent flows, and to prioritize the non-storm water MS4 discharges that will be investigated and eliminated in accordance with the Illicit Discharge Detection and Elimination (IDDE) program.

A.2.2.2.1 Monitoring Locations And Frequency

Per the requirements of Provision D.2.a.(2).(a) of the MS4 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. The requirements are as follows:

- For Copermittees with fewer than 125 known major MS4 outfalls that discharge to receiving waters within a WMA, at least 80 percent of the outfalls are required be visually inspected two times per year during non-storm water conditions. The following Copermittees in the San Diego Bay WMA fall into this category:
    - Airport Authority
    - County of San Diego
    - City of Coronado
    - City of Imperial Beach
    - City of La Mesa
    - City of Lemon Grove
    - City of National City
    - Port of San Diego
    - City of San Diego
    - Caltrans[2]
- For Copermittees with 125 major MS4 outfalls or more, but fewer than or equal to 500 that discharge to receiving waters within a WMA, all the outfalls is required be visually inspected at least annually during non-storm water conditions.
- For Copermittees with more than 500 major MS4 outfalls that discharge to receiving waters within a WMA, at least 500 outfalls are required to be visually inspected at least annually during non-storm water conditions. Copermittees with more than 500 major MS4 outfalls within a WMA are required to identify and prioritize at least 500 outfalls to be inspected considering the following:
    - Assessment of connectivity of the discharge to a flowing receiving water
    - Reported exceedances of non-storm water action levels (NALs) in water quality monitoring data
    - Surrounding land uses

[2] The California Department of Transportation (Caltrans) is not listed in the Municipal Permit as a Copermittee, but is participating voluntarily in the development of the Water Quality Improvement Plan as a Chollas Creek TMDL Responsible Party. Caltrans' participation is limited to an 864-acre area within the Chollas Creek Hydrologic Sub-Area (HSA) in the Pueblo HU.

  - Presence of constituents listed as a cause for impairment of receiving waters in the WMA listed on the Clean Water Act (CWA) Section 303(d) List (303(d) list);
  - Flow rate
- For a Copermittee with portions of its jurisdiction in more than one WMA and more than 500 major MS4 outfalls within its jurisdiction, at least 500 major MS4 outfalls within its inventory are required to be visually inspected at least annually during non-storm water conditions. Copermittees with more than 500 major MS4 outfalls in more than one WMA are required to identify and prioritize at least 500 outfalls to be inspected considering the following:
  - Assessment of connectivity of the discharge to a flowing receiving water
  - Reported exceedances of NALs in water quality monitoring data
  - Surrounding land uses
  - Presence of constituents listed as a cause for impairment of receiving waters in the Watershed Management Area listed on the CWA Section 303(d) List
  - Flow rate
- Inspections of major MS4 outfalls conducted in response to public reports and staff or contractor reports and notifications may count toward the required visual inspections of MS4 outfall discharge monitoring stations

Based on these criteria, Table A2-2 details the frequency at which Copermittees will inspect major outfalls within the San Diego Bay WMA.

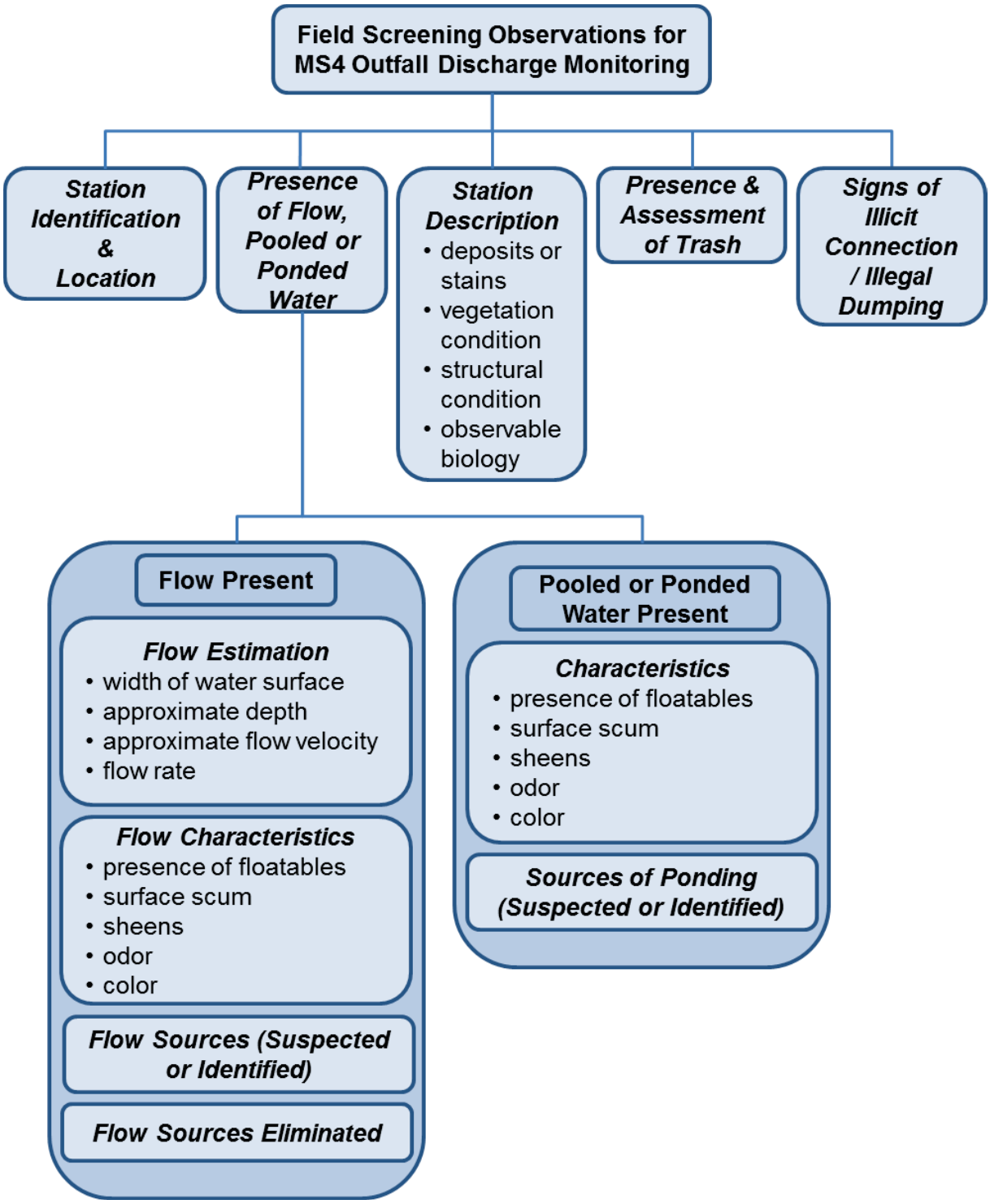
Table A2-2
MS4 Outfall Screening Frequency

Number of Major Outfalls	Major Outfalls required to be Screened	Frequency of screening
0-125	80%	2 per year
125-500	100%	1 per year
500+	≥500	1 per year

A.2.2.2.2 Visual Observations

Per the MS4 Permit, during a field screening visual observation inspection, each MS4 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. Figure A2-1 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 MS4 Permit.

Flow estimation will be performed as described in Attachment A.



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-1
Dry Weather MS4 Outfall Field Screening

A.2.2.3 Non-Storm Water Persistent Flow MS4 Outfall Discharge Monitoring

Each Copermittee is required to perform non-storm water persistent flow MS4 outfall discharge monitoring to determine whether persistent non-storm water discharges may be impacting receiving water quality.

A.2.2.3.1 Outfall Prioritization

Copermittees must each identify a minimum of the 5 highest priority major MS4 outfalls with non-storm water persistent flows that they will monitor within their respective jurisdictions in the San Diego Bay WMA, in accordance with MS4 Permit Provision D.2.b.(2)(b) (RWQCB, 2013). If a Copermittee has less than 5 major outfalls within the WMA, the Copermittee will monitor all its major MS4 outfalls with persistent flow. The Copermittees selected dry weather MS4 outfall discharge monitoring stations from the inventories developed pursuant to Provision D.2.b.(2)(a) for the San Diego Bay WMA as follows:

- *Based upon the dry weather MS4 outfall discharge field screening monitoring records developed pursuant to Provision D.2.a.(2)(c), each Copermittee must identify and prioritize the MS4 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.*

A.2.2.3.2 Monitoring Locations and Frequency

The major MS4 outfalls with non-storm water persistent flows selected by each Copermittee are presented in Table A2-3 and mapped in Figure A2-2.

Each selected major outfall will be monitored 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 MS4 outfalls remain within the Copermittee's jurisdiction in the San Diego Bay WMA:

- The non-storm water discharges have been effectively eliminated (i.e., no flowing, pooled, or ponded water) for three consecutive non-storm water monitoring events.
- The source of the persistent flows has been identified as a category of non-storm water 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-storm water discharge do not exceed NALs.
- The source of the persistent flows has been identified as a non-storm water 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 MS4 outfalls in the Water Quality Improvement Plan Annual Report.

Table A2-3
Selected Major MS4 Outfalls for Non-Storm Water Persistent Flow Monitoring

Jurisdiction	Dry Weather Outfall Stations	HA or HSA	Latitude	Longitude
City of Chula Vista	RC-8	909.12	32.64437	-117.00262
	RH-1	910.32	32.66018	-116.94133
	SC-2	910.20	32.61855	-116.95102
	SW-1	910.20	32.60811	-117.09231
	TC-35	909.11	32.64729	-116.968793
City of Coronado	Outfall No. 16	910.1	32.70003	-117.17182
City of Imperial Beach	H-outfall	910.1	32.589468	-117.113711
	K-outfall	910.1	32.588304	-117.107516
City of La Mesa	908-UNI-001	908.22	32.75463	-117.04908
	908-UNI-002	908.22	32.75498	-117.04639
	908-UNI-004	908.22	32.76308	-117.02855
	909-SPR-001	909.12	32.75483	-117.00118
	909-SPR-002	909.12	32.76324	-117.00118
City of Lemon Grove	Site 69	908.22	32.7347	-117.05626
City of National City	32	909.12	32.65887	-117.08274
	43B	908.32	32.65496	-117.10223
	433	908.31	32.686076	-117.100612
	762	908.32	32.67344	-117.09848
	775	908.32	32.66158	-117.10284
Port of San Diego[1]	Site 2172.1	919.12	32.625611	-117.101921
	Site CSD145	908.1	32.718884	-117.231408
	Site 1271.1	908.21	32.727256	-117.176754
	Site C3-2.1	910.1	32.69697	-117.165551
	Site 2941.1	909.12	32.627538	-117.107337
Airport Authority	None. Both outfalls are tidal.	N/A	N/A	N/A
City of San Diego	DW0120	908.22	32.74385	-117.0802
	DW0203	908.22	32.69642	-117.122397
	DW0179	908.32	32.6995067	-117.0357083
	DW0121	908.22	32.74102	-117.1439
	DW0225	910.20	32.576139	-117.087742
County of San Diego	MS4-SWT-021	909.12	32.66561	-117.02409
	MS4-SWT-023	909.12	32.65221	-117.04956
	MS4-SWT-030	909.21	32.72662	-116.9835
	MS4-SWT-055	909.12	32.74139	-117.01119
	MS4-SWT-235	909.22	32.75674	-116.91961

Note: HA = Hydrologic Area; HSA = Hydrologic Sub-Area; TBD = to be determined

1. Only 2 of the Ports Outfalls are persistent, but five are monitored.

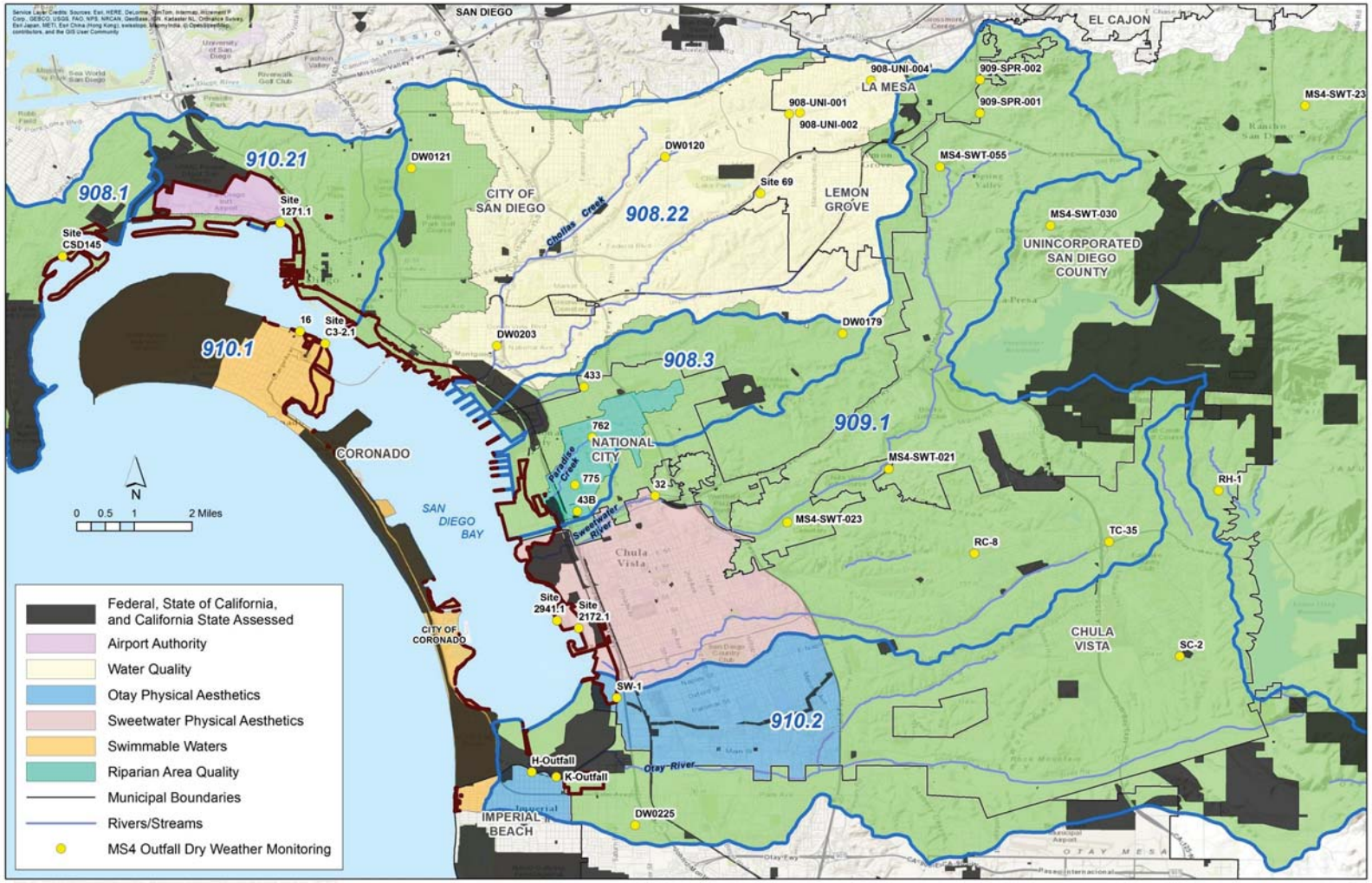


Figure A2-2
Selected Major MS4 Outfalls for Non-Storm Water Persistent Flow Monitoring

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A.2.2.3.3 Field Observations

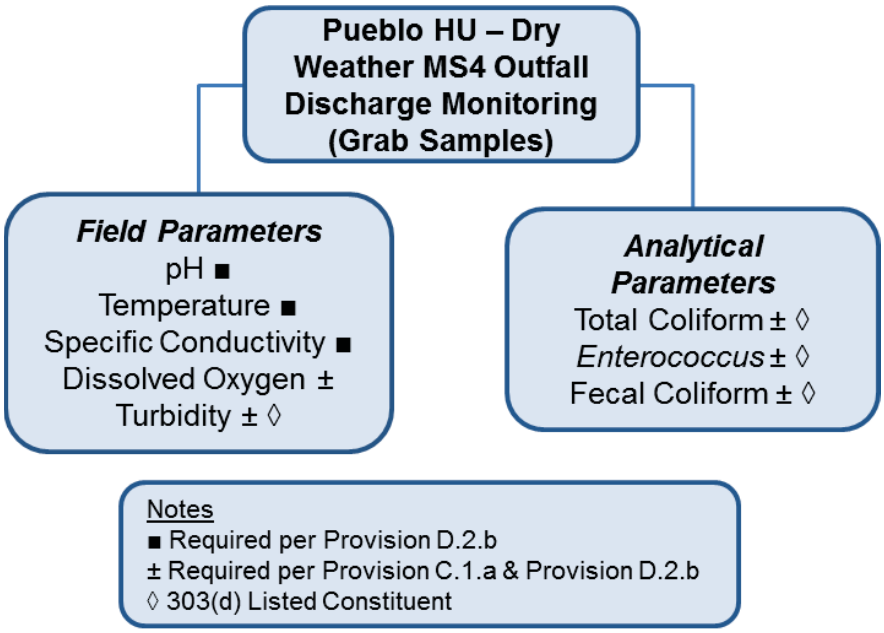
During the monitoring events, field observations will be recorded at each of the selected major outfall persistent flow monitoring sites. Flow estimation will be performed as described in Attachment A.

A.2.2.3.4 Field Monitoring

During the monitoring events, *in-situ* measurements for field monitoring parameters will be collected at each of the selected major outfall persistent flow monitoring sites. Field monitoring parameters include:

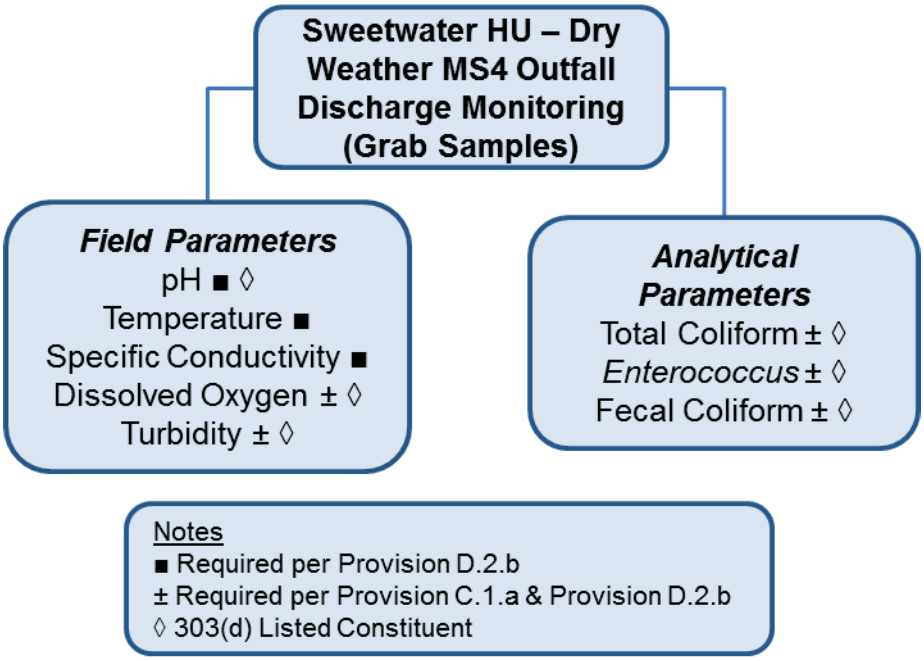
- pH
- Temperature
- Specific conductivity
- Dissolved oxygen
- Turbidity

Field monitoring will be documented on a field observation form. Analytical methods and detection limits for field monitoring parameters are provided in Figure A2-3, A2-4, A2-5 and A2-6.



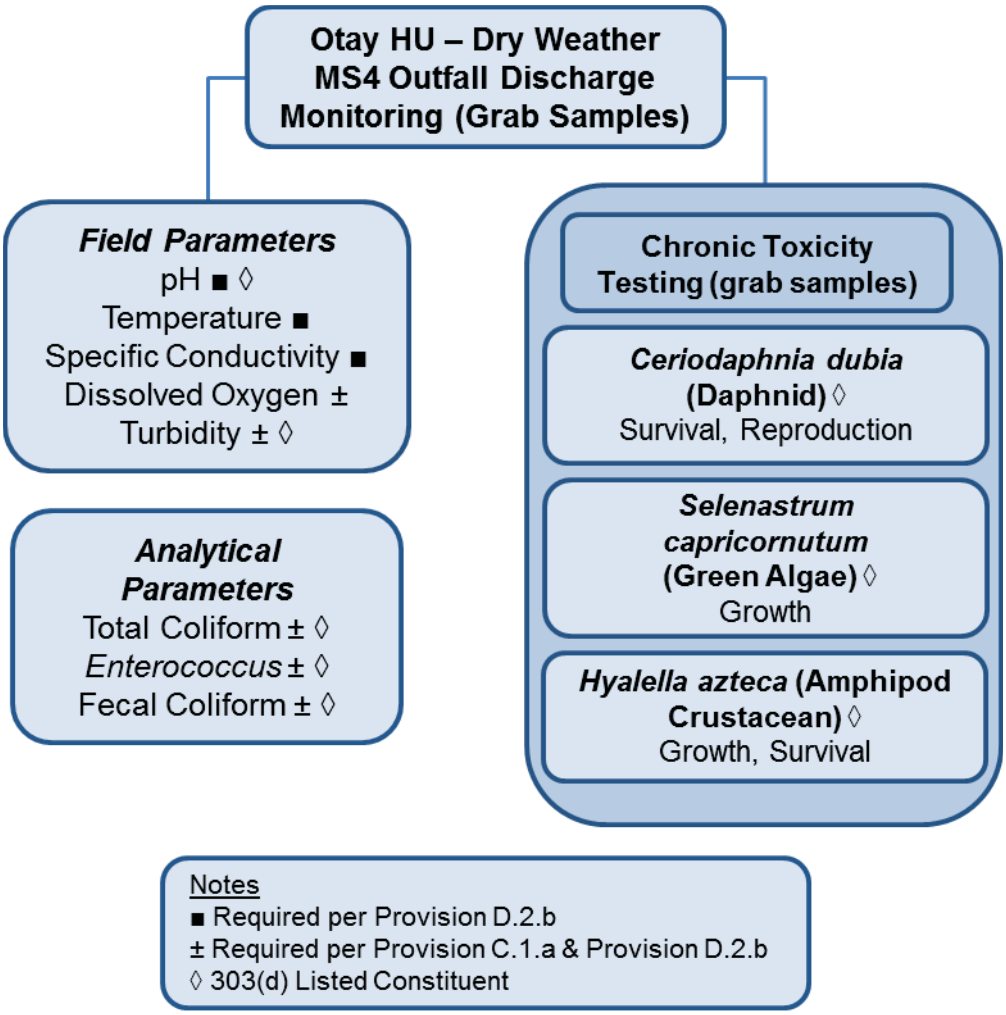
Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-3
Pueblo HU – Dry Weather MS4 Outfall Discharge Monitoring Grab Samples



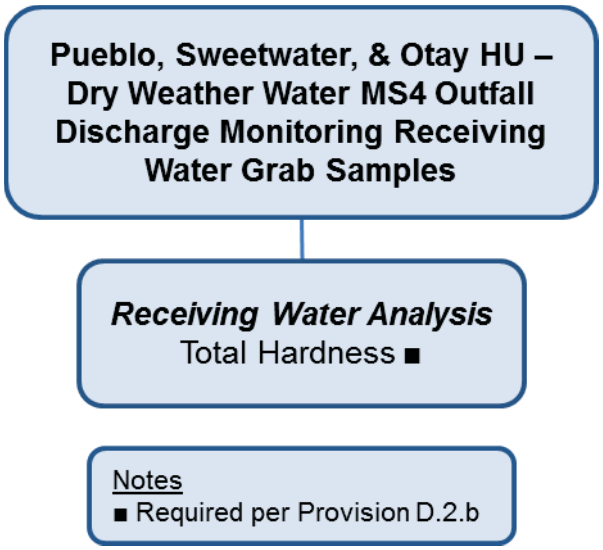
Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-4
Sweetwater HU – Dry Weather MS4 Outfall Discharge Monitoring Grab Samples



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-5
Otay HU Dry – Weather MS4 Outfall Discharge Monitoring Grab Samples



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-6
Pueblo, Sweetwater, & Otay HU – Dry Weather MS4 Outfall Discharge Monitoring Receiving Water Grab Samples

A.2.2.3.5 Analytical Monitoring

A.2.2.3.5.1 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 according to the procedures described in Attachment B, and will follow Surface Water Ambient Monitoring Program (SWAMP) protocols. Quality assurance and quality control procedures are outlined in Attachment C.

A.2.2.3.5.2 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 Bay WMA Water Quality Improvement Plan

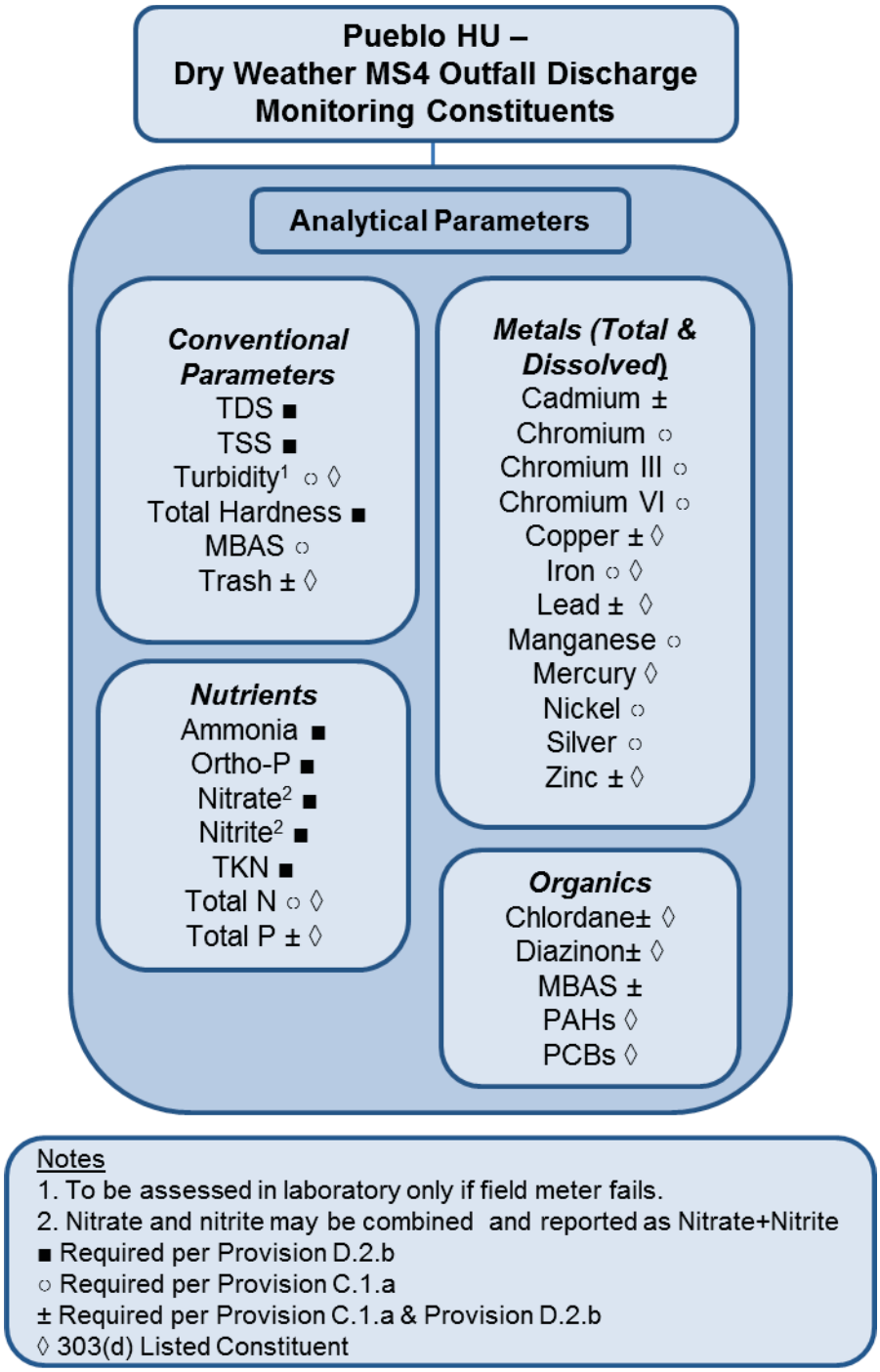
(2) Constituents listed as a cause for impairment of receiving waters in the San Diego Bay WMA as listed on the 303(d) list

(3) Constituents for implementation plans or load reduction plans (e.g., Bacteria Load Reduction Plans, Comprehensive Load Reduction Plans) developed for the San Diego Bay WMA where the Copermittees are listed RPs to a Total Maximum Daily Load (TMDL)

(4) Applicable NAL constituents listed in Provision C.1 of the MS4 Permit

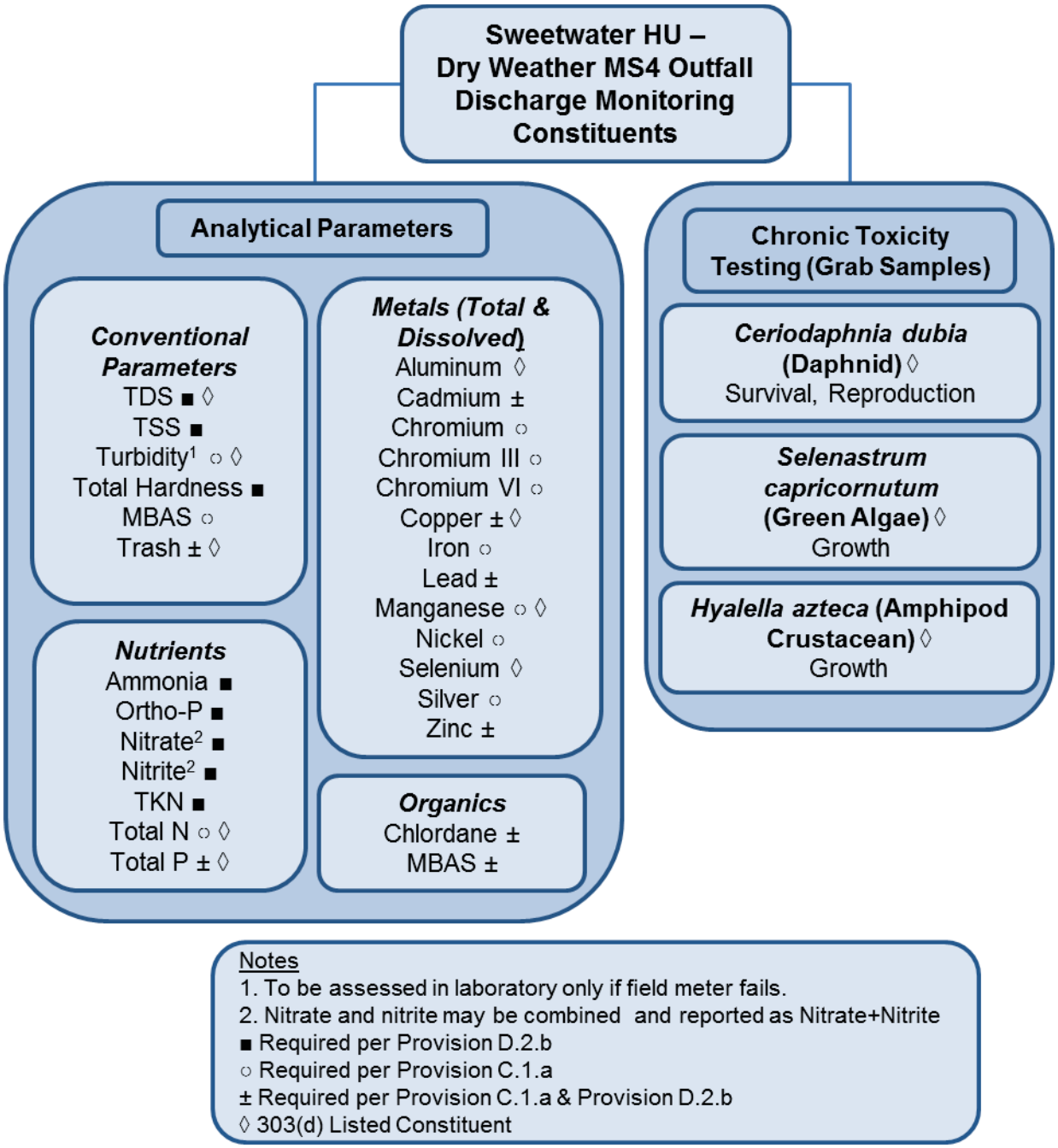
(5) Constituents listed in Table D-7 of the MS4 Permit

Figures A2-7, A2-8, and A2-9 detail the analyses required for selected MS4 outfall non-persistent flow monitoring. Appendix A5 details the analytes required for MS4 outfall for persistent flow monitoring including analytical methods and detection limits. Analytes that are field measured are not required to be analyzed by a laboratory. Chemical 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 should also be a participant of the Stormwater Monitoring Coalition's Intercalibration Program. Quality assurance and quality control procedures for laboratory analysis are outlined in Attachment C.



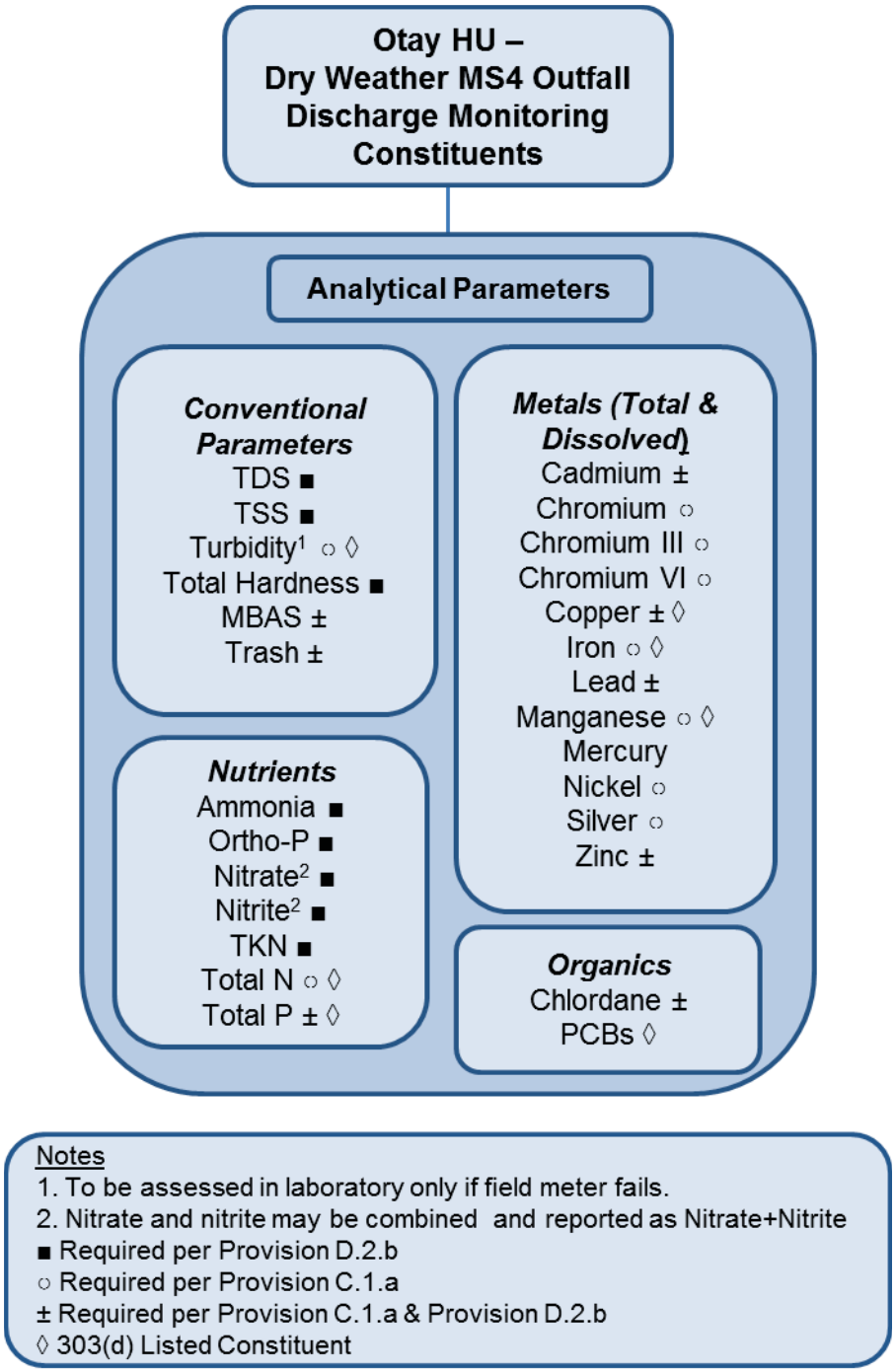
Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-7
Pueblo HU Dry Weather MS4 Outfall Discharge Monitoring Constituents



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-8
Sweetwater HU Dry Weather MS4 Outfall Discharge Monitoring Constituents



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-9
Otay HU Dry Weather MS4 Outfall Discharge Monitoring Constituents

A.2.3 Wet Weather MS4 Outfall Discharge Monitoring

This section details the wet weather MS4 outfall monitoring required to comply with the MS4 Permit. Each Copermittee is required to perform wet weather MS4 outfall monitoring to identify pollutants in storm water discharges from the MS4s, 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 MS4 Permit.

A.2.3.1 Storm Water MS4 Outfall Discharge Monitoring

Each Copermittee is required to perform wet weather MS4 outfall prioritization and monitoring to aid in the identification of pollutants in storm water discharges from the MS4s, 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 MS4 Permit.

A.2.3.1.1 Outfall Prioritization

The Copermittees selected wet weather MS4 outfall discharge monitoring stations from the inventories developed pursuant to Provision D.2.a.(3).(a).(1) of the MS4 Permit for the San Diego Bay WMA as follows:

- At least five wet weather MS4 outfall discharge monitoring stations that are representative of storm water discharges from areas consisting primarily of residential, commercial, industrial, and typical mixed-use land uses present within the Watershed Management Area
- At least one wet weather MS4 outfall discharge monitoring station for each Copermittee within the Watershed Management Area

The Copermittees may adjust the wet weather MS4 outfall discharge monitoring locations in the San Diego Bay WMA, as needed, to identify pollutants in storm water discharges from MS4s, 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 Bay WMA Water Quality Improvement Plan.

A.2.3.1.2 Monitoring Locations and Frequency

The monitoring locations for wet weather MS4 outfall monitoring are provided in Table A2-4 and are mapped in Figure A2-10.

Table A2-4
Wet Weather MS4 Outfall Monitoring Locations

Jurisdiction	Wet Weather Outfall Stations	HA or HSA	Latitude	Longitude
City of Chula Vista	SC-19	910.20	32.651985	-116.948903
City of Coronado	Outfall No. 59 & 60	910.10	32.68661	-117.193424
City of Imperial Beach	K-outfall ("K-2")g	910.20	32.58832	-117.10747
City of La Mesa	Outfall 908-UNI-MASS	908.22	32.754663	-117.043269
City of Lemon Grove	Site 69	908.22	32.7347	-117.05626
City of National City	44B (Paradise, HSA 908.32)	908.32	32.66974	-117.10247
Port of San Diego	CV-1	909.12	32.629627	-117.108012
Airport Authority	Upstream from Outfall 12	908.21	32.73635	-117.207699
City of San Diego	DW797	908.32	32.69541	-117.05776
County of San Diego	COSD MS4 SDB01	909.12	32.667388	-117.021871

Notes:

HA = Hydrologic Area; HSA = Hydrologic Sub-Area

Per the requirements of the MS4 Permit, each Copermittee will monitor its wet weather MS4 outfall discharge monitoring station(s) in the San Diego Bay WMA once annually.

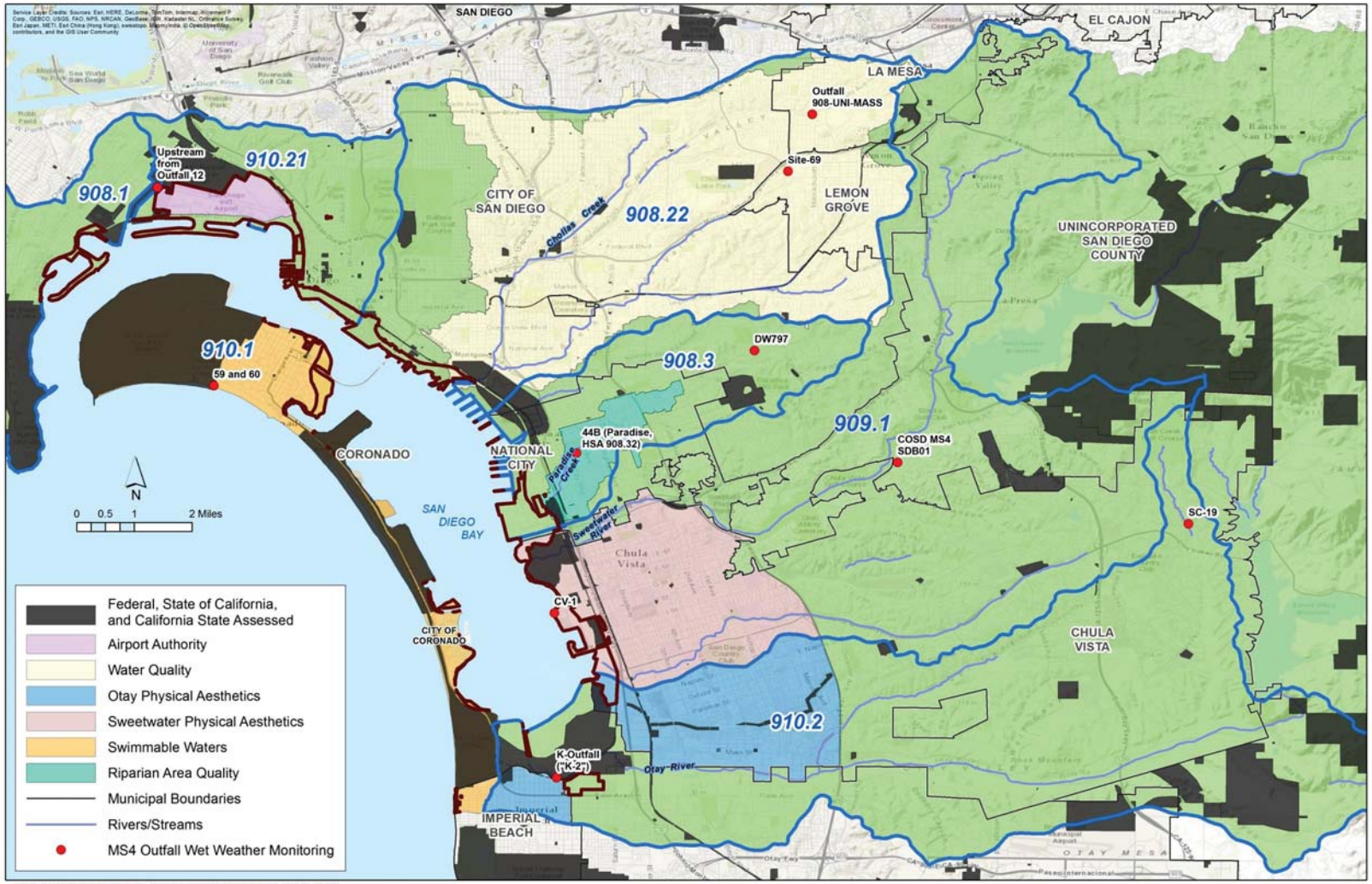


Figure A2-10
Selected MS4 Outfalls Wet Weather Discharge Monitoring

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A.2.3.1.2.1 Wet Weather Events

For each wet weather monitoring event, the following narrative descriptions and observations will be recorded at each wet weather MS4 outfall discharge monitoring station:

- 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

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 and at least a 70 percent chance of rainfall. The mobilization criteria must be met at least 24 hours prior to the anticipated onset of rainfall. For the purposes of the criteria, storm forecasts will be obtained from the National Weather Service website (http://www.wrh.noaa.gov/sgx/).

A.2.3.1.3 Field Observations

During the wet weather monitoring event, narrative descriptions and field observations will be recorded at each wet weather MS4 outfall discharge monitoring station. Narrative descriptions and observations include the location, date, and duration of the storm event(s) sampled, rainfall estimates for the storm event(s), and the duration between the sampled storm event and the end of the previous measurable (greater than 0.1 inch of rainfall) storm event.

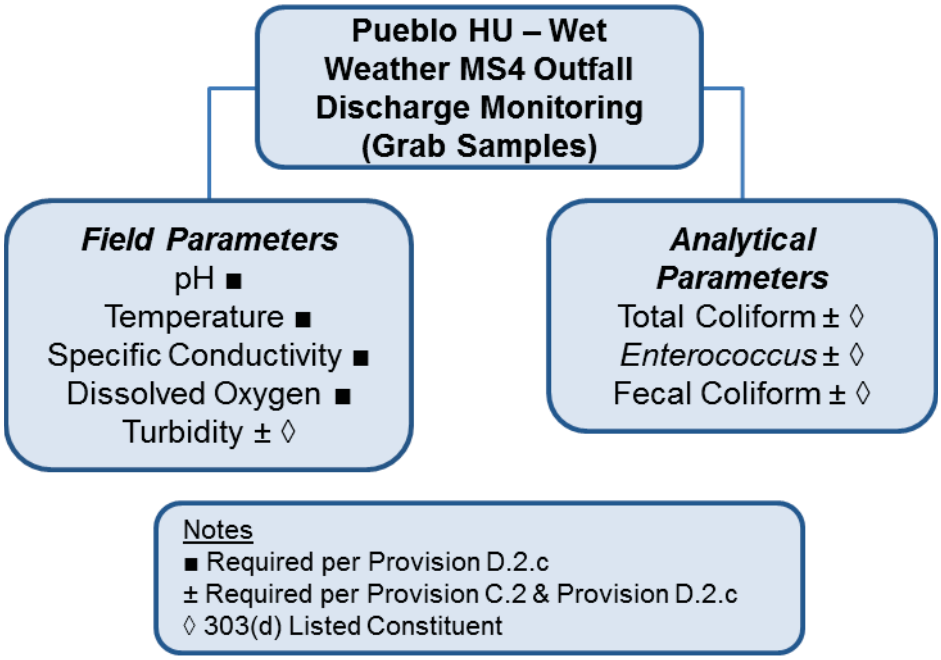
Flow estimation or measurement will be performed as described in Attachment A, using data from nearby United States Geological Survey (USGS) gauging stations, or flow rates may be measured or estimated in accordance with the United States Environmental Protection Agency (USEPA) Storm Water Sampling Guidance Document (EPA-833-B-92-001), Section 3.2.1, or other method proposed by the Copermittees that is acceptable to the RWQCB.

A.2.3.1.4 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:

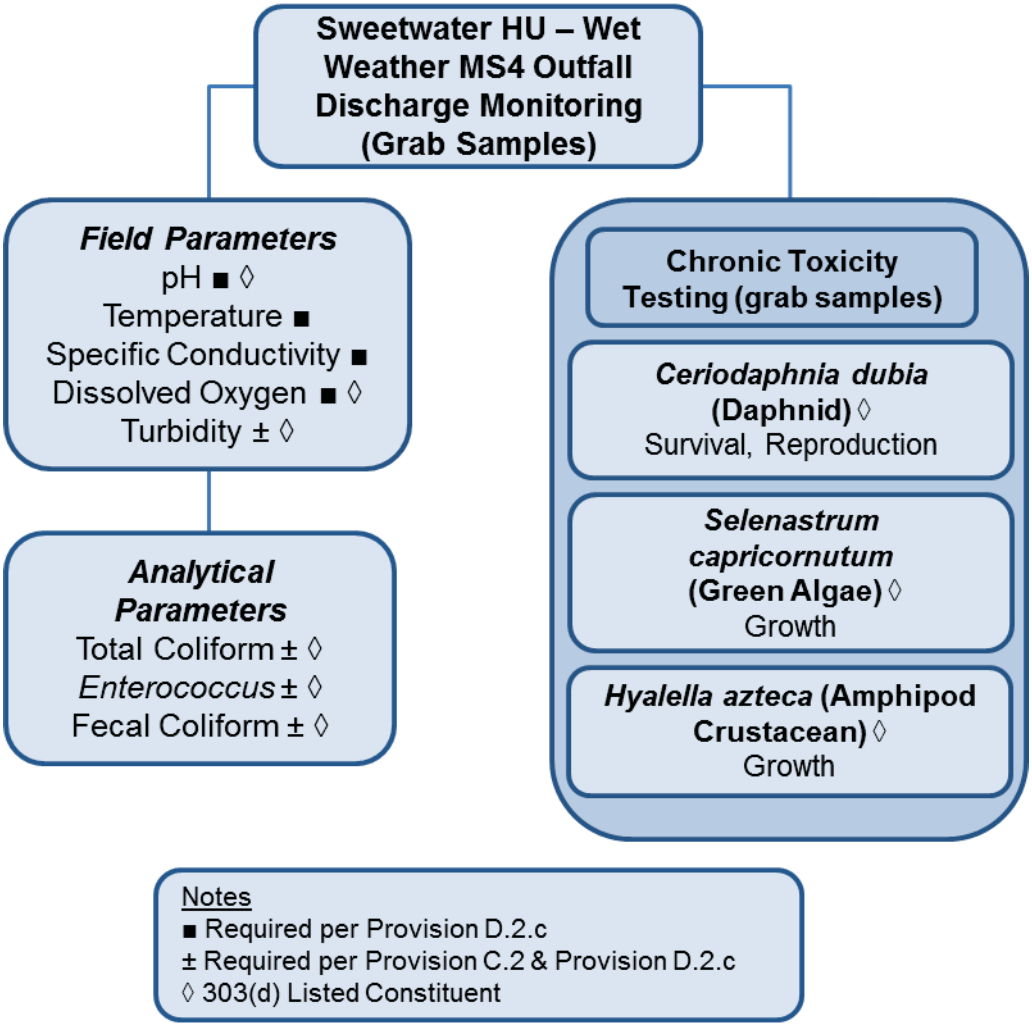
- pH
- Temperature
- Specific conductivity
- Dissolved oxygen
- Turbidity

Field grab parameters are detailed in Figures A2-11, A2-12, A2-13, and A2-14. Analytical methods and detection limits for field monitoring parameters are provided in Appendix A.



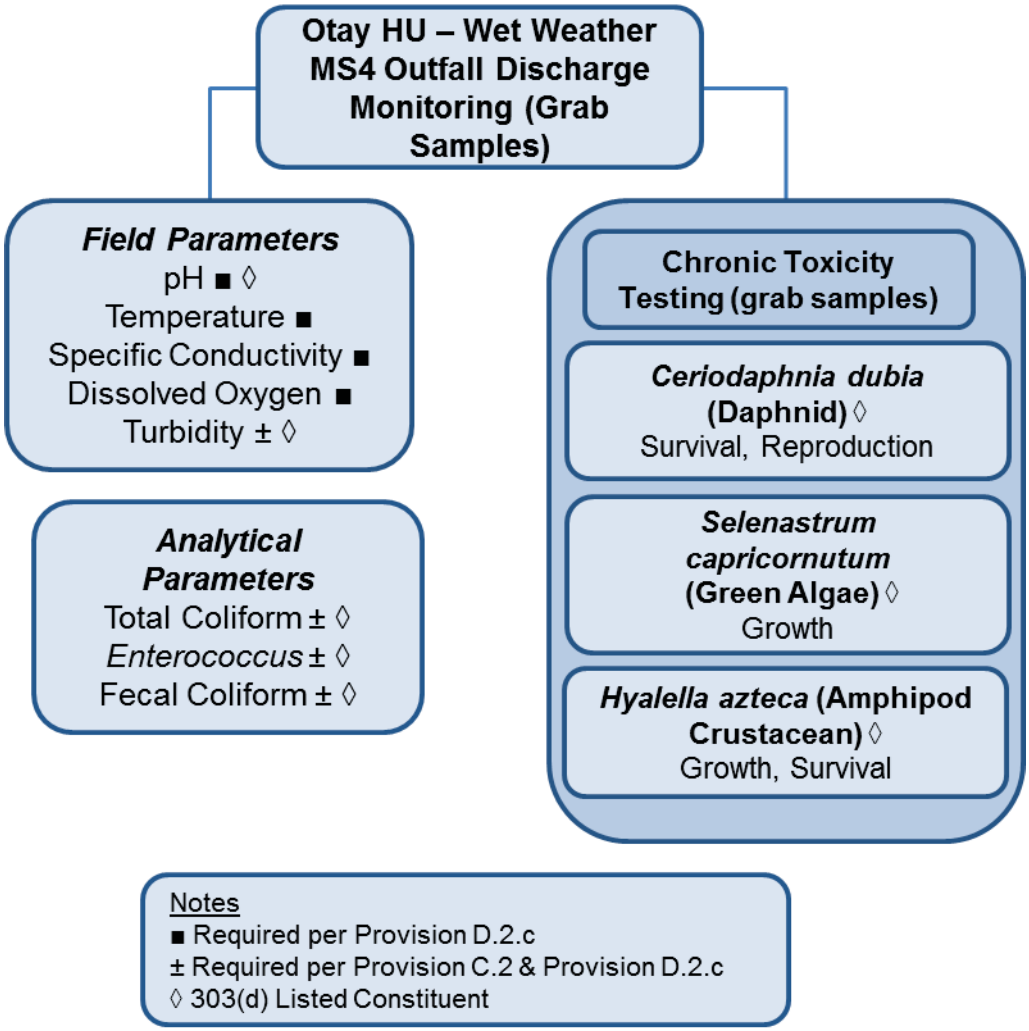
Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-11
Pueblo HU – Wet Weather MS4 Outfall Discharge Monitoring Grab Samples



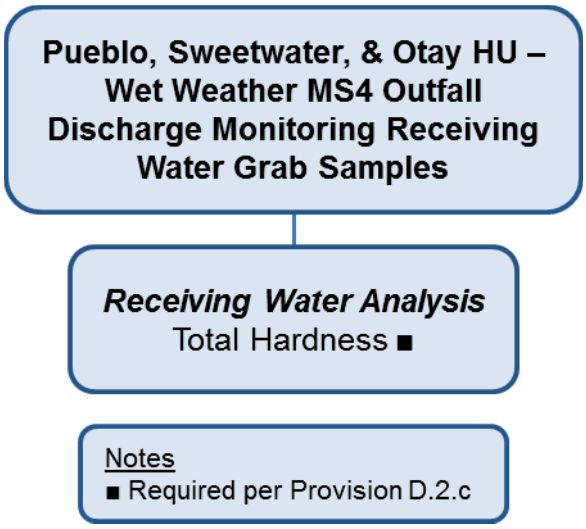
Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-12
Sweetwater HU – Wet Weather MS4 Outfall Discharge Monitoring Grab Samples



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-13
Otay HU – Wet Weather MS4 Outfall Discharge Monitoring Grab Samples



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-14
Pueblo, Sweetwater, & Otay HU – Wet Weather MS4 Outfall Discharge Monitoring Receiving Water Grab Samples

A.2.3.1.5 Analytical Monitoring

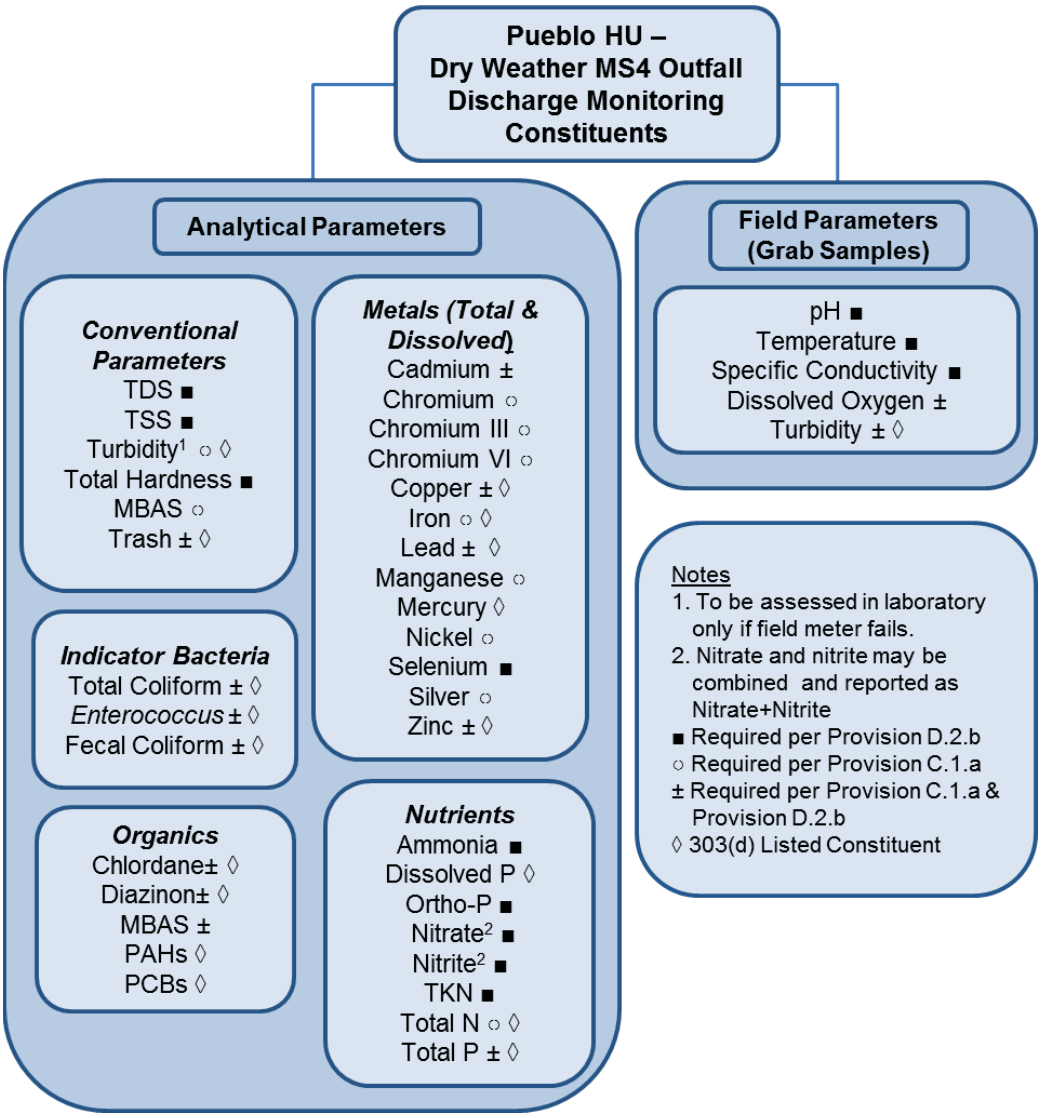
A.2.3.1.5.1 Sample Collection

Samples will be collected as follows:

- Grab samples will be collected for the analytes not amenable to composite sampling. These analytes are noted in Appendix A5. Samples will be collected in accordance with the protocol provided in Attachment B.
- Composite samples will be collected for all other analytes. 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 Attachment B.
    - 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 storm water discharge, or for the entire storm water discharge if the storm event is less than 24 hours at the time intervals listed in Attachment B based on the anticipated size of the storm. Some variation may occur depending on the actual storm intensity and

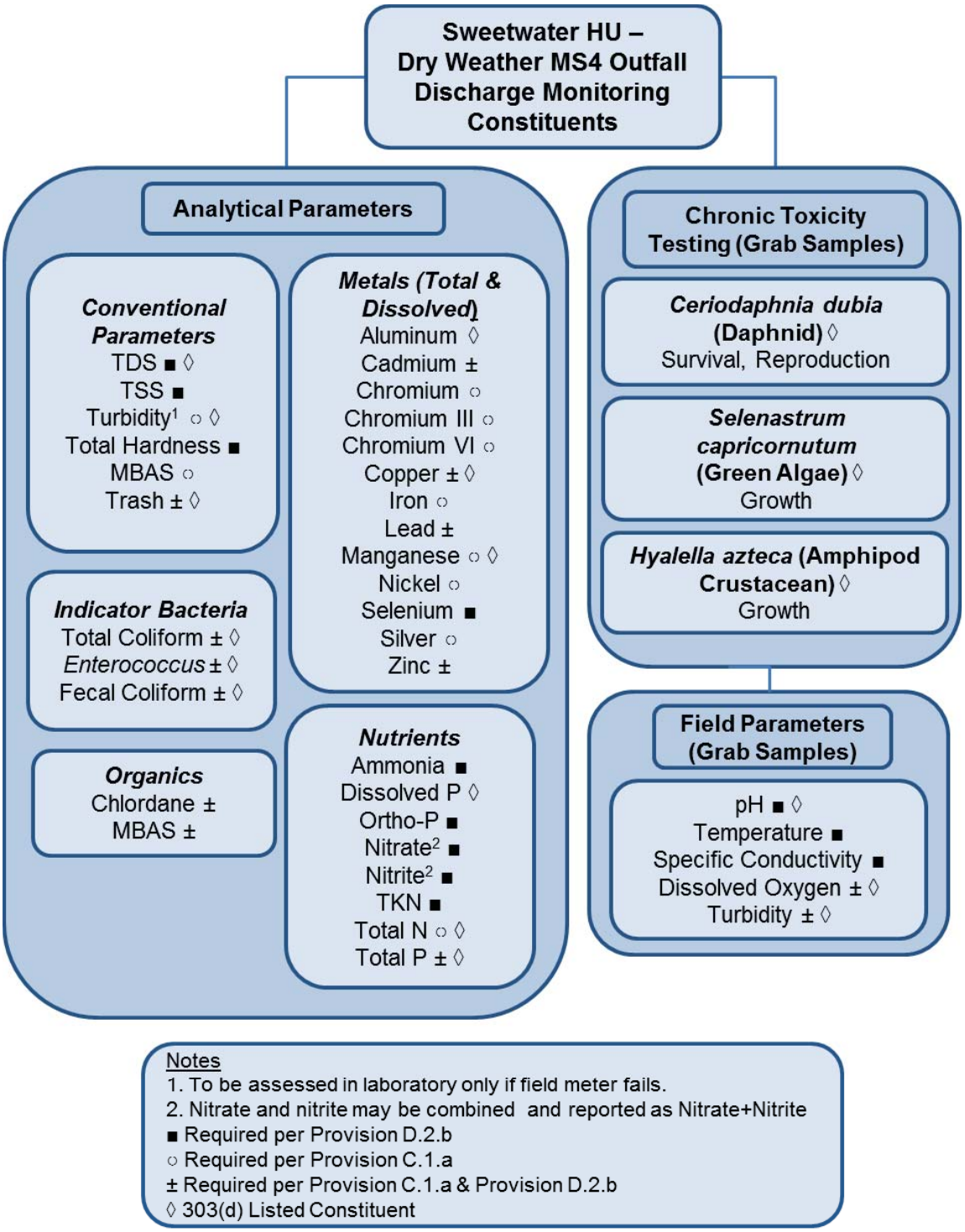
duration. After the storm event, the discrete samples will be composited into one time-weighted composite for chemistry analysis.

Figures A2-15, A2-16, and A2-17 detail the analyses required for selected wet weather MS4 outfall monitoring. Appendix A5 details the analytes required for MS4 outfall for persistent flow monitoring including analytical methods and detection limits. All samples will be collected in accordance with SWAMP protocols. An example COC form is included in Attachment C. Quality assurance and quality control procedures are outlined in Attachment C.



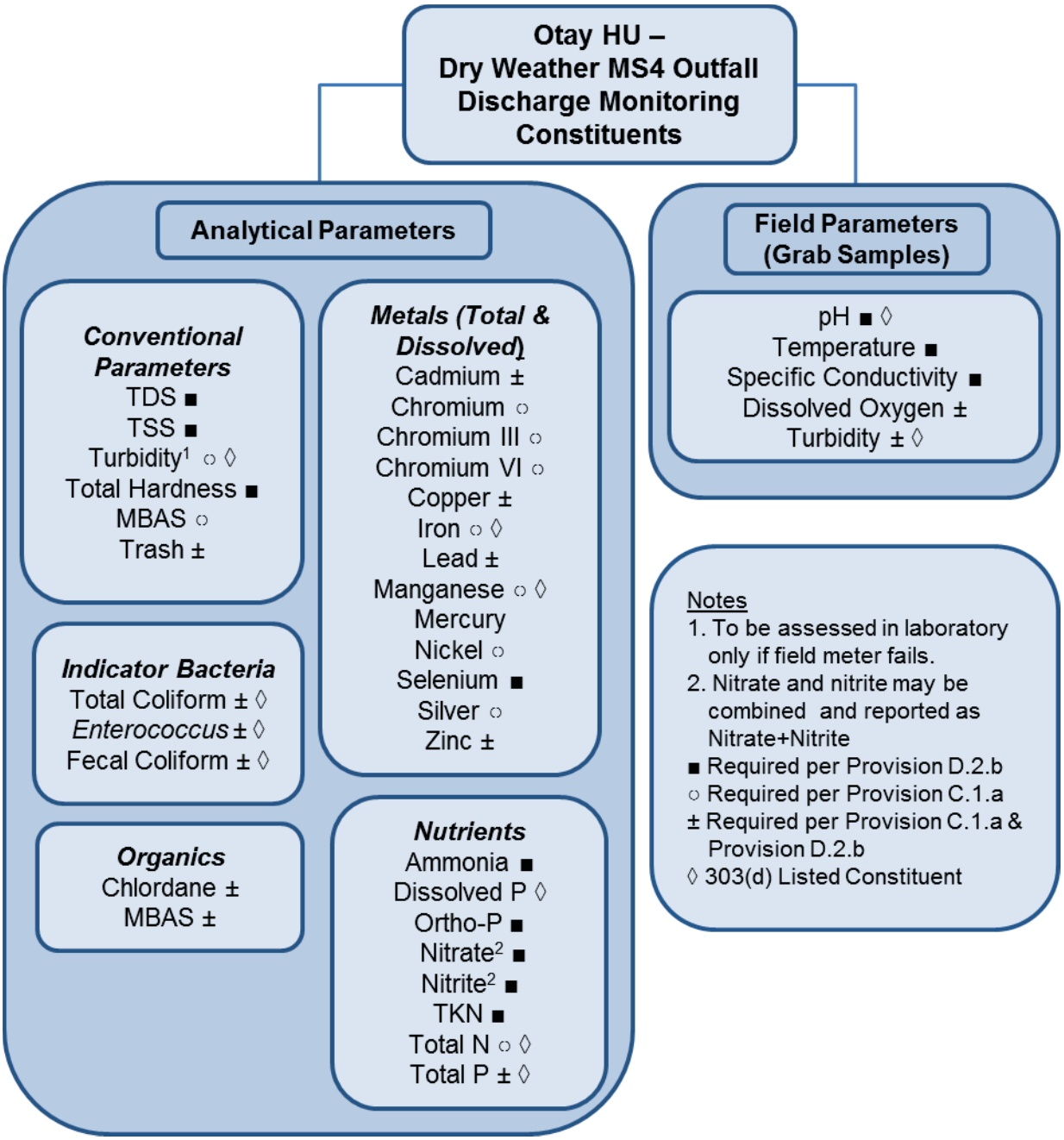
Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-15
Pueblo HU Wet Weather MS4 Outfall Discharge Monitoring Constituents



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-16
Sweetwater HU Wet Weather MS4 Outfall Discharge Monitoring Constituents



Note: This figure describes detailed monitoring procedures and analytical methods that are illustrative and may be revised on the basis of site-specific environmental conditions and equivalent alternate analytical methods.

Figure A2-17
Otay HU Wet Weather MS4 Outfall Discharge Monitoring Constituents

A.2.3.1.5.2 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 Bay WMA Water Quality Improvement Plan

(2) Constituents listed as a cause for impairment of receiving waters in the San Diego Bay WMA 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 Bay WMA where the Copermittees are listed as RPs under a TMDL

(4) Applicable storm water action level (SAL) constituents listed in Provision C.2 of the MS4 Permit.

Appendix A5 details the analyses required for wet weather MS4 outfall monitoring, including analytical methods and detection limits. Analytes that are field measured are not required to be analyzed by a laboratory. Chemical 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 should also be a participant of the Stormwater Monitoring Coalition's Intercalibration Program. Additionally, only one analysis of a collected sample is required. Quality assurance and quality control procedures for laboratory analysis are outlined in Attachment C.

A.2.4 MS4 Outfall Assessment and Monitoring

Each Copermittee must evaluate the data collected pursuant to Provisions D.2.b and D.2.c. Annual reporting assessments are presented in Section D.4.1. Report of Waste Discharge (ROWD) Assessments are presented in Section 4.2.4 of the Water Quality Improvement Plan.

A.2.4.1 Annual Report

The MS4 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 the dry and wet weather monitoring data collected by the Copermittees. Details of the two separate assessments are provided below. Each Copermittee will assess its MS4 monitoring programs and compile results as part of the San Diego Bay WMA Water Quality Improvement Plan Annual Report.

A.2.4.1.1 Dry Weather MS4 Outfall Assessments

Each Copermittee must assess and report the progress of its IDDE program (required pursuant to MS4 Permit Provision E.2) toward effectively prohibiting non-storm water and illicit discharges into the MS4s within its jurisdiction. Additionally, each Copermittee will assess its dry weather MS4 monitoring programs individually and compile results annually as part of the San Diego Bay WMA Water Quality Improvement Plan Annual Report. Assessments are presented below and summarized in Table A2-5.

Table A2-5
Annual Dry Weather MS4 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 Water Quality Improvement Plan 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-storm water 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-storm water discharges	Analyze data collected as part of the MS4 Permit-required dry weather outfall monitoring	
	Use a model or other method to calculate and estimate collective persistent non-storm water discharge volumes and pollutant loads. Specific calculations/estimates include: 1) Annual non-storm water volumes and loads discharged from the Copermittee's major MS4 outfalls to receiving waters within its jurisdiction, with an estimate of the percent contribution from each known source for each MS4 outfall 2) Annual identification and quantification (by volume and pollutant load) of sources of discharged non-storm water not subject to the Copermittee's legal authority	
Evaluate progress in achieving non-storm water volume and load reductions	Identify reductions and progress in achieving reductions	Prove minimum once during Permit cycle in Water Quality Improvement Plan Annual Report
	Assess the effectiveness of Water Quality Improvement Plan improvement strategies, with estimates of volume and load reductions attributed to specific strategies when possible	

Table A2-5 (continued)
Annual Dry Weather MS4 Outfall Assessments

	Identify modifications necessary to increase the effectiveness of Water Quality Improvement Plan strategies	
Identify data gaps	Identify data gaps in the monitoring data necessary to fulfill assessment requirements	Provide annually in Water Quality Improvement Plan Annual Report

- Identify sources of non-storm water discharges.
  - Identify the known and suspected controllable sources (e.g., facilities, areas, land uses, and pollutant generating activities) of transient and persistent flows within the Copermittee's jurisdiction in the San Diego Bay WMA.
  - Identify sources of transient and persistent flows within the Copermittee's jurisdiction in the San Diego Bay WMA that have been reduced or eliminated.
  - Identify modifications of the field screening monitoring locations and frequencies for the MS4 outfalls in Copermittee's inventory necessary to identify and eliminate sources of persistent flow non-storm water discharges (Provision D.2.b).
  - The JRMP Annual Report will be used to guide this assessment in the Water Quality Improvement Plan 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 storm water 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 MS4 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 subwatershed 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-storm water discharges.
  - Based on the data collected and applicable numeric action levels described in San Diego Bay WMA Water Quality Improvement Plan, 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 MS4 outfalls. The Water Quality Improvement Plan 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-storm water 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-storm water 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-storm water 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-storm water 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-storm water discharge do not exceed NALs (Provision C.1).
  - The source(s) of the persistent flows has (have) been identified as a non-storm water 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 MS4 outfall monitoring stations may be reprioritized accordingly for continued dry weather MS4 outfall discharge field screening monitoring as part of the Dry Weather MS4 Outfall Discharge Field Screening Program.
  - Each Copermittee must document removal or reprioritization of the highest priority persistent flow MS4 outfall monitoring stations identified under the Non-Storm Water Persistent Flow MS4 Outfall Discharge Monitoring Program in the Water Quality Improvement Plan Annual Report. When a Copermittee removes a persistent flow MS4 outfall monitoring station, it will be replaced with the next highest prioritized major MS4 outfall designated by that jurisdiction in the San Diego Bay WMA. If there are no remaining qualifying major MS4 outfalls within its jurisdiction, the number of major MS4 outfalls monitored will be reduced.

- Identify sources contributing to NAL exceedances.
  - For the highest priority major MS4 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 Bay WMA that may cause or contribute to the numeric action limit exceedances and report them annually.
- Estimate volumes and loads of non-storm water discharges.

- Annually, each Copermittee must (1) analyze the data collected as part of the Non-Storm Water Persistent Flow MS4 Outfall Discharge Monitoring Program from the highest priority major MS4 outfalls, and (2) use a model or another method to calculate or estimate and report the non-storm water volumes and pollutant loads collectively discharged from all the major MS4s 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 MS4 outfall
  - The annual non-storm water volumes and pollutant loads collectively discharged from the Copermittee's major MS4 outfalls to receiving waters within the Copermittee's jurisdiction
  - The annual volumes and pollutant loads for sources of non-storm water not subject to the Copermittee's legal authority that are discharged from the Copermittee's major MS4 outfalls to downstream receiving waters

- Evaluate progress in achieving non-storm water volume and load reductions
  - Based on evaluation of the data collected under the dry weather MS4 outfall monitoring program and annual assessments performed, the following assessments must be performed a minimum of once per Permit cycle:
    - Identify reductions and progress in achieving reductions in non-storm water and illicit discharges to the Copermittee's MS4 system.
    - Evaluate the effectiveness of the water quality improvement strategies being implemented toward reducing or eliminating non-storm water and pollutant loads discharging from the Copermittee's MS4 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 Water Quality Improvement Plan strategies being implemented toward reducing or eliminating non-storm water and pollutant loads discharging from the MS4 to receiving waters.

- Identify data gaps
  - Identify gaps in the monitoring data necessary to fulfill annual dry weather MS4 outfall assessment and reporting requirements on an annual basis.

A.2.4.1.2 Wet Weather Outfall Assessments and Illicit Discharges

The Copermittees must assess and report the progress of the water quality improvement strategies implemented as part of the Water Quality Improvement Plan and the JRMP toward reducing pollutants in storm water discharges from the MS4s. This is designated as the Wet Weather MS4 Outfall Discharge Monitoring Program. The assessment of this program will contain the elements provided below and summarized in Table A2-6.

The elements for assessment of this program include the following:

- Estimate volumes and loads of storm water discharges.
  - As part of the Water Quality Improvement Plan Annual Report, the Copermittees must annually analyze the monitoring data collected as part of the Wet Weather MS4 Outfall Discharge Monitoring Program. This includes calculating or estimating the following for each monitoring year:
    - The average storm water runoff coefficient for each land use type within the San Diego Bay WMA.
    - For storm events with measurable rainfall greater than 0.1 inch, the volume of storm water and pollutant loads discharged from the monitored MS4 outfalls to receiving waters within the San Diego Bay WMA.
    - The total flow volume and pollutant loadings discharged from each Copermittee's jurisdiction within the San Diego Bay WMA over the course of the wet season, extrapolated from the data produced from the monitored MS4 outfalls.
    - For storm events with measurable rainfall greater than 0.1 inch, the percent contribution of storm water volumes and pollutant loads discharged from the land use type within (1) each hydrologic subarea with a major MS4 outfall to receiving waters or (2) each major MS4 outfall to receiving waters.
    - Supporting information for calculations required for this assessment is provided in Attachment D.
- Evaluate Water Quality Improvement Plan analysis.
  - The Copermittees will evaluate the Water Quality Improvement Plan analysis on the basis of the wet weather MS4 outfall monitoring data collected and the applicable storm water numeric action levels (Provision C.2). This evaluation will include analyzing and comparing the monitoring data used to develop the Water Quality Improvement Plan, particularly the strategies, on an annual basis. Additionally, the Copermittees will evaluate whether those analyses should be updated as a component of the adaptive management described in the Water Quality Improvement Plan.

Table A2-6
Annual Wet Weather MS4 Outfall Assessments

Assessment	Component	Reporting
Estimate loads and volumes	Calculate or estimate the average storm water runoff coefficient for each land use type	Provide annually in Water Quality Improvement Plan Annual Report
	Calculate or estimate the volume of storm water and pollutant loads discharged from each monitored MS4 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 storm water volumes and pollutant loads discharged from each land use type within each hydrologic subarea with a major MS4 outfall or each major MS4 outfall for each qualifying storm event	
Evaluate Water Quality Improvement Plan analysis	Using data and applicable SALs, analyze and company to the analyses and assumptions used to develop the Water Quality Improvement Plan	
	Evaluate whether analyses and assumptions should be updated as a component of the adaptive management efforts	
Evaluate progress in achieving storm water pollutant reductions	Identify reductions and progress in achieving reductions from different land uses and/or drainage areas	Provide minimum once during Permit cycle in Water Quality Improvement Plan Annual Report
	Assess the effectiveness of Water Quality Improvement Plan improvement strategies, with estimates of volume and load reductions attributed to specific strategies when possible.	
	Identify modifications necessary to increase the effectiveness of Water Quality Improvement Plan strategies	
Identify data gaps	Identify data gaps in the monitoring data necessary to fulfill assessment requirements	Provide annually in Water Quality Improvement Plan Annual Report

- Evaluate progress in achieving storm water pollutant reductions.
  - Based on evaluation of the data collected under the wet weather MS4 outfall monitoring program and annual assessments performed, the following assessments must be performed a minimum of once per Permit cycle:
    - Identify reductions and progress in achieving reductions in storm water discharges to the Copermittee's MS4 system from different land uses and/or drainage areas
    - Evaluate the effectiveness of the water quality improvement strategies being implemented toward reducing pollutants in storm water discharging from the Copermittee's MS4 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 Water Quality Improvement Plan strategies being implemented toward reducing pollutants discharging from the MS4 to receiving waters.
- Identify data gaps
  - Identify gaps in the monitoring data necessary to fulfill annual wet weather MS4 outfall assessment and reporting requirements on an annual basis.

A.2.4.2 Data Management and Reporting

Data sharing templates have been developed to support reporting under previous Permit cycles. Copermittees will leverage existing data sharing templates in order to facilitate compilation of WMA-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

Attachment A
Flow Monitoring and Equipment Calibration Procedures

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Flow Monitoring and Equipment Calibration Procedures

This attachment describes the methodologies and equipment that are proposed to be used to complete flow monitoring and field measurements for the MS4 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 described in Appendix D.

Flow Monitoring

Dry Weather MS4 Outfall Flow Monitoring

Field-Based Flow Estimation

During non-storm water screening and MS4 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”.

Equipment-Based Flow Estimation

Copermittees may choose to perform optional equipment-based flow monitoring of non-storm water persistent flows. Equipment-based flow estimation procedures are described in Section B.1.2.1.

Wet Weather MS4 Outfall Flow Monitoring

During wet weather MS4 outfall monitoring, the flow rates and volumes will be measured or estimated from the MS4 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.

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 MS4 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 MS4 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 A-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 A-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 A-3).

Figure A-1
Sigma 910 Flowmeter and Area/Velocity Pressure Sensor

Figure A-2
HOBO Level Logger

Figure A-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.

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.

Equipment Calibration

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.

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.

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.

Attachment B
Sample Collection Procedures

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Sample Collection Procedures

This attachment describes the sampling procedures for the MS4 Outfall Monitoring Program.

Dry Weather MS4 Outfall Sample Collection

For dry weather monitoring events, the Copermittees will collect and analyze grab samples from each dry weather MS4 outfall discharge monitoring station to satisfy the requirements of the MS4 Permit. Analytes that are field measured are not required to be analyzed by a laboratory.

Wet Weather MS4 Outfall Sample Collection

For wet weather monitoring events, the Copermittees will collect and analyze samples from each wet weather MS4 outfall discharge monitoring station to satisfy the following requirements in accordance with the MS4 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 storm water discharge, or for the entire storm water 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 B-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 B-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 B.

A field observation data sheet will be completed 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.

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.

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.

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.

Confined Space

Several monitoring locations for this project are located in the underground MS4 system. To install, maintain, and uninstall monitoring equipment within the MS4, confined space entry will need to be performed. Confined spaces are defined as any space with only one entry and exit point; therefore, an MS4 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 MS4 prior to any personnel entering the system. If the MS4 is unsafe for entry, field personnel may attempt to ventilate the space. If the MS4 is still determined to be unsafe for entry, then no personnel will enter the MS4. Once the MS4 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 MS4, 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.

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)).

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Attachment C
Quality Assurance/Quality Control Procedures

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QUALITY ASSURANCE / QUALITY CONTROL

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 C-1

Table C-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.

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.

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.

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.

Temperature Blank

A temperature blank will be used to ensure that sample holding temperatures were maintained from sample collection through delivery to the laboratory.

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.

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 C-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 C-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

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 C-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	–	–	–	–	–	–	–	✓

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 specified in Appendix F. 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.

$$Completeness = \frac{Actual\ number\ of\ samples\ collected}{\text{Project required total samples to be collected}} * 100 \quad \text{Equation 2}$$

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.

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 D
Volume and Load Estimate Calculations

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Calculation of Runoff Volumes and Load Estimations for Assessment and Reporting

The methods to complete the Wet Weather MS4 outfall discharge monitoring assessment, as described in the Transitional Wet Weather MS4 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 MS4 Permit based on the MS4 wet weather monitoring data collected during the 2013-2014 and 2014-2015 wet seasons. Section II.D.4.b.(2)(b) of the MS4 Permit states:

(b) Based on the transitional wet weather MS4 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 storm water runoff coefficient for each land use type within the Watershed Management Area;
  - [b] The volume of storm water and pollutant loads discharged from each of the Copermittee's monitored MS4 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 MS4 outfalls; and
  - [d] The percent contribution of storm water volumes and pollutant loads discharged from each land use type within each hydrologic subarea with a major MS4 outfall to receiving waters or within each major MS4 outfall to receiving waters in the Copermittee's jurisdiction within the Watershed Management Area for each storm event with measurable rainfall greater than 0.1 inch.
- (ii) Identify modifications to the wet weather MS4 outfall discharge monitoring locations and frequencies necessary to identify pollutants in storm water discharges from the MS4s in the Watershed Management Area pursuant to Provision D.2.c.(1) (RWQCB, 2013).

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 MS4 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 D-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 D-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 D-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
Residential: Rural	1000	Spaced Rural Residential

Table D-1. Assessment Land Use Categories Developed from SanGIS Land Use Classes (Continued)

Assessment Land Use Category	SanGIS Land Use Classification	
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 D-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

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:

$$Runoff\ "C"_{Outfall\,Actual} = \left(\frac{Monitored\ StormWater\ Runoff\ Volume}{Area \times Rainfall} \right)_{Outfall} (UC)$$

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:

$$Runoff\ \ "C"_{WMALU} = \frac{\sum\left(Runoff\ \ "C" \times Area\right)_{OutfallLU}}{\sum Area_{OutfallLU}}$$

Monitored Outfalls Annual Runoff Volumes and Pollutant Loads Calculations

The annual stormwater runoff volumes and pollutant loads discharged from monitored MS4 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:

$$StormWaterVolume_{Outfall} = \left(Runoff\ \ "C"_{OutfallActual} \times Area_{Outfall}\right)\left(\sum Rainfall_{Event}\right)\left(UC\right)$$

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 MS4 outfall will be calculated based on the calculated annual volume and the chemistry results specific to each outfall as follows:

$$Pollutant\ Load_{Outfall} = \left(Storm\ WaterVolume \times Pollutant\ Concentration\right)_{Outfall}\left(UC)\right)$$

Where:

$$UC = \left(\frac{28.317\ L}{1\ ft^3}\right)\left(\frac{1\ g}{1000\ mg}\right)\left(\frac{1\ lbs}{453.592\ _g}\right), for\ \frac{mg}{L}\ concentration\ units;$$

$$UC = \left(\frac{28.317\ L}{1\ ft^3}\right)\left(\frac{1\ g}{10^6\ \mu g}\right)\left(\frac{1\ lbs}{453.592\ _g}\right), for\ \frac{\mu g}{L}\ concentration\ units;or$$

Watershed Management Area Jurisdictional Annual Runoff Volumes and Pollutant Loads Calculations

The total flow volume and pollutant loads discharged from each Copermittee's jurisdiction within the WMA over the course of the wet season will be calculated based on the data produced from monitoring MS4 outfalls during the 2013-2014 and 2014-2015 wet seasons. The WMA 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 MS4 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 MS4 will be calculated using the land use data, WMA 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 WMA 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 WMA area. An ALERT rain gauge located within the WMA will be selected for the volume calculations. In the event that data from more than one ALERT gauge are available for the WMA, 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 WMA 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 WMA during the wet season:

$$Storm\ Water\ Volume_{WMAJurisdLU} = \left(Runoff\ \ "C"_{WMALU}\right)\left(Area_{WMALU}\right)\left(\sum Rainfall_{Event}\right)\left(UC\right)$$

Where:

$$UC = \left(\frac{1\ ft}{12\ in}\right)\left(\frac{43{,}560\ ft^2}{1\ acre}\right)$$

$$StormWaterVolume_{WMAJurisd,} = \sum StormWaterVolume_{WMAJurisdLU}$$

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 WMA 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:

$$EMC_{OutfallActual} = Sampling\ \ Chemisty\ Result_{Outfall}$$

The overall or comingled outfall typical EMC for each measured constituent will be calculated using the following formula:

$$EMC_{OutfallCalculated} = \frac{\sum\left(Area_{OutfallLU} \times Runoff\ "C"_{OutfallLU} \times Typical\ EMC_{LU}\right)}{\sum\left(Area_{OutfallLU} \times Runoff\ "C"_{OutfallLU}\right)}$$

An EMC correction factor will be calculated for each constituent for each monitored outfall using the following formula:

$$CF_{OutfallEMC} = \frac{EMC_{OutfallActual}}{EMC_{OutfallCalculated}}$$

For each monitored outfall for each constituent, the calculated EMC correction will be applied to the land use type typical EMC value as follows:

$$EMC_{OutfallLU} = CF_{OutfallEMC} \times Typical\ EMC_{LU}$$

The calculation results for the monitored outfalls within the WMA will be compiled to determine the EMC value for each constituent of each land use type assessed within the WMA.

$$EMC_{WMALU} = \frac{\sum\left(Runoff\ "C" \times Area \times EMC\right)_{OutfallLU}}{\sum\left(Area \times Runoff\ "C"\right)_{OutfallLU}}$$

The total WMA pollutant load for each constituent within each jurisdiction will be calculated utilizing the follow the formula:

$$Pollutant\ Load_{WMAJurisd,} = \sum\left(StormWaterVolume_{WMAJurisdLU} \times EMC_{WMALU} \times UC\right)$$

Where:

$$UC = \left(\frac{28.317\,L}{1\ ft^3}\right)\left(\frac{1\,g}{1000\,mg}\right)\left(\frac{1\,lbs}{453.592_{\ g}}\right),\ for\ \frac{mg}{L}\ concentration\ units;$$

$$UC = \left(\frac{28.317\,L}{1\ ft^3}\right)\left(\frac{1\,g}{10^6\ \mu g}\right)\left(\frac{1\,lbs}{453.592_{\ g}}\right),\ for\ \frac{\mu g}{L}\ concentration\ units;or$$

$$UC = \left(10\,\frac{100\,mL}{L}\right)\left(\frac{28.317\,L}{1\ ft^3}\right),\ for\ \frac{MPN}{100\,mL}\ EMC\ units;$$

APPENDIX A3. FOCUSED PRIORITY MONITORING PROGRAM – DRAFT MONITORING PLAN

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ACRONYMS AND ABBREVIATIONS

Acronym or Abbreviation	Definition
BMI	benthic macroinvertebrate
CRAM	California Rapid Assessment Method
HA	Hydrologic Area
IBI	Index of Biological Integrity
ID	identification
MS4	municipal separate storm sewer system
Municipal 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
NPDES	National Pollutant Discharge Elimination System
RP	Responsible Party
SOP	standard operating procedure
SWAMP	Surface Water Ambient Monitoring Program
TMDL	total maximum daily load
WMA	Watershed Management Area

A.3 FOCUSED PRIORITY MONITORING

Focused priority monitoring will be implemented as part of the Water Quality Improvement Plan pursuant to 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 Municipal Permit. The goal of the San Diego Bay WMA Focused Priority Monitoring Program is to characterize current conditions and assess progress in the receiving waters, and effectiveness of water quality improvement strategies, if applicable to the focused priority implemented as part of the San Diego Bay WMA Water Quality Improvement Plan.

Focused Priority Monitoring includes the following monitoring to satisfy the requirements of Provision B.4 of the Municipal Permit:

- Riparian Area Monitoring – Paradise Creek
    - City of National City
- Physical Aesthetics Monitoring (Trash) – Sweetwater Hydrologic Area (HA) 909.1 and Otay HA 910.2
    - City of Chula Vista, City of Imperial Beach, and the Port of San Diego
- Swimmable Waters Monitoring – Otay HA 910.1
    - City of Coronado, City of Imperial Beach, and Port of San Diego

Other highest and focused priorities have existing monitoring plans and are discussed in Appendix A.5.

A.3.1 Riparian Area Monitoring – Paradise Creek

The goal of riparian area monitoring at paradise creek is to assess the cumulative impacts of discharges to benthic invertebrates and algae in the Paradise Creek receiving water. Specific monitoring details are provided below.

A.3.1.1 Assessment Locations

Sampling will be conducted in the City of National City along the reach of Paradise Creek within Kimball Park. Figure A3-1 presents the location of the assessment area.

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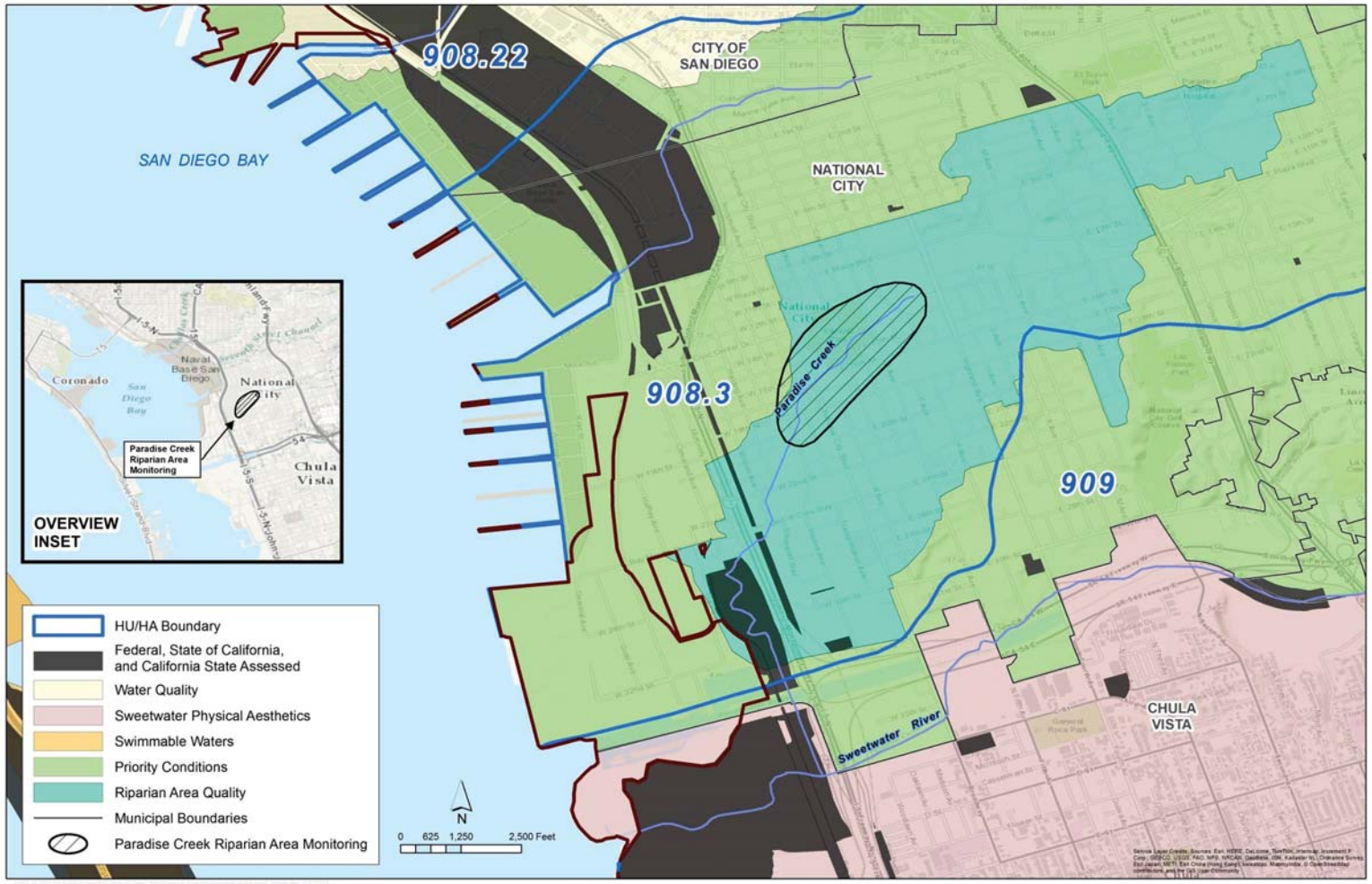

Figure A3-1
Location of Riparian Area Monitoring

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A.3.1.2 Number of Sampling Events

Three (3) dry weather events will be conducted during the Municipal Permit term.

A.3.1.3 Assessment Method

Habitat assessment will be conducted according to the California Rapid assessment Method (CRAM) for estuarine wetlands.[1]

A.3.2 Physical Aesthetics Monitoring – Sweetwater HA 909.1 and Otay HA 910.2

The goal of physical aesthetics monitoring in Sweetwater 909.1 HA and Otay 910.2 HA is to assess and identify receiving waters impacted by trash from the MS4. Specific monitoring details are provided below.

A.3.2.1 Monitoring locations

Sweetwater 909.1 HA monitoring locations under this program are within the jurisdiction of the City of Chula Vista and the Port of San Diego. Otay 910.2 HA monitoring locations under this program are within the jurisdiction of the City of Chula Vista, the Port of San Diego, and the City of Imperial Beach. There are 9monitoring locations in Sweetwater 909.1 HA and three monitoring locations in Otay 910.2 HA. Tables A3-1 present the Paired Receiving Water and MS4 Outfall Stations in the Focused area. Table A3-2 presents the Persistently Flowing Outfall Station Inventory in the Focused area that will be field screened twice during dry conditions. Figure A3-3 presents the location of the paired receiving water and MS4 outfall monitoring stations.

[1] Collins, J.N., E.D. Stein, M. Sutula, R. Clark, A.E. Fetscher, L. Grenier, C. Grosso and A. Wiskind. 2007. *California Rapid Assessment Method (CRAM) for Wetlands and Riparian Areas.* Version 5.0. Available from http://www.cramwetlands.org.

Table A3-1
Paired Receiving Water and MS4 Outfall Stations in Focused Priority Area

Site	Location	Hydrologic Subarea	Latitude	Longitude
C-1	West side of Bay Blvd., south of J St., south side of channel, under road, access from gate east side of Bay Blvd.	909.12	32.62116	-117.09449
ORW-1	South of Rancho Dr., SW corner of Shadow Pines condos, in canyon	910.20	32.59125	-117.03790
SR-4	South bank of Sweetwater River, between Broadway and Highland	909.12	32.65311	-117.09430
SV-1	North of I-805, south side of river, south of Plaza Bonita Mall	909.12	32.65076	-117.06646
SW-4	South of Main St., east side of trolley tracks, across from Otay Valley Regional Park, access from bridge at Hanson Aggregates	910.20	32.59043	-117.08368
TC-39	West of property at SW corner of L St. and Industrial Blvd., inlet at end of brow ditch between property and I-5	909.11	32.61487	-117.09086
2168.1	Outfall off of Pepper Park along Sweetwater Channel	909.12	32.649309005	-117.111502361
TelegraphCnyn Mouth	Mouth of Telegraph Canyon	909.11	32.617238	-117.096168
CV1-1.1	North end of Bayside Park in Chula Vista	909.12	32.6295319965	-117.108343322
2172.1	North end of Chula Vista Marina Basin	909.12	32.6256107322	-117.101921013
2162.1	South end of Chula Vista Bayfront	909.11	32.6205856513	-117.097457173
K-Outfall	Southeast side of the south bay	910.2	32.588304	-117.107516

Table A3-2
MS4 Outfall Dry Weather Field Screening Stations Inventory in Focused Priority Area

Site	Hydrologic Subarea	Latitude	Longitude
2185.1	32.62192051	-117.1004408	Dry weather outfall
2941.1	32.62753771	-117.1073369	Dry weather outfall
2175.1	32.62392325	-117.1012412	Dry weather outfall
NCMT030.1	32.65074241	-117.1203395	Dry weather outfall
NCMT1008.1	32.64823422	-117.1176928	Dry weather outfall
NCMT031.1	32.64968508	-117.120188	Dry weather outfall
NCMT032.1	32.64871894	-117.1199524	Dry weather outfall
NCMT033.1	32.64790477	-117.1197531	Dry weather outfall
NCMT034.1	32.64801773	-117.1182581	Dry weather outfall
NCMT035.1	32.64819461	-117.1178862	Dry weather outfall
NCMT026.1	32.65258795	-117.1208761	Dry weather outfall
NCMT028.1	32.65166124	-117.1206465	Dry weather outfall
NCMT1003.1	32.65224671	-117.120821	Dry weather outfall
NCMT004.1	32.65708543	-117.120383	Dry weather outfall
NC5-1.1	32.65758987	-117.118102	Dry weather outfall
CV1-2	32.63139829	-117.1043923	Dry weather outfall
C-2	32.62139	-117.09394	Dry weather outfall
C-3	32.62325	-117.09426	Dry weather outfall
C-6	32.62918	-117.09507	Dry weather outfall
C-7	32.63428	-117.09706	Dry weather outfall
C-9	32.63331	-117.09102	Dry weather outfall
C-11	32.63869	-117.07956	Dry weather outfall
C-12	32.63869	-117.07956	Dry weather outfall
C-13	32.63869	-117.07956	Dry weather outfall
C-14	32.63906	-117.07722	Dry weather outfall
C-15	32.63843	-117.07739	Dry weather outfall
C-16	32.63843	-117.07739	Dry weather outfall
C-17	32.63843	-117.07739	Dry weather outfall
C-18	32.63599	-117.07208	Dry weather outfall
C-19	32.63599	-117.07208	Dry weather outfall

Table A3-2 (continued)
MS4 Outfall Dry Weather Field Screening Stations Inventory in Focused Priority Area

Site	Hydrologic Subarea	Latitude	Longitude
C-20	32.63599	-117.07208	Dry weather outfall
C-22	32.63633	-117.06676	Dry weather outfall
C-23	32.62953	-117.09403	Dry weather outfall
C-24	32.62646	-117.09178	Dry weather outfall
C-25	32.634	-117.0906	Dry weather outfall
C-26	32.63792	-117.06728	Dry weather outfall
J-1	32.59239	-117.05917	Dry weather outfall
J-2	32.59487	-117.06681	Dry weather outfall
J-3	32.60097	-117.0659	Dry weather outfall
J-7	32.60622	-117.06266	Dry weather outfall
J-10	32.61112	-117.05745	Dry weather outfall
J-11	32.61077	-117.0571	Dry weather outfall
J-12	32.61277	-117.0554	Dry weather outfall
J-13	32.61275	-117.05539	Dry weather outfall
J-19	32.60159	-117.06313	Dry weather outfall
J-20	32.60995	-117.06001	Dry weather outfall
J-21	32.61802	-117.05405	Dry weather outfall
PC-1	32.59154	-117.04199	Dry weather outfall
PC-2	32.59611	-117.04087	Dry weather outfall
PC-32	32.6018	-117.03669	Dry weather outfall
PC-35	32.60028	-117.03806	Dry weather outfall
PR-6	32.61177	-117.03979	Dry weather outfall
SR-1	32.64136	-117.0998	Dry weather outfall
SR-2	32.63984	-117.09928	Dry weather outfall
SR-3	32.64884	-117.09623	Dry weather outfall
SR-6	32.65036	-117.08819	Dry weather outfall
SR-7	32.64995	-117.08656	Dry weather outfall
SR-9	32.65315	-117.07837	Dry weather outfall
SR-10	32.65122	-117.09283	Dry weather outfall
SV-2	32.64914	-117.06477	Dry weather outfall

Table A3-2 (continued)
MS4 Outfall Dry Weather Field Screening Stations Inventory in Focused Priority Area

Site	Hydrologic Subarea	Latitude	Longitude
SW-1	32.60811	-117.09231	Dry weather outfall
SW-2	32.5947	-117.0891	Dry weather outfall
SW-3	32.60094	-117.08464	Dry weather outfall
SW-5	32.59119	-117.081	Dry weather outfall
SW-6	32.59124	-117.07315	Dry weather outfall
TC-2	32.60702	-117.0758	Dry weather outfall
TC-3	32.62923	-117.04544	Dry weather outfall
TC-37	32.6287	-117.04292	Dry weather outfall
TC-38	32.61283	-117.0884	Dry weather outfall
H-Outfall	32.589468	-117.113711	Dry weather outfall
2185.1	32.62192051	-117.1004408	Dry weather outfall
2941.1	32.62753771	-117.1073369	Dry weather outfall
2175.1	32.62392325	-117.1012412	Dry weather outfall
NCMT030.1	32.65074241	-117.1203395	Dry weather outfall
NCMT1008.1	32.64823422	-117.1176928	Dry weather outfall

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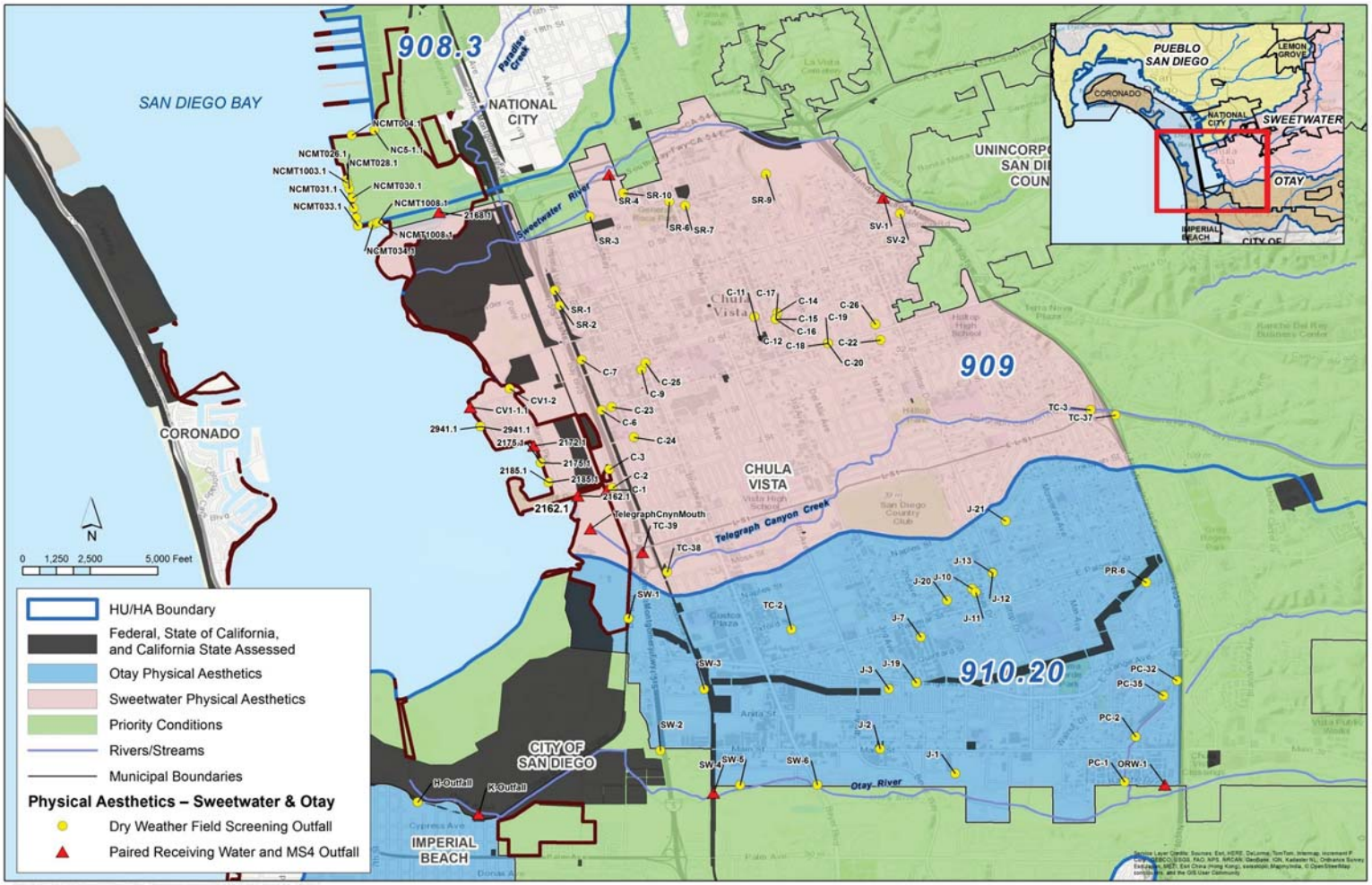

Figure A3-2
Location of Physical Aesthetics Monitoring

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A.3.2.2 Number of monitoring events

Sampling will be conducted during two (2) dry weather events annually (one dry season, one wet season), and one (1) wet weather event within three days following a storm event with at least 0.2 inch of precipitation.

A.3.2.3 Monitoring Summary

Table A3-3 presents a summary of monitoring to be conducted for Physical Aesthetics in the Sweetwater and Otay HAs.

Table A3-3
Physical Aesthetics (Trash) Receiving Water Monitoring – Sweetwater and Otay Rivers

	Wet weather monitoring	Dry Season, Dry Weather Monitoring	Wet weather season, Dry weather monitoring
RP Monitoring Approach	• Monitoring effort at 12 locations • Inspect predetermined transect of 2-25 feet (standard area) from major outfall MS4 sites. • Paired sampling – assess major outfall MS4 site when assessing receiving water	• Perform during regular MS4 inspections when possible • Inspect predetermined transect of 2-25 feet (standard area) away from major outfall MS4 sites. • Paired sampling – assess major outfall MS4 site when assessing receiving water	• Perform MS4 inspections at 12 locations • Inspect predetermined transect of 2-25 feet (standard area) away from major outfall MS4 sites. • Paired sampling – assess major outfall MS4 site when assessing receiving water
Frequency	• Annually inspect after one wet weather event during wet season at 12 locations	• Annual inspection at 12 locations	• Annual inspection at 12 locations
Timing of monitoring	• Sample within 72 hours of a storm	• During dry weather season (April 1st – October 31st)	• During dry periods, 72 hours or more after storm event

A.3.2.4 Assessment Methods

Trash assessments will be conducted according to methods are presented in the MS4 Outfall – Dry Weather Monitoirng Program. In addition, the monitoring approach and the methodology will parallel the following details from the San Diego Bay Debris Study Work Plan Plan[2]:

[2]San Diego Bay Debris Study Workgroup. 2014. *San Diego Bay Debris Special Study Work Plan.*

- •Characterize habitat conditions (e.g., concrete, riprap, homeless encampment nearby, etc.)
- Record habitat aesthetic rating (very good to very poor)
- Evidence of littering and illegal dumping (yes or no type of answer)
- Assess types of trash present (food wrapper, plastic bags, styrofoam, etc.)

A.3.3 Otay HA 910.1 – Swimmable Waters Monitoring

The goal of swimmable waters monitoring in the Coronado HA (910.1) is to assess the status of beaches in this HA by assessing for Indicator Bacteria and determine whether MS4 discharges may potentially be a source. Specific monitoring details are provided below.

A.3.3.1 Sampling locations

Swimmable waters monitoring has three receiving water monitoring locations that are associated with MS4 outfall locations: one at Tidelands Park in the San Diego Bay, and two locations in the Pacific Ocean at North Beach in Coronado and at the Imperial Beach Pier. Table A3-4 presents the MS4 Outfalls monitoring locations. Figure A3-3 presents the general areas to be monitored as part of the swimmable waters monitoring.

Table A3-4
Swimmable Waters MS4 Outfall Monitoring Locations

Monitoring Area	SiteID	HSA	Latitude	Longitude	Description
North Beach	North Beach Outfall	910.1	32.68665	-117.1934	Major Outfall
	North Beach Ocean	**910.1**	**32.6864**	**-117.1937**	**Outfall location varies with the tide**
City of Imperial Beach	H- Outfall	910.2	32.589468	-117.113711	Major Outfall
	EH030*	**910.2**	**32.588304**	**-117.107516**	**Major Outfall**
Tidelands Park	1203.1	910.1	32.690395	-117.164465	Outfall located off of Tidelands Park-closest to beach
	1206.1	910.1	32.690791	-117.164368	Outfall located off of Tidelands Park-second outfall from beach
	1219.1	910.1	32.691713	-117.164085	Outfall located off of Tidelands Park-third outfall from beach
	EH-070*	**910.1**	**32.68993**	**-117.16419**	**Coronado Tideland's Park Beach**

Notes:
Stations in **boldface** indicate where receiving water monitoring and MS4 outfall inspections will be conducted simultaneously.
*Monitoring location is also a DEH AB 411 monitoring site.

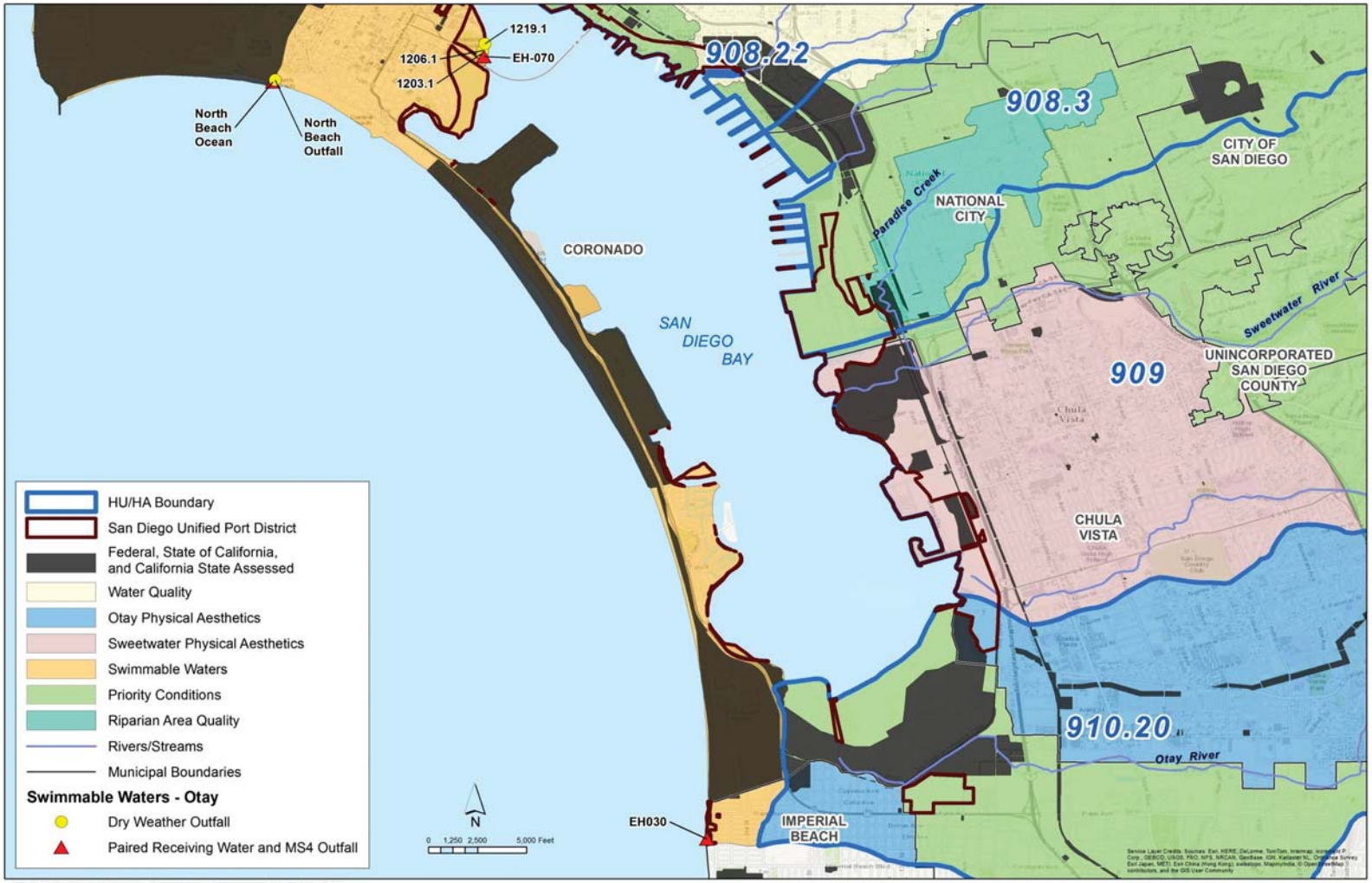

Figure A3-3
Locations for Swimmable Waters Monitoring

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A.3.3.2 Number of sampling events

Monitoring will be conducted at the following frequencies:

- Weekly during dry season/dry weather (May 1—Sep. 30)
- Monthly during wet season/wet weather (Oct. 1—April 30)
- During three wet weather events annually (Oct. 1—Apr. 30)[3]

A.3.3.3 Sample Collection and Analysis

Samples will be collected and analyzed for Indicator Bacteria according to Department of Environmental Health (DEH) protocols for receiving waters.[4] MS4 Outfalls will be sampled according to Section A.2 of this Appendix. Table A3-5 presents a summary of sample collection.

[3] Dry weather sample must be preceded by ≥72 hrs antecedent dry period following rainfall event of >0.1" and occur after the first wet event of the season

[4] http://www.cdph.ca.gov/healthinfo/environhealth/water/Documents/Beaches/RecommendedMethodsforAB411.pdf; http://www.sandiegocounty.gov/content/dam/sdc/deh/lwqd/Beach&Bay/bb_beach_water_quality_info.pdf

Table A3-5
Swimmable Waters Monitoring Summary

	Wet weather monitoring	Dry Season, Dry Weather Monitoring	Wet weather season, Dry weather monitoring	MS4 Monitoring
Responsible Party Monitoring Approach	Monitor at Tidelands Park and North Beach sites	• Tidelands Park and IB Pier* sites: Current DEH sites. (No additional monitoring to be done by RPs at these sites during this period) • North Beach: Past DEH site and City of Coronado's current transitional wet and dry monitoring location and dry weather MS4 major outfall monitoring location	• Expand DEH's dry weather monitoring to occur during the wet weather season. • Monitoring at Tidelands Park and North Beach sites • IB Pier site*	Perform monitoring at all three sites
Frequency	Annually sample three wet weather events during wet season at Tidelands Park and North Beach sites	• Tidelands Park and IB Pier* sites: Weekly • North Beach: Past DEH site and City of Coronado's current transitional wet and dry monitoring location and dry weather MS4 major outfall monitoring location	• Monthly at Tidelands Park and North Beach sites ❖ (November 1st – March 31) • IB Pier site*	Inspect MS4 monthly, year round
Timing of monitoring	Sample within 72 hours of a storm (consistent with Bacteria I TMDL[5])	During dry weather season (April 1st – October 31st)	During dry periods, 72 hours or more after storm event	Take sample at MS4 if there is flow/discharge

Note:
*Imperial Beach Pier: The Pacific shoreline of the Coronado HA 910.1 already has an established monitoring plan to assess the receiving water conditions through the South Bay Ocean Outfall Waste Discharge Requirements in Order R9-2014-0071 for the City of San Diego and Order R9-2014-0009 for the International Boundary and Water Commission. These permits establish a joint receiving water monitoring program for the South Bay Ocean Outfall and include weekly surf zone bacteria monitoring at 3 location along the Coronado HA 910.1. These locations include S12 Carnation Ave (Camp Surf), S8 Silver Strand State Beach, and S9 Avenida del Sol (Hotel del Coronado). In addition, the County of San Diego Department of Environmental Health performs AB 411 beach water quality monitoring throughout the year for public health along the Pacific shoreline of the Coronado HA 910.1. The existing beach water quality monitoring is sufficient to assess swimmable waters along the Pacific shoreline of the Coronado HA 910.1 and the San Diego Bay WMA Copermittees will utilize this data for the annual Water Quality Improvement Plan Monitoring and Assessment report.

[5]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.

A.3.4 References

California Department of Public Health. 2000. Recommended Methods for the Analysis of Recreational Marine Water to Comply with AB 411. Accessed January 6, 2015. http://www.cdph.ca.gov/healthinfo/environhealth/water/Documents/Beaches/RecommendedMethodsforAB411.pdf

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

County of San Diego Department of Environmental Health. Land and Water Quality Division Beach and Bay Monitoring Program. Accessed January 6, 2015. http://www.sandiegocounty.gov/content/dam/sdc/deh/lwqd/Beach&Bay/bb_beach_water_quality_info.pdf

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 Bay Debris Study Workgroup. 2014. *San Diego Bay Debris Special Study Work Plan.*

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APPENDIX A4. EXISTING MONITORING PLANS – DRAFT MONITORING PLAN

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A.4 Monitoring Plan References.....A4-1

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A.4 MONITORING PLAN REFERENCES

The following MAP components will be conducted under existing monitoring plans, as listed:

- Airport Authority Metals Monitoring
  - Reference : Appendix D1 – Transitional Dry Weather Monitoring Program
  - Reference: Appendix D2 – Transitional Wet Weather Monitoring Program
- Bacteria TMDL Monitoring (Chollas Creek)
  - Reference: Chollas Creek TMDL Monitoring Plan (Appendix C)
- Bight' 13
  - Reference: Southern California Bight Regional Monitoring Plan
- Chollas Creek Metals and Bacteria TMDLs
  - Reference: Chollas Watershed Comprehensive Load Reduction Plan
  - Reference: Chollas Watershed Comprehensive Load Reduction Plan – Phase II
- Chollas – Jurisdictional Boundary Study for Metals
  - Reference: Chollas Watershed Comprehensive Load Reduction Plan
  - Reference: Chollas Watershed Comprehensive Load Reduction Plan – Phase II
- Hydromodification Regional Monitoring Program
  - Reference: Hydromodification Management Plan
- Riparian Area
  - Reference: City of National City Paradise Creek Selenium Monitoring Plan.
- San Diego County Beach Water Quality (AB411) Monitoring
  - Reference: Beach Water Quality (AB411) Monitoring Plan
- San Diego Regional Reference Streams and Beaches Studies
  - Reference: San Diego Reference Stream Survey Workplan

- Sediment Quality Monitoring
    - Reference: Sediment Monitoring Plan (Appendix B)
- Shelter Island Copper TMDL
    - Reference: Shelter Island Yacht Basin TMDL Monitoring Plan (Appendix D)
- Shelter Island Shoreline Park Bacteria TMDL
    - Reference: Shoreline Park Bacteriological Monitoring Plan (Appendix E)
- SMC Regional Monitoring
    - Reference: Storm Water Monitoring Coalition Regional Monitoring Plan
- Trash – Pueblo San Diego Hydrologic Unit: Creek Refuse Assessment Program Special Study
    - Reference: Pueblo San Diego Hydrologic Unit: Creek Refuse Assessment Program Special Study Standard Operating Procedure
- Trash – San Diego Debris Special Study
    - Reference: San Diego Debris Special Study Work Plan

APPENDIX A5. ANALYTE LIST

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Analyte	Volume Required	Analytical Method	Target Reporting Limit	Units	Max Holding Time
Conventional Parameters					
Dissolved Oxygen	In field	Meter	0.01	mg/L	NA
Dissolved Organic Carbon	250 mL	SM 5310 C	0.50	mg/L	28D
Color	500 mL	SM 2120B	3	Color Units	48H
pH	In field	Meter	0.01	pH	NA
Specific Conductivity	In field	Meter	1	µS/cm	NA
MBAS	100 mL	SM5540C	0.05	mg/L	7D
Sulfates	250 mL	USEPA 300.0	0.5	mg/L	28D
TDS	500 mL	SM 2540C	10	mg/L	7D
Temperature	In field	Meter	0.1	◦C	NA
Total Hardness	Calculation from Calcium and Manganese	SM 2340B	0.662	mg/L	NA
Total Organic Carbon	250 mL	SM 5310 C	0.30	mg/L	28D
Trash	In field	Visual Observation	NA	Count	NA
TSS	1000 mL	SM 2540D	5	mg/L	7D
Turbidity	In field or lab: 250 mL	Meter	0.1	NTU	NA or 48H

Analyte	Volume Required	Analytical Method	Target Reporting Limit	Units	Max Holding Time
Indicator Bacteria					
Enterococcus	100 mL	SM 9230C	20	MPN/100mL	8H
Fecal Coliform	100 mL	SM 9221E	20	MPN/100mL	8H
Total Coliform	100 mL	SM 9221B	20	MPN/100mL	8H
Inorganic Analytes					
Aluminum (Dissolved)	250 mL	USEPA 200.8	0.3	µg/L	6M
Aluminum (Total)	250 mL	USEPA 200.8	0.3	µg/L	6M
Arsenic (Dissolved)	250 mL	USEPA 200.8	0.0004	µg/L	6M
Arsenic (Total)	250 mL	USEPA 200.8	0.0004	µg/L	6M
Cadmium (Dissolved)	250 mL	USEPA 200.8	0.0001	mg/L	6M
Cadmium (Total)	250 mL	USEPA 200.8	0.0001	mg/L	6M
Chromium (Dissolved)[2]	250 mL	USEPA 200.8	0.0002	mg/L	6M
Chromium (Total)[2]	250 mL	USEPA 200.8	0.0002	mg/L	6M
Chromium III (Dissolved)	NA	Calculated from Chromium and Chromium VI	NA	NA	NA
Chromium III (Total)	NA	Calculated from Chromium and Chromium VI	NA	NA	NA
Chromium VI (Dissolved)	250 mL	USEPA 218.6	0.0003	mg/L	28D
Chromium VI (Total)	250 mL	USEPA 218.6	0.0003	mg/L	28D
Copper (Dissolved)	250 mL	USEPA 200.8	0.0005	mg/L	6M
Copper (Total)	250 mL	USEPA 200.8	0.0005	mg/L	6M
Iron (Dissolved)	250 mL	USEPA 200.7	0.01	mg/L	6M

Analyte	Volume Required	Analytical Method	Target Reporting Limit	Units	Max Holding Time
Iron (Total)	250 mL	USEPA 200.7	0.01	mg/L	6M
Lead (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Lead (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Mercury (Dissolved)	250 mL	USEPA 200.8	0.20	µg/L	6M
Mercury (Total)	250 mL	USEPA 200.8	0.20	µg/L	6M
Manganese (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Manganese (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Nickel (Dissolved)	250 mL	USEPA 200.8	0.0008	mg/L	6M
Nickel (Total)	250 mL	USEPA 200.8	0.0008	mg/L	6M
Selenium (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Selenium (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Silver (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Silver (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Thallium (Dissolved)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Thallium (Total)	250 mL	USEPA 200.8	0.0002	mg/L	6M
Zinc (Dissolved)	250 mL	USEPA 200.8	0.005	mg/L	6M
Zinc (Total)	250 mL	USEPA 200.8	0.005	mg/L	6M

Analyte	Volume Required	Analytical Method	Target Reporting Limit	Units	Max Holding Time
Nutrients					
Ammonia	250 mL	USEPA 350.1	0.1	mg/L	28D
Nitrate[1]	250 mL	USEPA 353.2	0.1	mg/L	48H
Nitrite[1]	250 mL	USEPA 353.2	0.1	mg/L	48H
Orthophosphate	250 mL	USEPA 365.1	0.002	mg/L	48H
TKN	250 mL	USEPA 351.2	0.1	mg/L	28D
Total Nitrogen	Calculation	Calculated from TKN, Nitrate, and Nitrite	NA	NA	NA
Phosphorus (Dissolved)	250 mL	USEPA 365.1	0.01	mg/L	28D
Phosphorus (Total)	250 mL	USEPA 365.1	0.01	mg/L	28D
Organics					
Chlordane	1000ml	EPA 608	100	ng/L	7D
Diazinon	1000 mL	EPA 625	0.010	µg/L	7D
MBAS	500 mL	SM 5540C	0.05	mg/L	48H
PAHs	1000 mL	EPA 8270C	0.10	µg/L	7D
PCBs	1000 mL	GCMS SIM/ EPA 608	10/100	ng/L	7D/7D
Synthetic Organic Compounds					
MBAS	500 mL	SM 5540C	0.05	mg/L	48H
Organophosphate Pesticides	2 L	USEPA 625M	0.01	µg/L	7/40D
Synthetic Pyrethroids	2 L	GC/MS NCI-SIM	2-10	ng/L	7/40D

Analyte	Volume Required	Analytical Method	Target Reporting Limit	Units	Max Holding Time
Toxicity					
Growth with *Hyalella azteca*	15 L	EPA-821-R-02-013	NA	Pass/Fail	36H
Larval Survival and Growth with *Pimephales promelas*	15 L	EPA-821-R-02-013	NA	Pass/Fail	36H
Survival and Reproduction with *Ceriodaphnia dubia*	4 L	EPA-821-R-02-013	NA	Pass/Fail	36H
Growth with *Selenastrum capricornutum*	4 L	EPA-821-R-02-013	NA	Pass/Fail	36H

This table describes detailed monitoring and analytical methods that are illustrative and may be revised based on site-specific environmental conditions and equivalent alternate analytical methods.

NA = Not applicable; mL = milliliter; L = liter; D = day; H = hour; M = month

Sediment Toxicity and Benthic Community Effects are listed as a cause for impairment of receiving waters in the San Diego Bay WMA on the 303(d) list, however are not applicable to MS4 Outfalls.

1. Nitrite and nitrate may be combined and reported as nitrite+nitrate.
2. Analysis of Chromium in MS4 discharges is not explicitly required in the MS4 permit. Chromium is analyzed to calculate Chromium III.

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Appendix B Sediment Monitoring Plan

Appendix B

Sediment Monitoring Plan

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San Diego County Municipal Copermittees
Sediment Monitoring Plan-Draft

Prepared For:

County of San Diego Municipal Copermittees

September 2, 2014

San Diego County Municipal Copermittees Sediment Monitoring Plan-Draft

Prepared For:

County of San Diego Municipal Copermittees

Prepared By:

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September 2, 2014

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B Sediment Monitoring Plan QAPP

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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
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

1.0 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.

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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.

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2.0 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.

2.1 Field Collection Program

2.1.1 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 will vary within each San Diego County lagoon 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 each San Diego County lagoon 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.

2.1.2 Permitting

Scientific collecting permits from the California Department of Fish and Wildlife will need to be obtained in order to collect benthic infaunal samples containing invertebrate specimens. At a minimum, it can take up to three weeks to obtain the permit; however, at times it can take several months to receive a scientific collecting permit so applications should be submitted well in advance of the desired sampling dates. A minimum of 24 hours (business day 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.

2.1.3 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.

2.1.4 Sampling Vessels

Vessels used to collect sediment samples will be both stable and maneuverable and will have a sufficiently shallow draft to navigate into shallow waters (e.g. large inflatable boat). The vessels will be equipped with a side or rear davit from which to deploy and retrieve surface sampling equipment, and will be able to accommodate a minimum of two persons in addition to all appropriate sampling and safety equipment.

2.1.5 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.

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2.1.6 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).

2.1.7 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.

2.2 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).

2.2.1 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 2-1. Reporting limits (RLs) must be equal to or less than those listed in Table 2-1 in order to generate the chemistry LOE outlined in Section 2.3.3.1. Concentrations associated with the RLs in Table 2-1 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 2-1.

Table 2-1. 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 µg/kg
2,4′-DDE	0.50 µg/kg
2,4′-DDT	0.50 µg/kg
4,4′-DDD	0.50 µg/kg
4,4′-DDE	0.50 µg/kg
4,4′-DDT	0.50 µg/kg
Chlordane-alpha	0.50 µg/kg

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Parameter	Reporting Limit
Chlordane-gamma	0.54 µg/kg
Dieldrin	2.5 µg/kg
trans-Nonachlor	4.6 µg/kg
PCB Congeners	
2,4'-Dichlorobiphenyl	3.0 µg/kg
2,2',5-Trichlorobiphenyl	3.0 µg/kg
2,4,4'-Trichlorobiphenyl	3.0 µg/kg
2,2',3,5'-Tetrachlorobiphenyl	3.0 µg/kg
2,2',5,5'-Tetrachlorobiphenyl	3.0 µg/kg
2,3',4,4'-Tetrachlorobiphenyl	3.0 µg/kg
2,2',4,5,5'-Pentachlorobiphenyl	3.0 µg/kg
2,3,3',4,4'-Pentachlorobiphenyl	3.0 µg/kg
2,3',4,4',5-Pentachlorobiphenyl	3.0 µg/kg
2,2',3,3',4,4'-Hexachlorobiphenyl	3.0 µg/kg
2,2',3,4,4',5'-Hexachlorobiphenyl	3.0 µg/kg
2,2',4,4',5,5'-Hexachlorobiphenyl	3.0 µg/kg
2,2',3,3',4,4',5-Heptachlorobiphenyl	3.0 µg/kg
2,2',3,4,4',5,5'-Heptachlorobiphenyl	3.0 µg/kg
2,2',3,4',5,5',6-Heptachlorobiphenyl	3.0 µg/kg
2,2',3,3',4,4',5,6-Octachlorobiphenyl	3.0 µg/kg
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	3.0 µg/kg
Decachlorobiphenyl	3.0 µg/kg
PAHs (low molecular weight)	
Acenaphthene	20.0 µg/kg
Anthracene	20.0 µg/kg
Phenanthrene	20.0 µg/kg
Biphenyl	20.0 µg/kg
Naphthalene	20.0 µg/kg
2,6-Dimethylnaphthalene	20.0 µg/kg
Fluorene	20.0 µg/kg
1-Methylnaphthalene	20.0 µg/kg
2-Methylnaphthalene	20.0 µg/kg
1-Methylphenanthrene	20.0 µg/kg
PAHs (high molecular weight)	
Benzo(a)anthracene	80.0 µg/kg
Benzo(a)pyrene	80.0 µg/kg
Benzo(e)pyrene	80.0 µg/kg
Chrysene	80.0 µg/kg
Dibenzo(a,h)anthracene	80.0 µg/kg
Fluoranthene	80.0 µg/kg
Perylene	80.0 µg/kg
Pyrene	80.0 µg/kg

DDD Dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethylene
DDT dichlorodiphenyltrichloroethane
mg/kg milligrams per kilogram
µg/kg micrograms per kilogram

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2.2.2 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.

2.2.2.1 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). Test conditions are summarized in Table 2-2.

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.

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Table 2-2. 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

2.2.2.2 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 2-3 and Table 2-4, 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.

<u>*Mytilus galloprovincialis* Sediment-Water Interface Development Sublethal Test</u>

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.

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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 2-3. 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
	Feeding	None
	Water Renewal	None
	Aeration	Constant gentle aeration
	Acceptability Criteria	Mean control normal-alive ≥ 80%

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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 2-4. 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

2.2.3 Benthic Infauna Analysis

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. 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.

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2.2.3.1 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.

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3.0 DATA REVIEW, MANAGEMENT, AND ANALYSIS

3.1 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).

3.2 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).

3.2.1 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 Toxicity[2]	Moderate Toxicity[2]	High Toxicity[2]
Short-Term Survival Tests	*E. estuarius* 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 100[2]	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.

3.2.2 Sediment Chemistry

Sediment chemistry will be assessed using the analyte list presented in Table 2-1. 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**

3.2.3 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

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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**

3.2.4 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).

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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.

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4.0 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.

4.1.1 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.

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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."

4.1.2 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.

4.1.3 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."

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5.0 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 based on the Sediment Monitoring Report conclusions 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.

Since the WQIPs are still in development and there will be not WQIP Annual Reports in 2015, the Copermittees will include the Sediment Monitoring Report with the Transitional Monitoring and Assessment Report due to the San Diego RWQCB on January 31, 2015. The Sediment Monitoring Report will include the results from the 2013 Bight Program and any follow-up monitoring collected in 2014 to satisfy Provisions D.1.e.(1)(b) and D.1.e.(2) of the Permit. Additional sediment quality monitoring or stressor identification studies conducted after 2014 will be included in the WQIP Annual Reports.

6.0 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	August-September 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	TBD
Final Sediment Monitoring Plan incorporated into WQIPs	December 2014
Draft Sediment Monitoring Report	Summer 2015

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Final Sediment Monitoring Report incorporated into appropriate WQIP Annual Report	December 2015
Potential Stressor ID Studies	TBD
Potential Human health risk assessment	TBD

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7.0 REFERENCES

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Appendix A

Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality

Appendix B

Sediment Monitoring Plan QAPP

Appendix C Chollas Creek TMDL Monitoring Plan

Appendix C

Chollas Creek TMDL Monitoring Plan

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CHOLLAS CREEK WATERSHED
FINAL MONITORING PLAN
COMPREHENSIVE LOAD REDUCTION PLAN

Submitted to:
City of San Diego
Transportation & Storm Water Department
9370 Chesapeake Drive Suite 100
San Diego, California 92123

Submitted by:
AMEC Environment & Infrastructure, Inc.
San Diego, California

With Assistance from:
Larry Walker & Associates
and
Tetra Tech, Inc.

May 2012

AMEC Project No. 5013110036

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APPENDIX A QAPP

ACRONYMS AND ABBREVIATIONS

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
BMP	best management practice
BPA	Basin Plan Amendment
Caltrans	California Department of Transportation
CLRP	Comprehensive Load Reduction Plan
CFU	Colony-forming Units
CTL(1)	Chollas Creek Tidal Compliance Monitoring Location
CWA	Clean Water Act
DPR3	South Chollas Creek Mass Loading Station
Diazinon TMDL	Investigation Order No. R9-2004-00277, California Department of Transportation and San Diego Municipal Separate Storm Sewer system Copermittees Responsible for the Discharge of Diazinon into the Chollas Creek Watershed, San Diego, California
Dissolved Metals TMDL	Resolution No. R9-2007-0043, A Resolution Adopting an Amendment to the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Total Maximum Daily Loads for Dissolved Copper, Lead and Zinc in Chollas Creek, Tributary to San Diego Bay (approved under State Water Resources Control Board Resolution No. 2008-0054)
EDD	Electronic data deliverable
FIB	Fecal Indicator Bacteria
GIS	Geographic Information Systems
LA	Load Allocation
LWA	Larry Walker and Associates
mL	milliliter
MLS	Mass Loading Station
MOU	Memorandum of Understanding
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer System
NA	Not Applicable
NTU	Nephelometric Turbidity Units
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
*.pdf	Portable Document Format
pH	potential Hydrogen
QAPP	Quality Assurance Project Plan
REC-1	Water contact recreation
SD8(1)	North Chollas Creek Mass Loading Station
SDRWQCB	San Diego Regional Water Quality Control Board
State Board	State Water Resources Control Board
SWAMP	Surface Water Ambient Monitoring Program

ACRONYMS AND ABBREVIATIONS (Cont.)

TBD	To Be Determined
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
µS/cm	micro Siemens per centimeter
WLA	Waste Load Allocation
WQO	Water Quality Objective
WURMP	Watershed Urban Runoff Monitoring Program

1.0 PROJECT DESCRIPTION

1.1 Introduction

The San Diego Regional Water Quality Control Board (SDRWQCB) has issued the following resolutions and investigative orders in the Chollas Creek Watershed:

- Investigation Order No. R9-2004-00277, California Department of Transportation (Caltrans) and San Diego Municipal Separate Storm Sewer System (MS4) Copermittees Responsible for the Discharge of Diazinon into the Chollas Creek Watershed, San Diego, California, herein referred to as the Diazinon Total Maximum Daily Load (TMDL).
- Resolution No. R9-2007-0043, A Resolution Adopting an Amendment to the Water Quality Control Plan for the San Diego Basin (9) to Incorporate TMDLs for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay (approved under State Water Resources Control Board Resolution No. 2008-0054), herein referred as the Dissolved Metals TMDL.
- Resolution No. R9-2010-0001, A *Resolution Amending the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Revised TMDLs for Indicator Bacteria Project I-Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek),* herein referred to as the Bacteria TMDL.

The Chollas Creek TMDLs have identified the responsible parties of the MS4s (Phase I and Phase II) and Caltrans as point sources that have been assigned Waste Load Allocations (WLAs). Owners and operators of small MS4s (Phase II MS4s) and controllable nonpoint sources, identified by the San Diego Water Board as significant sources of bacteria discharging to the receiving waters and/or Phase I MS4s, are subject to the Bacteria TMDL, however are not included in this Monitoring Program. The Basin Plan Amendment (BPA), which is Attachment A in each TMDL, outlines an Implementation Plan that includes a compliance schedule and a description of minimum monitoring requirements to assess compliance with the TMDLs, WLAs, and Load Allocations (LAs). The Phase I MS4s and Caltrans (hereafter called the Responsible Parties) have developed this Monitoring Plan as part of the Comprehensive Load Reduction Plan (CLRP) for the Chollas Creek Watershed. The CLRP provides a comprehensive, watershed approach to management strategies designed to address the approved TMDLs, draft TMDLs, and other constituents listed on the Clean Water Act (CWA) Section 303(d) List of Water Quality Limited Segments, herein referred to as the 303(d) List.

1.2 Purpose

The purpose of this Monitoring Plan is to outline a CLRP Monitoring Program designed to fulfill the monitoring requirements of the approved TMDLs and generate data to support the Chollas Creek CLRP. The Chollas Creek CLRP Monitoring Program will collect data to evaluate the approved TMDL, Dissolved Metals TMDL, Diazinon TMDL and other 303(d) Listed constituents. A list of the applicable pollutants for the Chollas Creek Watershed is provided in Table 1-1.

The goals of the Chollas Creek CLRP Monitoring Program include the following:

- To assess progress toward meeting TMDL numeric targets and WLAs.
- To characterize potential sources of approved TMDL pollutants, draft TMDL pollutants, and other 303(d) Listed constituents.
- To support the selection and evaluation of potential best management practices (BMPs).

The following four principal types of monitoring will be conducted to address the goals of the Chollas Creek CLRP Monitoring Program.

- Compliance Monitoring is required by approved TMDLs to demonstrate progress toward meeting TMDL requirements including numeric targets and WLAs.
- Optional Monitoring is not required by the Bacteria TMDL; however if sufficient funds are available, it may be implemented by Responsible Parties to better understand water quality conditions in the receiving water and support the goals of compliance monitoring. Optional Monitoring may be added to (and removed from) the compliance monitoring effort as deemed appropriate by the Responsible Parties.
- Follow-up Monitoring will be implemented to characterize the source, magnitude, and duration of exceedances of bacteria water quality objectives (WQOs) in the receiving water based on the results of compliance monitoring.
- Special Studies will be implemented based on the available data and resources to address management questions regarding adopted TMDLs, and 303(d) Listed pollutants. Special Studies may require the development of separate agreements and funding opportunities between the Responsible Parties.

1.3 Watershed Background

The Chollas Creek Watershed encompasses approximately 18,000 acres of mainly urbanized land located southeast of downtown San Diego, in the San Diego Mesa Hydrologic Area, and within the larger Pueblo San Diego Hydrologic Unit. Land use in the Chollas Creek Watershed is predominantly composed of residential (48 percent) road (20 percent), and open space (9 percent) land uses. The remaining watershed land uses consist of office/institutional (6 percent), freeway (5 percent), commercial (4 percent), industrial (3 percent), and other miscellaneous land uses.

The creek includes two main tributaries, the north fork and the south fork. The drainage area of the northern fork (i.e., 8,794 acres) of the watershed is larger than that of the southern fork (i.e., 7,575 acres). The headwaters of the north fork originate approximately 1.5 miles west of the jurisdictional boundary of the City of La Mesa. From this point, the north fork flows in a southwesterly direction for approximately 3 miles before it is joined by several smaller tributaries, which feed into the main stem of the creek. The creek then flows in a southerly direction for approximately 1.5 miles before discharging into San Diego Bay. The south fork of Chollas Creek flows in a west–southwesterly direction from its headwaters in the City of Lemon

Grove and is the product of two smaller creek branches. The north and south fork of Chollas Creek merge approximately 0.8 miles east of the creek's mouth at San Diego Bay, in a tidally influenced section of the creek.

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 due to elevated bacteria levels. Table 1-1 and Figure 1-1 present the water bodies in the Chollas Creek Watershed that have been identified in the Bacteria TMDL and placed on the 2010 State Board's Section 303(d) List. Per the Bacteria TMDL, impaired waters were given a priority number of 1, 2, or 3 with 1 being the highest priority. The prioritized list identifies segments or areas where bacterial water quality improvements are most likely to occur first (Priority 1), and segments or areas where bacterial water quality improvements are most likely to require more time to accomplish (Priority 3). Priority 1 waters also include waterbodies likely to be removed from the CWA Section 303(d) List. Chollas Creek is listed as Priority 3. The ultimate goal of the Bacteria TMDL analysis is to achieve the necessary pollutant load reductions to restore and protect designated beneficial uses, particularly water contact recreation (REC-1). Beneficial uses within the Chollas Creek 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 1-2.

Table 1-1.
TMDL Pollutants and Other 303(d) Listed Constituents

Waterbody	TMDL Pollutants[(a) (b) (c)]	Other 303(d) Listed Constituents[(d)]
Chollas Creek	Indicator bacteria, dissolved copper, dissolved lead, dissolved zinc, diazinon	Total nitrogen and trash
San Diego Bay Shoreline, near Chollas Creek (Mouth of Chollas Creek)	-	Benthic community effects and sediment toxicity[(c)]

Note:
(a) Source: California RWQCB, San Diego Region. Resolution No. R9-2010-0001.
(b) Source: California RWQCB, San Diego Region. Resolution No. R9-2007-0043.
(c) Source: California RWQCB, San Diego Region. Resolution No. R9-2004-00277.
(d) Source: USEPA, 2010; Integrated Report (CWA, 303(d) List / 305(b) Report).

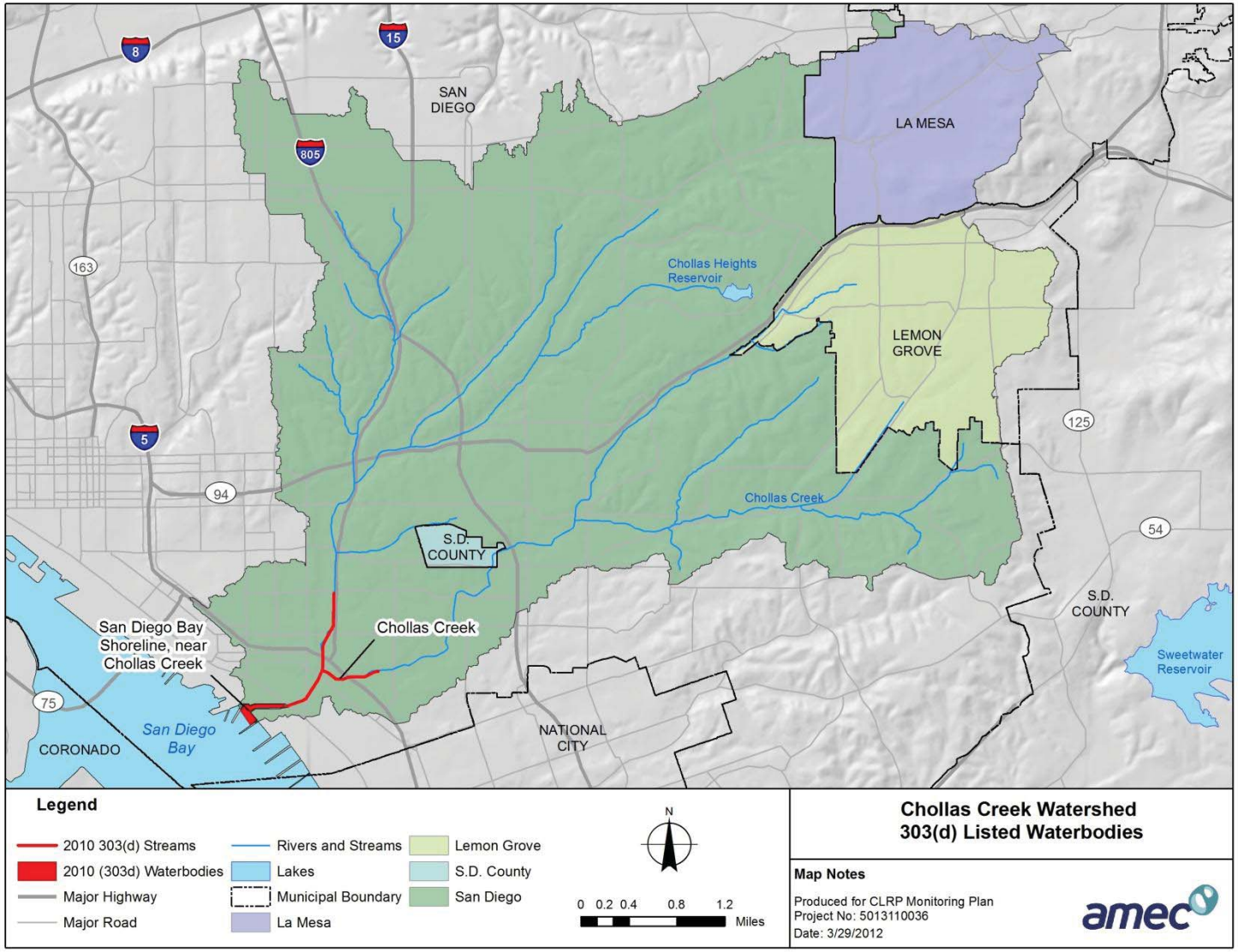

Figure 1-1. Watershed Map

Table 1-2.
Beneficial Uses Listed in Basin Plan

Inland Surface Water	Hydrologic Unit Basin Number	Municipal and Domestic Supply (MUN)	Contact Recreation (REC1)	Non-Contact Recreation (REC2)	Warm Freshwater Habitat (WARM)	Wildlife Habitat (WILD)
Chollas Creek	908.22	+	○	●	●	●

Notes:
Source: Basin Plan = Water Quality Control Plan for the San Diego Basin (9) (San Diego RWQCB, 2007).
● Beneficial use
○ Potential beneficial use
\+ Indicates that the water body has been exempted by the Regional Board from the municipal use designation under the terms and conditions of State Board Resolution No. 88-63, *Sources of Drinking Water Policy*.

1.4 Project Organization and Responsibilities

The approved Bacteria TMDL identifies the Responsible Parties and Lead Agency for the Chollas Creek Watershed. The Responsible Parties are collaborating on the implementation of the monitoring programs for their watershed. The Responsible Parties, excluding owners and operators of small MS4s, are:

- City of San Diego (Lead Agency)
- City of La Mesa
- City of Lemon Grove
- San Diego County
- San Diego Unified Port District
- Caltrans

For compliance monitoring, Responsible Parties, Consultants, and Laboratory staff will have the following roles and responsibilities. Figure 1-2 presents the organization chart for the Chollas Creek CLRP Monitoring Program.

- **Contract Manager:** To be determined. The Contract Manager will contract with the selected consultants and/or laboratories to implement the CLRP Compliance Monitoring Program and act as the liaison between the Responsible Parties and Contractors.
- **Project Manager:** To be determined. The Project Manager will be responsible for overseeing the day to day activities of implementing the CLRP Compliance Monitoring Program.

- **Project QA Officer:** To be determined. The Project Quality Assurance Officer will conduct quality assurance oversight for the project independently from project management and from the project's monitoring program.
- **Laboratory QA Officer:** Project Manager
- **Sampling Agency's Project Manager:** To be determined.

Currently, a separate MOU for the Diazinon and Dissolved Metals TMDLs exists. The roles and responsibilities for the compliance monitoring are described in the Chollas Creek TMDL Dissolved Metals Monitoring Plan (AMEC Environment & Infrastructure, Inc. [AMEC], 2011). The United States Navy is an additional Responsible Party included in the MOU for the Diazinon and Dissolved Metals TMDL and is not a Responsible Party listed in the Bacteria TMDL.

Figure 1-2. Organizational Chart

To be determined at a later date by Responsible Parties.

1.5 Implementation Schedule

The Diazinon TMDL was adopted on August 14, 2002. The Dissolved Metals TMDL was adopted on June 13, 2007. The effective date of the Bacteria TMDL is April 4, 2011. The CLRP provides a compliance timeline outlining the interim reduction milestones over the 20 year compliance period for the approved TMDLs. Figure 1-3 provides an overall timeline for the Chollas Creek CLRP Monitoring Program. Per the TMDL, Responsible Parties must submit a CLRP including Monitoring Plan 18 months after the effective date (October 4, 2012).

- **Compliance Monitoring** is scheduled to begin 30 days after submittal of the Quality Assurance Project Plan (QAPP) and Monitoring Plan to the RWQCB pending any comments or revisions by the RWQCB.
- **Follow-up Monitoring** will be implemented after the Dry Weather Exceedance Reduction Milestone, which is scheduled seven years after the effective date of the TMDL.
- **Special Studies** will be implemented based on the available data and resources. Each study will have a project specific schedule that will be provided in a separate QAPP

For Fiscal Year 2013 (July 2012 through June 2013), Table 1-3 provides the schedule of program activities for the Chollas Creek CLRP Monitoring Program including work plans, monitoring, and reporting. Program deliverables are described in Section 3 of this document. Note that follow-up monitoring does not begin until 2018, and thus is not reflected in the project schedule. The Responsible Parties are funding a San Diego Regional Reference Stream Study that began in Fiscal Year 2012 and will be completed in Fiscal Year 2014.

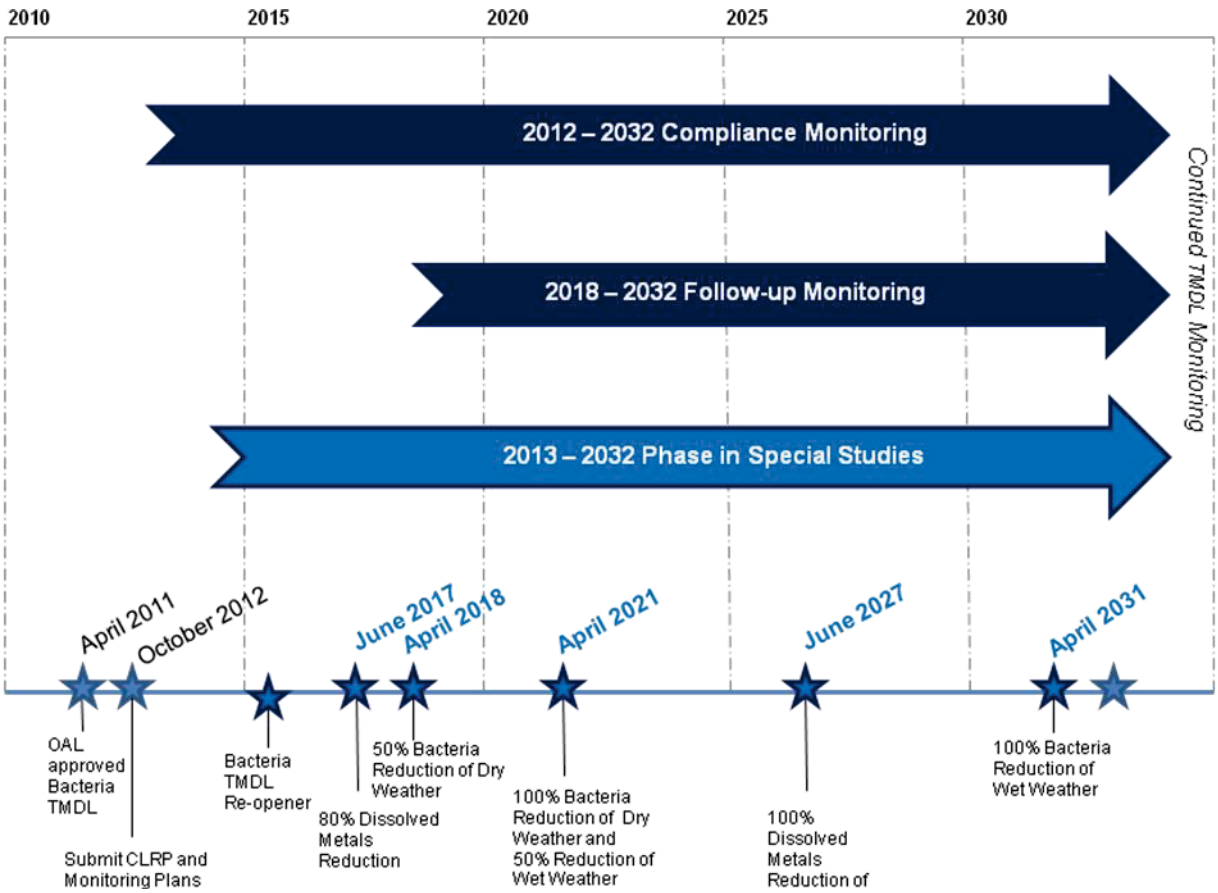

Figure 1-3. Chollas Creek CLRP Monitoring Program Timeline

Note:
The compliance schedule for Dissolved Metals and Diazinon TMDLs was incorporated into the San Diego Municipal Storm Water Permit (Order No. R9-2007-0001) and includes numeric limitations for diazinon in accordance with the TMDL.

Table 1-3.
Project Schedule for Fiscal Year 2013

Activity	Date (MM/DD/YY)		Deliverable
	Anticipated Date of Initiation	Anticipated Date of Completion	
TMDL Monitoring			
QAPP/Monitoring Plan	Submitted herein	Submitted herein	QAPP/Monitoring Plan
Compliance Monitoring	11/4/12	11/4/13	NA
Special Studies			
San Diego Regional Reference Stream Study[(a)]	11/1/11	11/1/14	Project Report will be completed in Fiscal Year 2014
Jurisdictional Boundary Monitoring	10/1/12	6/30/13	Annual Special Studies Summary to be included in the Watershed Urban Runoff Monitoring Program (WURMP) Annual Report
Reporting	NA	6/1/14	Annual CLRP Monitoring Summary to be included in the San Diego Bay WURMP Annual Report

Notes:
NA = Not applicable
[(a)] This study began in Fiscal Year 2012 and will be completed in Fiscal Year 2014.

1.6 TMDL Numeric Targets and WLAs

The Compliance Monitoring Program will be updated to reflect requirements of newly approved and adopted TMDLs as well as any delisted segments, as appropriate. This Monitoring Plan is intended to allow for the inclusion of additional monitoring under the Special Studies Program to address draft TMDL and/or other 303(d) Listed constituents. QAPPs developed for each special study will define numeric action limits for the pollutants of concern, when appropriate.The Bacteria TMDL defines the numeric targets and WLAs for the Responsible Parties. Data collected during the Chollas Creek CLRP Monitoring Program will be utilized to evaluate progress and attainment of TMDL targets and WLAs. Tables 1-4 and 1-5 provide the numeric targets, WLAs, and LAs for the Chollas Creek Watershed per the Bacteria TMDL. The Diazinon and Dissolved Metals TMDL numeric targets, WLAs, and LAs are summarized in the Chollas Creek Dissolved Metals TMDL Monitoring Plan (AMEC, 2011).

Attainment of the TMDLs in the receiving water is based on the frequency that the dry or wet weather days in any given year exceed the respective numeric objective. For dry weather, the TMDL numeric target is based on the geometric mean water quality objective and a 0 percent allowable exceedance frequency as presented in Table 1-4. The “existing” dry weather exceedance frequencies for impaired waterbodies will be calculated using the available historical data from the years 1996 to 2002 per the Bacteria TMDL. For wet weather, the TMDL numeric target is based on the single-sample maximum and an allowable exceedance frequency of 22

percent as well as the geometric mean as presented in Table 1-4. The Bacteria TMDL provides a modeled estimate of the "existing" wet weather exceedance frequency for Chollas Creek Watershed. Responsible Parties will compare the "existing" exceedance frequencies for dry and wet weather to the mandated frequency reductions in order to evaluate progress toward attaining the TMDL.

Table 1-4.
Numeric Targets for Bacteria TMDL

Parameter	Dry Weather[a]		Wet Weather[b]	
	WQO (MPN/100mL) [c]	Allowable Exceedance[c]	WQO (MPN/100mL) [d]	Allowable Exceedance[e]
Enterococcus	33	0%	61	22%
Fecal Coliform	200	0%	400	22%

Notes:
mL = mililiters
MPN = Most Probable Number
Source (including footnotes): California RWQCB, San Diego Region. Resolution No. R9-2010-0001.

[a] Dry weather days defined as days with less than 0.2 inch of rainfall observed on each of the previous 3 days.

[b] Wet weather days defined as days with rainfall events of 0.2 inches or greater and the following 72 hours.

[c] Dry weather numeric objectives based on the 30-day geometric mean (or equivalent) water quality objectives in Water Quality Control Plan for the San Diego Basin (1994). 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.

[d] Wet weather numeric objectives based on the single sample maximum (or equivalent) water quality objectives in the Water Quality Control Plan for the San Diego Basin (1994). 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 percent allowable exceedance frequency as determined for Leo Carillo Beach in Los Angeles County. At the time the wet weather watershed model was developed, the 22 percent exceedance frequency from Los Angeles County was the only reference beach exceedance frequency available. The 22 percent allowable exceedance frequency used to calculate the wet weather TMDLs is justified because the San Diego Region watersheds' exceedance frequencies will likely be close to the value calculated for Leo Carillo Beach, and is consistent with the exceedance frequency that was applied by the Los Angeles Regional Board.

Table 1-5.
Indicator Bacteria TMDL for Chollas Creek

Pollutant	TMDLs, WLAs & LAs for Controllable Sources (Billion MPN/Year)				
	Total Watershed TMDL[a]	MS4 WLA[b]	Caltrans WLA[c]	Agriculture LA[d]	Open LA[e]
Dry Weather					
Enterococcus	66	66	0	0	0
Fecal Coliform	398	398	0	0	0
Total Coliform	1,991	1,991	0	0	0
Wet Weather					
Enterococcus	1,152,645	802,918	2,062	0	347,665
Fecal Coliform	520,440	252,479	892	0	267,070
Total Coliform	13,247,626	9,880,784	46,652	0	3,321,191

Notes:
Source: California RWQCB, San Diego Region. Resolution No. R9-2010-0001.
(a) TMDLs, WLAs, and LAs calculated based on numeric targets and percent allowable exceedance frequency. Meeting the numeric targets in the discharge and/or RW indicate the TMDLs, WLAs, and/or LAs have been met.
(b) MS4 WLA = Point source WLA for discharges from Municipal MS4 land uses.
(c) Caltrans WLA = Point source WLA for discharges from Caltrans land uses, assumed to be equal to the Caltrans Existing Load.
(d) Agriculture LA = Non-point source LA for discharges from Agriculture land uses, assumed to be equal to the Agriculture Existing Load.
(e) Open Space LA = Point source WLA for discharges from Open Space land uses, assumed to be equal to the Open Space Existing Load.

2.0 MONITORING APPROACH

This section describes the purpose, scope, and type of sampling conducted for each monitoring program including Compliance Monitoring, Optional Monitoring, Follow-Up Monitoring, and Special Studies. Additional details of the sampling and analytical methodology and data quality objectives are described in the QAPP, provided as Appendix A.

2.1 Compliance Monitoring

This section reflects all of the compliance monitoring requirements set forth in the approved TMDLs for the Chollas Creek Watershed.

2.1.1 Chollas Creek Diazinon and Dissolved Metals TMDL Monitoring

Monitoring has been conducted in the north and south forks of Chollas Creek since 2006 to comply with the Chollas Creek Diazinon TMDL and since 2009 to comply with the Chollas Creek Dissolved Metals TMDL. The monitoring is executed under SDRWQCB Investigation Order No. R9-2004-0277, which was approved on August 13, 2004. Storm water monitoring has been conducted each season since the 2006-2007 storm season.

Compliance monitoring is designed to meet the receiving water monitoring requirements of the TMDLs. Compliance monitoring will be conducted each year at the compliance monitoring locations on north and south Chollas Creek. The data generated will be used to address the following questions:

- Are water quality samples meeting the numeric targets for Diazinon in Chollas Creek?
- Are water quality samples meeting WQOs for dissolved copper, dissolved lead, and dissolved zinc in Chollas Creek?
- Are water quality samples meeting the narrative WQO for toxicity in Chollas Creek?

Monitoring is conducted at two compliance locations during three storm events each wet season (October 1 to April 30). Monitoring is conducted for the first two storm events after October 1 and for the first storm event after February 1 that meet the United States Environmental Protection Agency‘s (USEPA) mobilization criteria.

The USEPA's storm criteria are as follows:

- A rainfall event of at least 0.10 inch in the drainage area.
- No storm of 0.10 inch or greater in the drainage area for at least seventy-two hours prior to a monitored storm event.
- A storm event within plus or minus 50 percent of the median storm volume and duration for the region.

Compliance monitoring is conducted at the Chollas Creek south fork location (DPR3) and the Chollas Creek north fork location (SD8(1)). Storm water samples are collected as flow-weighted composite samples. The required analytes, method numbers, and reporting limits are included in the Chollas Creek TMDL Dissolved Metals Monitoring Plan (AMEC, 2011).

2.1.2 Bacteria Compliance Monitoring

Compliance monitoring is designed to meet the receiving water monitoring requirements of the Bacteria TMDL. Compliance monitoring, including wet and dry weather sampling, will be conducted each year at the compliance monitoring locations. The data generated will be used to address the following questions:

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

Per the Bacteria TMDL, receiving water monitoring will be conducted with the existing Regional MS4 Mass Loading Station (MLS) Monitoring Program. Therefore, the scope of compliance monitoring accounts for the frequency and type of sampling activities of the existing programs in order to facilitate overlap of monitoring efforts and resources. Table 2-1 provides the general scope of Compliance Monitoring Program.

Table 2-1.
Scope of Compliance Monitoring

Number of Monitoring Locations	Wet Weather Monitoring		Dry Weather Monitoring	
	Grab Samples Per Site Per Event	Event Frequency	Grab Samples Per Site Per Event	Event Frequency
3	1	3 storms	1	monthly

2.1.2.1 Compliance Monitoring Locations

The Bacteria TMDL identifies the lower 1.2 miles of Chollas Creek as the targeted segment in the TMDL. Three monitoring locations were selected based on the compliance requirements set forth in Resolution No. R9-2010-0001. The resolution requires receiving water compliance monitoring to occur at or near the mouth of the creek, such as the MLS or Mass Emission Station, and one or more locations upstream of the mouth, such as the Watershed Assessment Station. The two MLSs in the Chollas Creek Watershed, SD8(1) and DPR3, were selected for compliance monitoring. A third compliance monitoring location approximately 100 yards south of the confluence of the north and south forks of Chollas Creek was also selected to fulfill the TMDL compliance monitoring requirements, since it reflects the loading of the entire watershed. Figure 2.1 presents a map of the compliance monitoring locations within the watershed. Table 2.2 provides the location name and coordinates for the compliance monitoring locations.

Table 2-2.
Compliance Monitoring Location

Site ID	Site Name	Site Type	Latitude	Longitude
CTL(1)	Chollas Tidal	Creek	32.69120	-117.12354
SD8(1)[(a)]	North Chollas Creek MLS	Creek	32.70493	-117.12132
DPR3[(a)]	South Chollas Creek MLS	Creek	32.69130	-117.11682

Notes:
CTL = Chollas Tidal Compliance Monitoring Location
SD8(1) = North Chollas Creek Mass Loading Station
DPR3 = South Chollas Creek Mass Loading Station
[(a)] Monitoring location also selected to fulfill monitoring requirements of the Diazinon and Dissolved Metals TMDL.

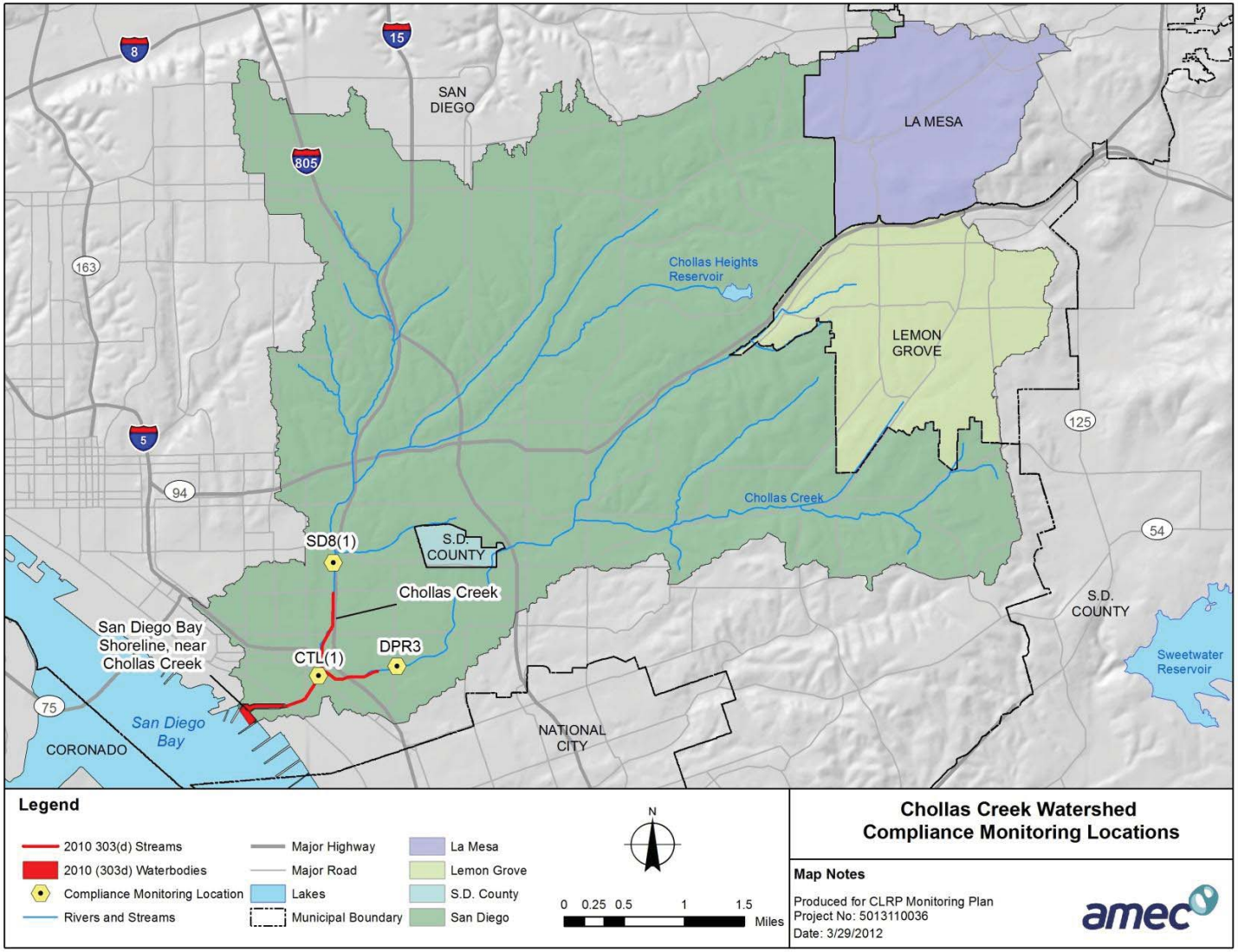

Figure 2-1. Map of Compliance Monitoring Locations

2.1.2.2 Constituents

Fecal indicator bacteria (FIB) are the target constituents for Chollas Creek, as indicated by the TMDL. Grab samples will be representative of the environmental conditions of each location, therefore, the grab samples will be collected from the horizontal center of the stream to the maximum extent practicable. For intermittent streams, sampling will be suspended once the stream is too low to sample. Samples collected during wet and dry weather monitoring will be analyzed for FIB in accordance with Surface Water Ambient Monitoring Program (SWAMP) requirements provided in the QAPP (Appendix A). Table 2-3 presents the constituents, reporting limits, and analytical methods.

Table 2-3.
Compliance Analyses for Bacteria TMDL

Parameter	Project Reporting Limit[(a)] (per 100mL)	Analytical Method
Enterococcus	10 CFU	TBD
Fecal Coliform	20 MPN	TBD
Total Coliform	20 MPN	TBD

Notes:
CFU = Colony Forming Units
TBD = To be determined by the Responsible Parties.
(a) The reporting limits are consistent with the existing AB411 program to facilitate overlap with that program. However, reporting limits may be lower depending on the laboratory used to conduct the analysis.

2.1.2.3 Dry Weather Monitoring

Dry weather monitoring will be conducted monthly at the compliance monitoring location(s) listed in Table 2-2 between January and December of the compliance period. Dry weather sampling will occur on dry weather days when there is measureable flow at the location. Samples are to be collected 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 the compliance monitoring location(s). Methodology for field observations and sample collection is described in the QAPP (Appendix A).

2.1.2.4 Wet Weather Monitoring

Wet weather monitoring will be conducted at the compliance monitoring location(s) during three storm events each wet season (October 1 to April 30). Storms resulting in greater than 0.2 inches of precipitation will be targeted for analysis. One grab sample will be collected per storm within 24 hours of the end of precipitation. The storm events will be spread throughout the wet season to the maximum extent practicable as follows:

- Storm Event 1 (October to November)
- Storm Event 2 (December to January)

- Storm Event 3 (February to April)

During each wet-weather monitoring event, field observations will be recorded and a grab water sample will be collected at the compliance monitoring locations. Grab samples will be collected using the same sample technique as during a dry weather monitoring event, taking additional safety precautions as needed. Methodology for field observations and sample collection is described in the QAPP (Appendix A).

2.1.3 Future Considerations

The Bacteria TMDL monitoring will be coordinated with the Diazinon and Dissolved Metals TMDLs monitoring to the maximum extent possible, however there are two differences in storm monitoring requirements that support the need for autonomous or semi-autonomous monitoring programs: (1) The definition of a wet weather event, and (2) the distribution of events throughout the storm season.

1. The Diazinon and Dissolved Metals TMDLs state that storm events are captured per the USEPA's mobilization criteria defined as 0.10 inch storm event. This differs from the Bacteria TMDL which requires a storm event greater than 0.20 of an inch. The difference in mobilization criteria between the TMDLs may require separate monitoring programs, as storm events less than 0.2 inches are common in the Chollas Creek Watershed.

2. The Diazinon and Dissolved Metals TMDLs require monitoring of the first two storm events after October 1 and the first storm event after Feburary 1, whereas the Bacteria TMDL compliance monitoring will target three storm events throughout the entire wet season (early, mid, and late season). This difference makes it unlikely that sampling will be coordinated for all three events.

2.2 Optional Monitoring

Optional monitoring is not mandatory to meet TMDL monitoring requirements and may be suspended at any time. Optional monitoring is presented in the Monitoring Plan so that the procedures are available should the Responsible Parties decide to conduct the monitoring. The Chollas Creek Watershed Responsible Parties will determine when any optional monitoring elements will be implemented. The Chollas Creek Watershed Responsible Parties will determine each year whether the optional monitoring will be initiated, modified, or eliminated (although optional monitoring may be revised more frequently if approved by the Responsible Parties). Modifications to optional monitoring elements will be documented in the Annual CLRP Monitoring Summary. The decision to initiate, modify, or eliminate optional monitoring will be communicated to the SDRWQCB Project Manager to clearly inform the SDRWQCB whether the monitoring is to occur.

The field measurements in Table 2-4 are considered optional for Chollas Creek. Flow may be monitored during sampling events or throughout the year at the compliance monitoring locations. Flow monitoring is considered optional since it is not clearly specified by the TMDL, however, flow information will be needed to calculate the WLA.

Table 2-4.
Optional Field Parameters

Field Parameter	Recommended SWAMP Reporting Limit	Method
Dissolved Oxygen	NA	Field Meter
Flow	NA	TBD
pH	NA	Field Meter
Specific Conductivity	2 µS/cm	Field Meter
Temperature	NA	Field Meter
Turbidity	5 NTU	Field Meter

Notes:
pH = potential Hydrogen
µS/cm = micro Siemens per centimeter
NTU = Nephelometric Turbidity Units

2.3 Follow-Up Monitoring

Per the TMDL, if exceedances of the numeric targets are observed in the monitoring data, additional monitoring locations and/or other source identification methods must be implemented to identify the sources causing the exceedances. Additionally, the locations and/or other source identification methods must also be used to demonstrate that the bacteria loads have been addressed. The Responsible Parties have designed the Follow-up Monitoring Program to be implemented prior to the end of the compliance period in order to facilitate compliance with the interim reduction milestones. The Follow-up Monitoring Program should address both expected exceedances and sources limiting the attainment of the milestone. Implementation of follow-up monitoring, if necessary, is scheduled to begin after the first milestone requiring 50 percent reduction of dry or wet weather exceedances.

The Follow-up Monitoring Program will utilize an adaptive monitoring approach to determine the sources contributing to exceedances in the receiving water. Each year, the program will evaluate compliance data to determine if follow-up monitoring is needed and the monitoring approach would be modified to address the pattern of exceedances. The data generated will be used to address the following questions:

- What are the potential sources/areas causing exceedances in the receiving water?
- Are MS4 discharges contributing to WQO exceedances in the receiving water?
- What is the magnitude and duration of the exceedance condition?

2.3.1 Initiation of Follow-up Monitoring

Follow-up monitoring will be implemented based on exceedances of receiving water numeric targets and allowable frequencies recorded each year at the compliance monitoring locations. Follow-up monitoring is designed to address persistent exceedances and to assess the frequency of exceedances over relatively long-term periods. Compliance dates will be consistent with dates presented in the CLRP. Under the Compliance Monitoring Program, FIB

results will be compared to TMDL numeric targets and mandated frequency reductions, as described in Section 1.6.

Follow-up monitoring will occur when:

- Allowable exceedance frequency of dry weather data has not been reduced by at least 50 percent by year seven (2018).
- Allowable exceedance frequency of wet weather data has not been reduced by at least 50 percent by year ten (2021).
- After the 100 percent reduction milestones for both wet and dry weather (i.e., the respective final compliance dates), the initiation criteria will be updated to reflect the most applicable 'trigger' based on the available data and possible revisions to the TMDL.

2.3.2 Follow-up Monitoring Approach

The approach implemented for the Follow-up Monitoring Program will be adaptive based on the type of exceedance (wet or dry weather), the frequency of exceedances, and watershed specific data following the first interim milestone. Four types of follow-up monitoring options were identified in the Copermittee Compliance Framework (Larry Walker and Associates [LWA], 2011) and are summarized below. These options are designed to assist with source identification and TMDL compliance and more than one type of monitoring may be implemented per monitoring year.

- Upstream Monitoring: Upstream monitoring may be implemented in watersheds with clear jurisdictional boundaries, hydrologic breaks, or to isolate non-point source inputs along the receiving water. This option will characterize sources throughout the extent of the receiving water and will require additional monitoring to further isolate and identify sources. This option may provide useful data for watersheds where pollutant sources are largely unknown. Follow-up monitoring locations would be located in the receiving water, upstream of the compliance monitoring location.
- Representative Land Use Monitoring: Representative land use monitoring may be implemented in HSAs where homogenous land uses are present and discharge to the MS4. It may provide useful data for distinguishing between non-MS4 land uses and MS4 land uses that may be contributing to receiving water objective exceedances. This data may also be used to further calibrate and validate the watershed model and facilitate selection of management measures and/or BMPs. Follow-up monitoring locations would be selected to be representative of the major land use types present in the watershed.
- Localized Outfall Monitoring: Localized outfall monitoring may be implemented at monitoring stations adjacent to the receiving water in which objective exceedances were detected. It may provide useful data for identification of MS4 discharges to the receiving water in the direct vicinity of the objective exceedance. Monitoring may be employed in watersheds or HSAs that have a limited number of outfalls and may assist in determining whether the MS4 is causing or contributing to particular receiving water exceedances. If WQO exceedances are recorded at the follow-up monitoring locations then additional actions must be taken to

bring the location into compliance. This may lead to additional monitoring in the immediate area or an evaluation of management measures and/or BMPs.

- Source Identification Monitoring: Microbial source testing may be added to any of the monitoring options described in the previous sections including both compliance monitoring and follow-up monitoring locations. This will assist in identification of pollutant sources that contribute to exceedances that may or may not be the result of MS4 discharges. Specifically, if no human sources are identified then it is possible to report that controllable sources are not causing the exceedances of WQOs at the monitoring location. This may lead to a potential special study to further identify sources of human fecal bacteria or natural sources.

Follow-up monitoring locations will be identified after compliance year six and will be updated each year after that, to reflect the most recent compliance data set. Therefore, monitoring locations are not provided in this Monitoring Plan. Aerial imagery, Geographic Information Systems (GIS), and field surveys may be utilized to assist with determination of appropriate sampling locations.

Follow-up monitoring will be unique to each location and monitoring condition, therefore the monitoring approach for each specific case will be determined at that time.

A summary of follow-up monitoring will be provided in the Annual CLRP Monitoring Program Summary. The summary will include the monitoring approach, monitoring locations, sampling protocols, summary of results, and planned actions.

2.4 Special Studies

Special studies will be utilized to support the CLRP implementation strategies for the other 303(d) Listed constituents, draft TMDL pollutants, and potentially approved TMDL pollutants. To support CLRP implementation, special studies may be designed to further characterize pollutants in receiving waters or watershed and/or evaluate the effectiveness of the CLRP. A detailed QAPP will be needed for special studies to detail the monitoring approach, sampling and analytical methods, sample location information, and other pertinent study information.

The Chollas Creek Responsible Parties will determine each year whether a special study should be initiated, modified, or eliminated based on available funding (although special study monitoring may be revised more frequently if approved by the Responsible Parties). Initiation or completion of special studies will be noted in the Annual CLRP Monitoring Summary. The decision to initiate, modify, or eliminate special studies will be communicated to the Regional Board so they are clearly informed of planned monitoring.

Currently the Chollas Creek Responsible Parties are participating in a regional special study to evaluate natural sources of bacteria in reference streams in San Diego County. The goal of the San Diego Regional Reference Stream Study is to determine the exceedance frequency of bacteria due to natural sources. The Study will help inform strategies that address the Bacteria TMDL. The Chollas Creek Responsible Parties have determined that sufficient information is available to develop the CLRP and initiate management actions on TMDL and non-TMDL constituents. Additionally, as water quality conditions are not expected to change until a series of management actions are initiated/completed, no additional special studies are currently scheduled for the first year of monitoring.

3.0 DATA MANAGEMENT AND REPORTING PROCEDURES

This section describes the management of field and analytical data and reporting procedures for the Chollas Creek CLRP Monitoring Program.

3.1 Data Management

Field Data Records and Analytical Data Reports will be sent to and kept by the designated Lead Agency Project Manager. Data will be submitted in a standardized SWAMP-compatible format. The Lead Agency will compile the monitoring data and provide an annual CLRP Monitoring Summary to RWQCB.

The Sampling Agency will review all Field Data Log Sheets for completeness, maintain the original hardcopies, and scan electronic copies (personal data form [*.pdf]) for storage in the project file. Copies of Field Data Log Sheets and photographs for each event will be submitted to the Lead Agency on a quarterly basis. The field crew will retain the original Field Data Log Sheets.

The laboratories will provide data in electronic format: both *.pdf copies of lab reports and a SWAMP-compatible Electronic Data Deliverable (EDD). Analytical results will be submitted to the Sampling or Lead Agency in *.pdf format and as a SWAMP compatible EDD within three weeks of submittal of samples. A SWAMP-compatible template will generate data files that can be uploaded to the SWAMP regional database. The Sampling or Lead Agency will review all lab reports and EDDs for accuracy, completeness, and compatibility with SWAMP. The contract laboratory shall retain original Chain-of-Custody forms. The contract laboratory will retain copies of the preliminary and final data reports.

3.2 Reporting Procedures

The Sampling Agency will provide quarterly sampling summaries to the Lead Agency as a status of monitoring activities. The update will include a brief summary of activities completed in the previous quarter and the field observations recorded. The Lead Agency will provide quarterly updates to the other participating Responsible Parties during regularly scheduled Watershed Workgroup meetings.

The Lead Agency will generate an Annual CLRP Monitoring Summary, which will be included in the WURMP Annual Report as an appendix. The Annual CLRP Monitoring Summary will describe the sample collection methods, sampling events, and present key findings of the analytical results. As part of the first year's assessment, the "existing" dry weather exceedance frequency will be calculated based on the 1996 to 2002 data set which will be used to evaluate progress toward attaining the TMDL. Any deviations from protocols listed in the Monitoring Plan and/or QAPP and the implications of those deviations on the interpretation of the data will be included in the report.

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APPENDIX A

QAPP

APPENDIX A

CHOLLAS WATERSHED
FINAL QUALITY ASSURANCE PROJECT PLAN

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GROUP A ELEMENTS: PROJECT MANAGEMENT

1.0 TITLE AND APPROVAL SHEETS

CHOLLAS WATERSHED
FINAL Quality Assurance Project Plan
Comprehensive Load Reduction Plan (CLRP)

May 2012

Submitted to:
City of San Diego
Transportation and Storm Water Department

Submitted by:
AMEC Environment & Infrastructure, Inc.
San Diego, California

QAPP Revision Number: 1.0

APPROVAL SIGNATURES

PROJECT ORGANIZATION:

Title:	Name:	Signature:	Date*:
Insert Title of Person Here	Insert Name of Person		
Insert Title of Person Here	Insert Name of Person		
Insert Title of Person Here	Insert Name of Person		
Insert Title of Person Here	Insert Name of Person		
Insert Title of Person Here	Insert Name of Person		
Insert Title of Person Here	Insert Name of Person		
Insert Title of Person Here	Insert Name of Person		

REGIONAL BOARD (SDSWRCB):**

Title:	Name:	Signature:	Date*:
Insert Title of Person Here	Insert Name of Person		
Insert Title of Person Here	Insert Name of Person		

* This is a contractual document. The signature dates indicate the earliest date when the project can start.

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ACRONYMS AND ABBREVIATIONS

^{o}C	degree Celsius
µs/cm	microsiemens per centimeter
303(d) List	Clean Water Act (CWA) Section 303(d) List of Water Quality Limited Segments
AB411	Assembly Bill 411
Bacteria TMDL	A *Resolution Amending the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Revised Total Maximum Daily Loads for Indicator Bacteria Project I-Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek)*
Basin Plan	State Water Resources Control Board's San Diego Region Basin Plan
BMP	Best Management Practice
BPA	Basin Plan Amendment
Caltrans	California Department of Transportation
CFS	Cubic Feet Per Second
COC	Chain-of-Custody
CLRP	Comprehensive Load Reduction Plan
CWA	Clean Water Act
Diazinon TMDL	Investigation Order No. R9-2004-00277, California Department of Transportation and San Diego Municipal Separate Storm Sewer system Copermittees Responsible for the Discharge of Diazinon into the Chollas Creek Watershed, San Diego, California
Dissolved Metals TMDL	Resolution No. R9-2007-0043, A Resolution Adopting an Amendment to the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Total Maximum Daily Loads for Dissolved Copper, Lead and Zinc in Chollas Creek, Tributary to San Diego Bay (approved under State Water Resources Control Board Resolution No. 2008-0054)
DHS	Department Of Health Services
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
ft	Feet
ft^2	Square Feet
ft/s	Feet Per Second
FIB	Fecal Indicator Bacteria
ID	Identification
JPEG	Joint Photographic Experts Group
LA	Load Allocation
mL	Millimeter
MLS	Mass Loading Station
MOU	Memorandum of Understanding

ACRONYMS AND ABBREVIATIONS (CONTINUED)

MS4	Municipal Separate Storm Sewer System
MPN	Most Probable Number
*.pdf	Portable Document Format
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RP	Responsible Party
RPD	Relative Percent Difference
SDRWQCB	San Diego Regional Water Quality Control Boards
SOP	Standard Operating Procedure
SWAMP	Surface Water Ambient Monitoring Program
TBD	To Be Determined
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	Waste Load Allocation
WQO	Water Quality Objective
WURMP	Watershed Urban Runoff Management Program

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2.0 DISTRIBUTION LIST

Title:	Name (Affiliation):	Tel. No.:	QAPP No*:
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Insert Title of Person Here	Insert Name of Person		

Laboratory Managers will receive an electronic copy of the QAPP.

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3.0 PROJECT/TASK ORGANIZATION

3.1 Involved Parties and Roles

The 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. The Bacteria TMDL identifies the Responsible Parties and Lead Agency for the Chollas Creek Watershed. The Responsible Parties will collaborate in the implementation of the Monitoring Programs. The Responsible Parties, excluding owners and operators of small MS4s and controllable nonpoint sources, are:

- City of San Diego
- City of La Mesa
- City of Lemon Grove
- San Diego County
- San Diego Unified Port District
- Caltrans

Responsible Parties, consultants, and laboratory staff will have the following roles and responsibilities (Table 3-1):

- **Contract Manager:** To be determined. The Contract Manager will be responsible for establishing contracts with the selected consultants and/or laboratories to implement the Comprehensive Load Reduction Plan (CLRP) Compliance Monitoring Program and act as the liaison between the Responsible Parties and consultants.
- **Project Manager:** To be determined. The Project Manager will be responsible for overseeing the day to day activities of implementing the CLRP Compliance Monitoring Program.
- **Project Quality Assurance (QA) Officer:** To be determined. The Project QA Officer will be responsible for overseeing the project QA activities independently from the Project Manager to ensure that project implementation is being conducted in accordance with this Quality Assurance Project Plan (QAPP).
- **Laboratory QA Officer:** Project Manager
- **Sampling Project Manage**r: To be determined.

Table 3-1.
Personnel Responsibilities

Name	Organizational Affiliation	Role/Responsibility	Contact Information
		Contract Manager	
		Project Manager	
		Project QA Officer	
		Laboratory QA Officer	
		Sampling Project Manager	

3.2 Quality Assurance Officer Role

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

3.3 Persons Responsible for QAPP Update and Maintenance

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

3.4 Organizational Chart and Responsibilities

Figure 3-1 presents the organization chart for the Chollas Creek CLRP Monitoring Program.

Figure 3-1. Organizational Chart

To be determined at a later date by Responsible Parties.

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4.0 PROBLEM DEFINITION/BACKGROUND

4.1 Problem Statement

The San Diego Regional Water Quality Control Board (SDRWQCB) has issued the following resolutions and investigative orders in the Chollas Creek Watershed:

- Investigation Order No. R9-2004-00277, California Department of Transportation (Caltrans) and San Diego Municipal Separate Storm Sewer system (MS4) Copermittees Responsible for the Discharge of Diazinon into the Chollas Creek Watershed, San Diego, California, herein referred to as the Diazinon Total Maximum Daily Load (TMDL).
- Resolution No. R9-2007-0043, A Resolution Adopting an Amendment to the Water Quality Control Plan for the San Diego Basin (9) to Incorporate TMDLs for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay (approved under State Water Resources Control Board Resolution No. 2008-0054), herein referred as the Dissolved Metals TMDL.
- Resolution No. R9-2010-0001, A *Resolution Amending the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Revised TMDLs for Indicator Bacteria Project I-Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek),* herein referred to as the Bacteria TMDL.

The Chollas Creek TMDLs have identified the responsible parties (RPs) of the MS4s and Caltrans (hereafter called the RPs) as point sources that have been assigned Waste Load Allocations (WLAs). The Basin Plan Amendment (BPA), which is Attachment A in each TMDL, outlines an Implementation Plan that includes a compliance schedule and a description of minimum monitoring requirements to assess compliance with the TMDLs, WLAs, and Load Allocations (LAs).The Responsible Parties have developed this QAPP as part of the CLRPs for the Chollas Creek Watershed.

The Chollas Creek CLRP Monitoring Program is designed to fulfill the monitoring requirements of the BPA and generate data to support the Chollas Creek CLRP. The Chollas Creek CLRP Monitoring Program is described in detail in the Monitoring Plan. The goals of the Chollas Creek CLRP Monitoring Program include the following:

- To assess progress toward meeting the Bacteria TMDL numeric targets and WLAs.
- To characterize potential sources of approved TMDL pollutants, draft TMDL pollutants, and other 303(d) Listed constituents.
- To support the selection and evaluation of potential best management practices (BMPs).

The following four principal types of monitoring will be conducted to address the goals of the Chollas Creek CLRP Monitoring Program.

- Compliance Monitoring is required by approved TMDLs to demonstrate progress toward meeting TMDL requirements including numeric targets and WLAs.
- Optional Monitoring is not required by the TMDL; however if sufficient funds are available, it may be implemented by Responsible Parties to better understand water quality conditions in the receiving water and support the goals of compliance monitoring. Optional Monitoring may be added to (and removed from) the compliance monitoring effort as deemed appropriate by the Responsible Parties.
- Follow-up Monitoring will be implemented to characterize the source, magnitude, and duration of exceedances of bacteria water quality objectives (WQOs) in the receiving water based on the results of compliance monitoring.
- Special Studies will be implemented based on the available data and resources to address management questions regarding adopted TMDLs, and 303(d) Listed pollutants. Special Studies may require the development of separate agreements and funding opportunities between the Responsible Parties.

The purpose of this QAPP is to outline the methodology and data requirements to meet the goals of the Chollas Creek CLRP Monitoring Program and address specific monitoring requirements of the compliance monitoring and optional monitoring components scheduled to be implemented during Fiscal Year 2013.

4.2 Decisions or Outcomes

The data generated by this project will be used to track water quality at the compliance monitoring locations during wet and dry weather conditions. Compliance monitoring is designed to meet the receiving water monitoring requirements of the BPA. Compliance monitoring will evaluate data collected including the approved Bacteria TMDL pollutants and other optional field parameters.

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

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

4.3 Water Quality or Regulatory Criteria

The Bacteria TMDL BPA defines the numeric targets and WLAs for the Responsible Parties. Data collected as part of the Chollas Creek CLRP Monitoring Program will be utilized to evaluate progress and attainment of TMDL targets and WLAs. The receiving water limitation, WLAs and LAs for the Chollas Creek Watershed are provided in Tables 1-4 and 1-5 of the Monitoring Plan per the Bacteria TMDL. The TMDL numeric targets for Diazinon and Metals are presented in the Chollas Creek TMDL Dissolved Metals Monitoring Plan (AMEC Environment & Infrastructure, Inc. [AMEC], 2011).

5.0 PROJECT/TASK DESCRIPTION

5.1 Work Statement and Products

This QAPP reflects the compliance monitoring, optional monitoring, and reporting components of the Chollas Creek CLRP Monitoring Program.

5.1.1 Compliance Monitoring

5.1.1.1 Bacteria TMDL

The Bacteria TMDL identifies the lower 1.2 miles of Chollas Creek as the targeted segment for indicator bacteria. Compliance monitoring is designed to meet the receiving water monitoring requirements of the BPA. Compliance monitoring, including wet and dry weather sampling, will be conducted each year at the compliance monitoring locations. The wet and dry weather monitoring components are described below:

- Wet weather monitoring will be conducted to characterize the bacteria concentrations during representative storm events. Wet weather monitoring will be conducted for three storm events each wet season (October 1 – April 30).
- Dry weather monitoring will be conducted throughout the year to characterize non-storm flow conditions. Dry weather monitoring will be conducted monthly or until measurable flow ceases at intermittent stream sites.

5.1.1.2 Diazinon and Dissolved Metals TMDLs

The Diazinon TMDL identifies Diazinon-induced toxicity in storm water collected from Chollas Creek. While the lowest 3.5 miles of Chollas Creek comprise the actual listed segment of Chollas Creek for dissolved copper, lead, and zinc, the Dissolved Metals TMDL considers all upstream tributaries of Chollas Creek in the TMDL. Compliance monitoring is designed to meet the receiving water monitoring requirements of the BPAs. Compliance monitoring will be conducted each year at the compliance monitoring locations. The wet weather monitoring components are described below:

- Wet weather monitoring will be conducted to characterize toxicity, diazinon concentrations, and copper, lead, and zinc concentrations and loading during representative storm events. Wet weather monitoring will be conducted for three storm events each wet season (October 1 – April 30). Detailed information regarding the compliance monitoring can be found in the monitoring plan.

Sampling, laboratory analysis, and quality assurance/quality control details are not reflected in this QAPP. See the Chollas Creek TMDL Dissolved Metals Monitoring Plan (AMEC Environment & Infrastructure, Inc. [AMEC], 2011).

5.1.2 Optional Monitoring

All optional monitoring is considered above and beyond the requirements of the BPAs and the data needed to answer the compliance monitoring questions. Optional monitoring is presented in the QAPP so that the procedures are available should the Responsible Parties decide to conduct the monitoring. If optional monitoring is conducted, it would be implemented concurrently with the Compliance Monitoring to supplement that data set.

5.1.3 Reporting

The Lead Agency will compile the project data and provide an annual CLRP Monitoring Summary to SDRWQCB.

5.2 Monitored Constituents and Measurement Techniques

Samples will be analyzed for fecal indicator bacterial (FIB) and may be analyzed for in-situ field measurements. Analysis of FIB, including *Enterococcus*, fecal coliform, and total coliform, are required for compliance with the TMDL. Measurement of *in-situ* field parameters is considered optional and will be implemented at the discretion of the Responsible Parties. The Responsible Parties may opt to analyze some, all, or none of the field measurements listed in Table 5-2. Table 5-1 provides a master list of analytical constituents as well as Surface Waters Ambient Monitoring Program (SWAMP) reporting limits (RLs). The Lead Agency will select methods approved by the California Department of Health Services (DHS) Environmental Laboratory Accreditation Program (ELAP). Common methods for FIB analysis include multi-tube fermentation, membrane filtration, and Enterolert® by IDEXX Laboratories (for *Enterococcus* only).

The laboratory shall conduct the appropriate dilutions to generate results and avoid greater than values. The following ranges are applicable to all methods and are obtained by performing dilutions, when appropriate from 20-160,000 most probable number (MPN)/100 milliliter (mL) for fecal coliform and *Enterococcus* and 20-1.6 million for total coliform (County of San Diego, 2011). Table 5-2 provides a master list of optional in-situ field measurements, and the SWAMP reporting limits.

Table 5-1.
Master List of Analytical Constituents

Constituents	Method	Target Reporting Limit[(a)]	Sampling Type
Indicator Bacteria			
Enterococcus	TBD	10 colonies/100 mL	D,W
Fecal coliform	TBD	20 MPN/100 mL	D,W
Total coliform	TBD	20 MPN/100 mL	D,W

Notes:
TBD To be determined by the Responsible Parties.
D designates dry weather sampling.
W designates wet weather sampling.
(a) The reporting limits are consistent with methodology of the Assembly Bill 411 Monitoring Program to facilitate comparable results throughout the region. However, reporting limits may be lower depending on the lab used to conduct the analysis.

Table 5-2.
Master List of Optional In-situ Field Parameters

Parameters	Method	SWAMP Target Reporting Limit	Sampling Type
Conductivity	Field Meter	2 µS/cm	TBD
Flow	Field Meter	NA	TBD
pH	Field Meter	NA	TBD
Temperature	Field Meter	NA	TBD
Turbidity	Field Meter	5 NTU	TBD

Notes:
µS/cm – microsiemen per centimeter
NA – not applicable
NTU – nephelometric turbidity unit

5.3 Project Schedule

Compliance Monitoring is scheduled to begin 30 days after submittal of the QAPP and Monitoring Plan to the SDRWQCB pending any comments or revisions. Table 5-3 provides the schedule for the annual activities for the Chollas Creek CLRP Monitoring Program to be implemented in Fiscal Year 2013 including work plans, monitoring, and reporting. Program deliverables are described in Section 3 of the Monitoring Plan.

Table 5-3.
Project Schedule for Fiscal Year 2013

Activity	Date (MM/DD/YY)		Deliverable
	Anticipated Date of Initiation	Anticipated Date of Completion	
QAPP/Monitoring Plan	Submitted herein	Submitted herein	QAPP/Monitoring Plan
Compliance Monitoring	11/4/12	11/4/13	NA
Reporting	NA	6/1/14	Annual CLRP Monitoring Summary to be included in the WURMP Annual Report

Notes:
WURMP Watershed Urban Runoff Management Program

5.4 Geographical Setting

The Chollas Creek Watershed (Figure 5-1) encompasses approximately 18,000 acres of mainly urbanized land located southeast of downtown San Diego, in the San Diego Mesa Hydrologic Area, and within the larger Pueblo San Diego Hydrologic Unit. Land use in the Chollas Creek Watershed is predominantly composed of residential (48 percent), road (20 percent), and open space (9 percent). The remaining watershed land uses consist of office/institutional (6 percent), freeway (5 percent), commercial (4 percent), industrial (3 percent), and other miscellaneous land uses.

The creek includes two main tributaries, the north fork and the south fork. The drainage area of the northern fork (i.e., 8,794 acres) of the watershed is larger than that of the southern fork (i.e., 7,575 acres). The headwaters of the north fork originate approximately 1.5 miles west of the jurisdictional boundary of the City of La Mesa. From this point, the north fork flows in a southwesterly direction for approximately 3 miles before it is joined by several smaller tributaries, which feed into the main stem of the creek. The creek then flows in a southerly direction for approximately 1.5 miles before discharging into San Diego Bay. The south fork of Chollas Creek flows in a west–southwesterly direction from its headwaters in the City of Lemon Grove and is the product of two smaller creek branches. The north and south fork of Chollas Creek merge approximately 0.8 miles east of the creek's mouth at San Diego Bay, in a tidally influenced section of the creek.

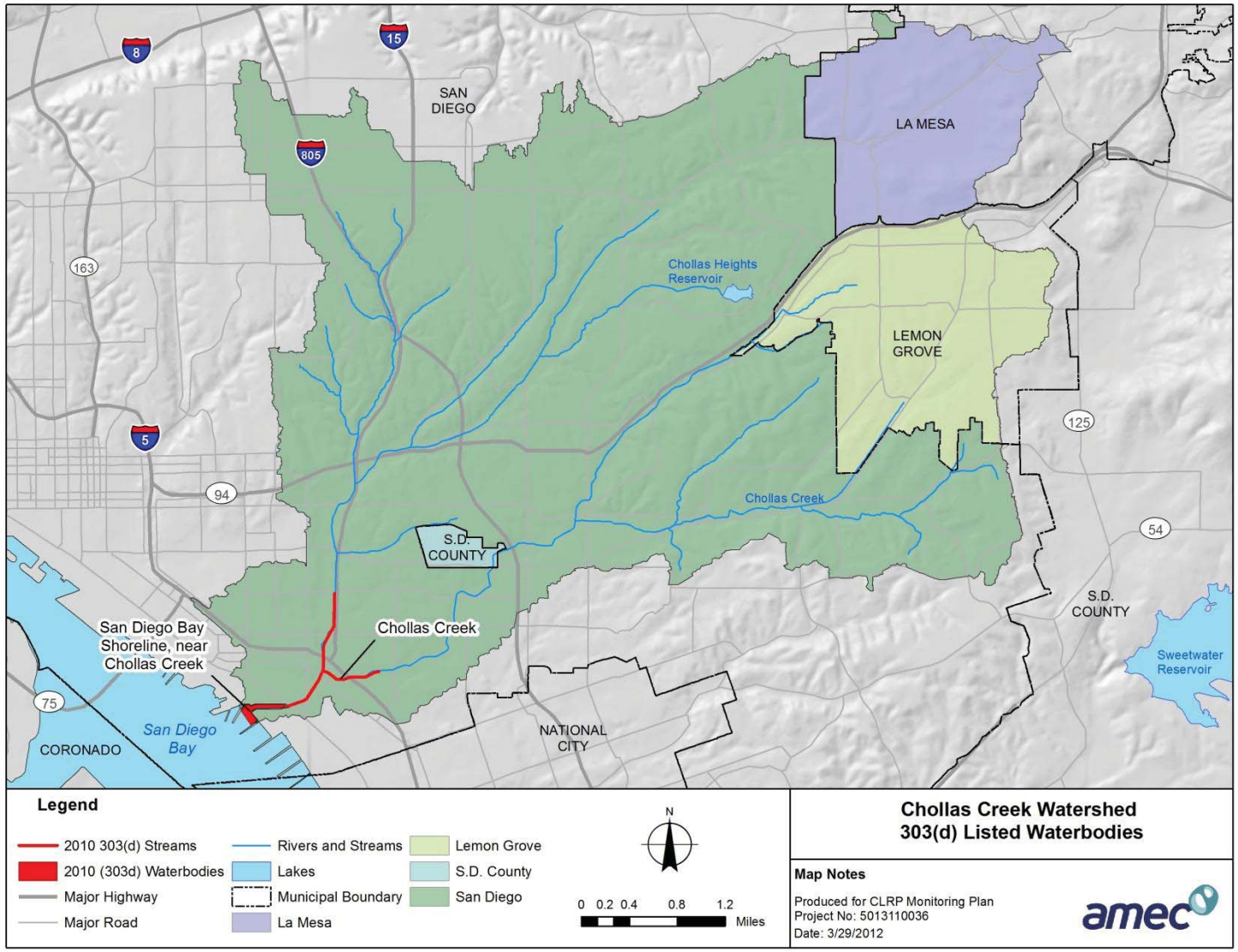

Figure 5-1. Project Area

5.5 Constraints

To be determined at a later date by Responsible Parties.

6.0 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Data quality will be assessed using data quality objectives (DQOs) such as accuracy, precision, and completeness. The applicable DQOs are provided for each analysis type in Table 6-1. Measurement quality objectives for laboratory analyses are provided in Table 6-2. Measurement quality objectives for field measurements, which are optional analyses, are provided in Table 6-3. Details on DQOs and how they are measured are provided below.

Table 6-1.
Data Quality Objectives

Measurement or Analysis Type	Applicable Data Quality Indicators
Laboratory – Bacteria (Required)	Accuracy, Precision, Completeness
In-situ Field Measurements (Optional)	Accuracy, Precision, Completeness

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

Precision is a measurement of the repeatability of test measurements. Precision can be measured in the laboratory using laboratory replicates. Precision can be measured in the field using field duplicates. Relative percent differences (RPDs) will be calculated to determine the precision between duplicate samples. This calculation is shown below:

$$RPD = \frac{abs[x_1 - x_2]}{0.5 \times (x_1 + x_2)} \times 100$$

Where: x_1 is the primary sample concentration; x_2 is the duplicate sample concentration.

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

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

Table 6-2.
Measurement Quality Objectives for Laboratory Data

Group	Parameter	Accuracy	Precision[(a)]	Target Reporting Limit	Completeness
Bacteria	*Enterococcus*	Positive control and reference material = 80-120% recovery. Negative control = no growth on filter.	Lab Replicate RPD<25%	10 colonies/ 100 mL	90%
Bacteria	Fecal coliform	Positive control and reference material = 80-120% recovery. Negative control = no growth on filter.	Lab Replicate RPD<25%	20 MPN/ 100 mL	90%
Bacteria	Total coliform	Positive control and reference material = 80-120% recovery. Negative control = no growth on filter.	Lab Replicate RPD<25%	20 MPN/ 100 mL	90%

Notes:
[(a)] Not applicable, if native concentration of either sample is less than reporting limit.
[(b)] The reporting limits are consistent with methodology of the Assembly Bill 411 Monitoring Program to facilitate comparable results throughout the region. However, reporting limits may be lower depending on the lab used to conduct the analysis.

Table 6-3.
Measurement Quality Objectives for Optional Field Data

Group	Parameter	Accuracy	Precision	SWAMP Target Reporting Limit	Completeness
Field Analysis	Conductivity	TBD	TBD	2 µS/cm	90%
Field Analysis	Velocity	TBD	TBD	0.1 ft/s	90%
Field Analysis	pH	TBD	TBD	NA	90%
Field Analysis	Temperature	TBD	TBD	NA	90%
Field Analysis	Turbidity	TBD	TBD	5 NTU	90%

Notes:
ft/s feet per second
pH potential Hydrogen

7.0 SPECIAL TRAINING NEEDS/CERTIFICATION

7.1 Specialized Training or Certifications

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

- Sampling in accordance with the QAPP
- Safety procedures, site hazards, and safety awareness in accordance with the Sampling Agency's Health and Safety Plan.

The bacteria analysis will performed by a California DHS ELAP-certified analytical laboratory.

7.2 Training and Certification Documentation

The Sampling Agency will maintain records of training at their respective offices as detailed in Table 7-1. Documentation includes the date of training, the topic, the instructor name, and list of trainees.

Table 7-1.
Specialized Personnel Training or Certification

Specialized Training Course Title or Description	Training Provider	Personnel Receiving Training/Organizational Affiliation	Location of Records & Certification[(a)]
Sampling SOPs and Health and Safety Training	Sampling Agency	Sampling Agency Field Staff	Sampling Agency Address

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

7.3 Training Personnel

Field staff will be trained on proper procedures for *in-situ* field measurements (if applicable), sampling, post-sampling processing, sample handling, and flow measurements in accordance with the QAPP and Monitoring Plan. The Sampling Agency's Project Manager is responsible for training their respective employees prior to the start of sampling, and to conduct any training sessions as needed throughout the course of the program.

Trained laboratory analysts will perform sample analysis for this program.

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8.0 DOCUMENTS AND RECORDS

Documentation and record keeping are essential to project organization, consistency, and data verification. There are many types of documents and records required by this project. Table 8-1 identifies the document and record types, where they will be retained and archived, and what will be their respective dispositions. Final and revised versions of the QAPP will be distributed to Responsible Parties (Section 3.0), analytical laboratory, and the sampling agency.

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

Documentation Category	Identify Type Needed	Retention	Archival	Disposition
Project Plans	QAPP	Project Manager /SDRWQCB	Document/Portable Document Format (*.pdf)	Minimum 5 years
	Monitoring Plan	Project Manager /SDRWQCB	Document/*.pdf	Minimum 5 years
Sampling Records	Water Sampling Field Data Sheets/ Electronic Data Deliverable (EDD), if necessary	Sampling Agency	Field Notebook/ *.pdf/ Excel Spreadsheet	Minimum 5 years
	Creeks only: Instrument Maintenance and Calibration Records	Sampling Agency	Field Notebook/ *.pdf	Minimum 5 years
	Training Records	Sampling Agency	Field Notebook/ *.pdf	Minimum 5 years
	Photographs	Sampling Agency	Field Notebook/ Joint Photographic Experts Group (JPEG)	Minimum 5 years
	Creeks only: In-situ Field Measurements	Sampling Agency	*.pdf or Excel spreadsheet	Minimum 5 years
Analytical Records	Chain-of-Custody	Analytical Laboratory	Field Notebook/ *.pdf	Minimum 5 years
	Laboratory Reports	Analytical Laboratory	*.pdf/Microsoft Excel (Excel) spreadsheet	Minimum 5 years
	EDD	Analytical Laboratory	Excel spreadsheet or Database	Minimum 5 years
Data Records	Corrective Action Forms	Sampling Agency/ Laboratory	*.pdf	Minimum 5 years
CLRP Monitoring Summary	Final Report	Sampling Agency, Responsible Parties[(a)], SDRWQCB	Document/*.pdf	Minimum 5 years

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GROUP B: DATA GENERATION AND ACQUISITION

9.0 SAMPLING DESIGN

This section provides an overview of the sampling design. The sampling design is given in detail within the Monitoring Plan.

9.1 Project Description and General Design

The scope of compliance monitoring accounts for the frequency and type of sampling activities of the existing Regional MS4 MLS Monitoring Program in order to facilitate overlap of monitoring efforts and resources. Table 9-1 provides the general scope of Chollas Creek Compliance Monitoring Program.

Table 9-1
Scope of Compliance Monitoring

Number of Monitoring Locations	Wet Weather Monitoring		Dry Weather Monitoring	
	Grab Samples Per Event Per Site	Monitoring Frequency	Grab Samples Per Event Per Site	Monitoring Frequency
3	1	3 storms	1	monthly

9.2 Monitoring Locations

Three monitoring locations were selected based on the compliance requirements set forth in the Bacteria TMDL. Table 9-2 provides monitoring location information and Figures 9-1 through 9-3 provide an image of each monitoring location. The Bacteria TMDL requires receiving water compliance monitoring to occur at or near the mouth of the creek, such as the MLS or Mass Emission Station, and one or more locations upstream of the mouth, such as the Watershed Assessment Station. The two MLSs in the Chollas Creek Watershed, SD8(1) and DPR3, were selected for compliance monitoring. A third compliance monitoring location approximately 100 yards south of the confluence of the north and south forks of Chollas Creek was also selected to fulfill the TMDL compliance monitoring requirements, since it reflects the loading of the entire watershed. A watershed overview map of the monitoring locations is provided in Figure 9-4.

Table 9-2.
Sampling Site

Site ID	Site Name	Site Type	Latitude	Longitude
CTL(1)	Chollas Tidal	Creek	32.69120	-117.12354
SD8(1)	North Chollas Creek MLS	Creek	32.70493	-117.12132
DPR3	South Chollas Creek MLS	Creek	32.69130	-117.11682

Figure 9-1. CLT(1) Tidally Influenced Monitoring Location

Figure 9-2. SD8(1) North Chollas Creek MLS

Figure 9-3. DPR3 South Chollas Creek MLS

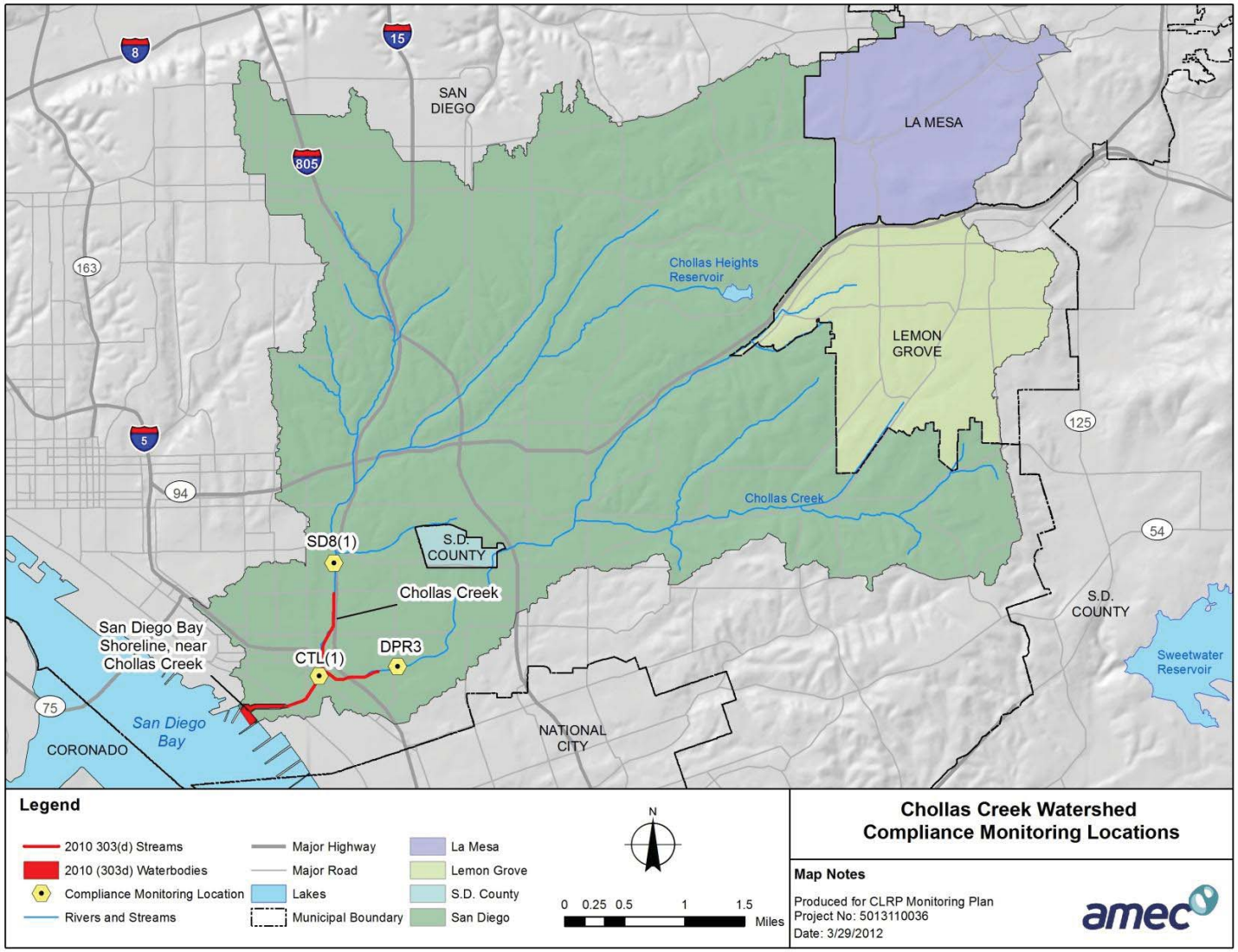

Figure 9-4. Sampling Locations

9.3 Wet Weather Sampling

Wet weather monitoring will target three storms with a trigger rainfall of 0.2 inches or greater between October 1 and April 30. United States Geological Survey (USGS) rain gauges throughout the watershed will be used to assess the trigger rainfall; however a flow trigger may be used as supplement to a rainfall trigger. One grab sample will be collected per storm at each site within 24 hours of the end of precipitation. Each grab sample will be collected at the compliance monitoring locations listed in Table 9-2 and analyzed for FIB analysis. *In-situ* field measurements (optional) and flow measurements will also be collected for each grab sample collected. The three storms will be targeted to occur during the early, mid, and late-season of the wet weather season to characterize seasonal changes, or during the following months to the maximum extent practicable:

- Storm 1 (Early season): October – November
- Storm 2 (Mid-season): December – January
- Storm 3 (Late-season): February – April

9.4 Dry Weather Sampling

Dry weather monitoring will occur at the compliance sites listed in Table 9-2 once per month throughout the duration of the compliance period. Dry weather sampling will occur on a dry weather day if there is measureable flow at the site. A dry weather day is defined as having an antecedent dry period of 72 hours with less than 0.1 inches of rainfall. Sampling may be conducted on any day of the month as long as the criterion for a dry weather day is met and there is measurable flow at the site. One grab sample will be collected and analyzed for FIB during each dry weather event. *In-situ* field measurements (optional) and flow measurements will be collected for each grab sample collected. Based on the data collected, the Responsible Parties may consider increasing the sample frequency to once per week during the summer months when contact and non-contact recreation occur more frequently.

Sampling will be suspended once the stream is too low to sample. Field crews will check the creek for flow periodically and sample at a later date that month, if flow occurs. The flow conditions and date of site visits will be noted on field data sheets.

9.5 Monitoring Logistics

Wet weather and dry weather sampling will consist of a team of two field scientists collecting one grab sample for each sampling event. The sampling field staff will deliver samples to the laboratory courier at a designated meeting location or directly to the laboratory within the 6-hour holding time. Sample runners independent of the sampling team may be used instead of the sampling field staff during wet weather monitoring to deliver samples to the courier or laboratory. If samples are delivered to couriers during dry or wet weather events, meeting locations will be utilized to exchange samples between the couriers and sampling field staff (or

runners). After receiving samples, the couriers will deliver samples to the laboratory to meet bacteria holding times.

9.6 Laboratory Distribution

Laboratories will be ready to receive, preserve, and analyze bacteria samples as necessary according to this QAPP as they are delivered during wet weather and dry weather sampling. Sample delivery times for wet weather events may include weekends and 24-hour delivery (holidays excluded). However, sample collection may be timed by the Sampling Agency so that sample collection and delivery will occur during daylight hours. Timing of sample collection and delivery during the daytime is possible since sampling may occur within any time during the 24 hours of the end of precipitation. Dry weather samples will be delivered to the laboratory during business hours Monday through Friday (holidays excluded). Additional details regarding the sampling handling and distribution is provided in Section 11.

10.0 SAMPLING METHODS

Table 10-1 presents the sampling locations and methods for each monitoring site. The water samples will be collected and analyzed for the bacterial analysis listed in Table 5-1. The collection of samples will be in accordance with the Standard Operating Procedure (SOP) for Conducting Field Measurements and Field Collections of Water and Bed Sediment Samples in SWAMP MPSL-DFG Field SOP v1.0 (SDRWQCB, 2007).

Table 10-1.
Sampling Locations and Sampling Methods

Sampling Type	Number of Sites	Station Code	Matrix	Depth (units)	Constituent Category per Site	Maximum # Samples per Site[a]	Sample Type	Sampling SOP #
Wet Weather	3	CTL(1)	Water	Mid-depth or Just Below Surface	*In-situ* Field (Optional) and Flow	5[b]	Grab	MPSL-DFG Field SOP v1.0
		SD8(1)						
		DPR3			Bacteria			
Dry Weather	3	CTL(1)	Water	Mid-depth or Just Below Surface[b]	*In-situ* Field (Optional) and Flow	14[c]	Grab	MPSL-DFG Field SOP v1.0
		SD8(1)						
		DPR3			Bacteria			

Notes:
[a] Maximum number of samples includes field duplicates and field blanks.
[b] Samples may be collected at the surface if water level is too low. If this occurs, it will be noted on the field data sheet.
[b] One sample per storm (3 storms per year), 1 field blank, 1 field duplicate
[c] One sample per month (12 months per year), 1 field blank, 1 field duplicate

10.1 Field Observations and Documentation

Field observations will be recorded during each monitoring event to record site conditions and actions taken during sampling. Field data sheets will be used to record general observations and potential sources of bacteria located within the vicinity of the site. General observations include weather, debris/trash observed, color and clarity of the water, odor, and any other conditions of interest. Potential sources of bacteria will be identified, including human-related sources, activities, and natural sources. Field data sheets will also be used to document possible field equipment failure that may occur during sampling activities.

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

- Site identification (ID)
- Date and time
- Monitoring project name
- Field team personnel
- Weather conditions
- Miscellaneous comments
- Water quality observations
- *In-Situ* field measurements (optional)
- Grab sample IDs
- Grab sample date/time
- Approximate sampling depth
- Runoff characteristics

10.2 In-Situ Field Measurements

The Responsible Parties may choose to collect *in-situ* field measurements for the some, all, or none of the following list of constituents:

- Conductivity
- Flow
- pH
- Temperature
- Turbidity

10.2.1 In-Situ Water Quality Measurements

If the Lead Agency elects to collect *in-situ* water quality measurements, the measurements will be made in the field by placing the probe(s) directly in the water column. Probes should be exposed to flow in a representative portion of the creek. A secondary container may be used if the water depth does not allow the probe to be completely submerged. Troubleshooting and corrective actions will be recorded in the calibration log and/or field data sheet. Field meters will be calibrated according to the manufacturer's specifications prior to use. I*n-situ* field measurements will be collected at the same sample time and sample point as the grab sample. Field measurement values and collection times will be recorded on the field data sheet.

10.2.2 Flow Monitoring

Dry weather and wet weather flow monitoring will occur as an instantaneous flow measurement recorded at the time of sample collection. Velocity will be measured using a handheld flow meter selected by the Sampling Agency to measure instantaneous velocity. USGS cross-sectional stream rating methodologies (Rantz, 1982) will be used to calculate flow when conditions allow. Flow will ultimately be calculated as a function of velocity and area as provided below:

$$Q = A \times V$$

Where:
Q = Flow (cubic feet per second [cfs])
A = Area (square feet [$ft^{2]}$)
V = Velocity (feet per second [ft/s])

If the flow meter should become nonoperational during field activities and troubleshooting methods are unable to resolve the issue, or conditions do not allow for use of the flow meter, the timed object method may be used as a temporary replacement method of measuring velocity.

Another method to estimate flow is to use the Time-Object Method. This method measures velocity (V) by recording the time (T) it takes for a floatable object such as a leaf or twig to travel a measured distance (D).

$$V = \frac{D}{T}$$

Where:
V = Velocity (ft/s)
D = Distance (foot [ft])
T = Time (second)

Estimate or measure the channel cross-sectional area, then calculate the volumetric flow rate (Q) using the following equation:

$$Q = A \times V$$

Where:
Q = Flow (cfs)
V = Velocity (ft/s)
A = Area (ft^2)

10.3 Grab Sampling

10.3.1 Wet Weather Grab Sampling

Grab samples will be representative of the environmental conditions at each monitoring location. Sampling will occur in the middle of the water column height, or just below the water surface, in a manner that avoids collection of surface scum and sediment from the bottom. Although grab samples will ideally be collected from the horizontal center of the stream, the stream stage may rise quickly and unexpectedly during storm conditions. As such, sample collection may need to be adapted depending on site conditions, including collecting samples closer to the banks of the stream so as to allow a safe sampling approach. The sample container will be attached to a grab pole and submersed into the water column, facing downward, to mid-depth (or just below the surface) and turned slightly upwards while moving the bottle upstream through the water until full to eliminate cross contamination from the sampling equipment.

Should field staff still consider the grab pole method to be unsafe, sampling may proceed using a sterilized bucket. This decision will be made by the field lead on-site at the time of the sampling event. If samples are to be collected using a bucket, it will be noted on the field data sheet and the Sampling Manager will be informed.

10.3.2 Dry Weather Grab Sampling

Samples will be collected during base flow or low flow conditions at the creek. Grab samples will be representative of the environmental conditions of each monitoring location, therefore grab samples will be collected at flowing, non-ponded sections of the stream. Sampling will occur in the middle of the water column height, or just below the water surface, to avoid collection of surface scum and sediment from the bottom to the maximum extent practicable. The sample container will be submersed into the water column, facing downward, to mid-depth (or just below the surface) and turned slightly upwards while moving the bottle upstream through the water until full to eliminate cross contamination from the sampler. The sampler will take

precaution and collect the samples in a manner that does not disturb the bottom sediments. A grab pole may be required if the center of the creek cannot be reached by hand.

10.3.3 Sample Handling

The following sample handling protocols will be followed when collecting samples to minimize the possibility of contamination. Further information regarding sample handling and custody is provided in Section 11.

- Field personnel will be thoroughly trained in the proper use of sample collection gear.
- Unused (new), clean, powder-free nitrile gloves will be worn while collecting samples and will be replaced with new, clean gloves between samples and/or sites.
- Previously unused (new) sample bottles of the recommended type will be employed. Sample bottles and bottle caps will be protected from contact with solvents, dust, or other contaminants during storage and bottle handling.
- Field personnel will make an effort, within reason, to prevent large gravel and uncharacteristic floating debris from entering the sample containers. Personnel will also make an effort to not disturb sediments that may be at the bottom of the channel.
- The inside of the sampling container and lids will not be touched during preparation and sampling activities.
- Vehicle engines will be turned off during sampling activities to minimize exposure of samples to exhaust fumes.
- New bags of previously unopened ice will be used to cool samples following sample collection.
- FIB samples will be collected directly into a sterilized polyethylene or polypropylene container to the maximum extent practicable.
- Sodium thiosulfate may be used if chlorine is suspected in the water. If used, care will be taken during sampling to avoid flushing out the preservative tablet.

Once sample containers are filled, they will be promptly placed on ice, in a clean cooler (maximum temperature of 6 ^{o}C), in the dark and transported to the laboratory for processing to meet holding times.

10.4 Field Corrective Actions

Any failures (e.g., instrument failures) that occur during data collection will be the responsibility of the sampling team conducting the work. Samplers will carry basic spare parts and consumables with them to the field, and will have access to spare parts to be stored at their respective agency. In the case of field instruments, problems will be addressed through instrument cleaning, repair, or replacement of parts or the entire instrument, as warranted. If meters fail in the field, sampling teams will instruct the laboratory to analyze for required constituents that were not collected in the field and will record this modification on the field data

sheet and notify the Sampling Manager immediately. All troubleshooting and corrective actions will be recorded in the calibration log and/or field data sheet. Records of all repairs or replacements of field instruments will be maintained at the offices of field sampling personnel.

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11.0 SAMPLE HANDLING AND CUSTODY

The sample container for *Enterococcus*, fecal coliform, total coliform will be a minimum of 150 mL, sterilized, plastic bottle. All bottles will be pre-labeled with the following information:

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

Grab samples will be marked with a unique sample ID will be used to track the sample throughout its analyses. These sample IDs are also entered directly on to field and laboratory data sheets. All observations recorded in the field, as well as, information recorded in processing all field samples in the laboratory will be transcribed to Microsoft Excel spreadsheets. Hard copies of these field and laboratory data sheets will be maintained by the responsible agency.

Once sample containers are filled, they will be placed on ice, in a cooler, in the dark and transported to the laboratory for processing. Chains of custody will accompany the collected water samples. Sampled water will be kept below 6 °C and transferred to an analytical laboratory within holding times. Chain-of-Custody (COC) forms for the samples will be completed and transported to the analytical laboratory with the samples. The analytical laboratory will ensure that all samples are handled and analyzed within the proper holding time. Sample holding times are listed in table 11-1. Custody of all samples will be transferred from the field personnel to laboratories.

Table 11-1.
Sample Handling and Custody

Analysis	Container	Minimum Sample Volumes[(a)]	Initial Preservation	Holding Time
Enterococcus	Factory-sealed, pre-sterilized, 150 mL sterile Plastic (high density polyethylene or polypropylene) container	150 mL	< 6°C in the dark[(b)]	6 hours
Fecal coliform				
Total coliform				

Notes:
°C degree Celsius
[(a)] Minimum sample volume is representative of total volume needed to analyze all three FIB.
[(b)] Sodium thiosulfate may be used if chlorine is suspected in the water. Sodium thiosulfate is used for chlorine elimination.

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12.0 ANALYTICAL METHODS

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

The field analyses and methods, which are optional analyses, are provided below in Table 12-2. If field measurements are collected, they will be measured using properly calibrated field meters.

Table 12-1.
Laboratory Analytical Methods

Analyte	Laboratory	Project Action Limits-MPN/100mL[(a)(b)]		Project Reporting Limit (per 100mL) [(c)]	Analytical Method		Achievable Laboratory Limits	
		Dry Weather	Wet Weather		Analytical Method/SOP	Modified for Method (yes/no)	MDL	Method
Enterococcus	TBD	33(0%)	61(22%)	10 colonies	TBD	TBD	TBD	TBD
Fecal coliform		200(0%)	400(22%)	20 MPN	TBD	TBD	TBD	TBD
Total coliform		1,000(0%)	10,000(22%)	20 MPN	TBD	TBD	TBD	TBD

Notes:
MDL method detection limit
[(a)] Indicator Bacteria TMDL, Receiving Water Limitation for Tecolote Creek (HU 905.00)
[(b)] The number preceding the parenthesis is the water quality objective. The number in parenthesis is the allowable exceedance frequency.
[(b)] The reporting limits are consistent with methodology of the Assembly Bill 411 Monitoring Program to facilitate overlap with that program. However, reporting limits may be lower depending on the lab used to conduct the analysis

Table 12-2.
Field Methods (Optional)

Analyte	Organization	Project Action Limit	SWAMP Reporting Limit	Analytical Method	
				Analytical Method/SOP	Modified for Method
Conductivity	Sampling Agency	NA	2 µS/cm	Field Meter	No
Flow	Sampling Agency	NA	NA	Calculated from Field Data	No
pH	Sampling Agency	NA	N/A	Field Meter	No
Temperature	Sampling Agency	NA	N/A	Field Meter	No
Turbidity	Sampling Agency	NA	5 NTU	Field Meter	No

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13.0 QUALITY CONTROL

This section addresses QA/QC activities associated with both field sampling and laboratory analyses. The field QC samples are used to evaluate potential contamination and sampling error introduced prior to submittal of samples to the analytical laboratory. Laboratory QA/QC activities provide information needed to assess laboratory contamination, analytical precision, and analytical accuracy. If any QA/QC standards are not met, the appropriate corrective actions will be taken in accordance with Section 22 of this document and the laboratories' QA Manuals. The Project Manager is responsible for making decisions on corrective actions pertaining to laboratory analysis. If issues are identified by Sampling Agency's staff, the laboratory Project Manager or Sampling Agency's Project Manager will be notified immediately and documentation of the issue and the corrective action will be made.

13.1 Quality Control Types

A set of QC samples will be submitted to the laboratory based on the frequencies discussed in Section 10. The analytical laboratory may also require more QC samples if one type of analysis is to be run in more than one batch. The main types of QC samples that will be utilized for this study include field blanks, field duplicates, laboratory replicates, and positive and negative controls. The field blanks, duplicate samples, and laboratory replicates may be collected from different sites during a particular sampling event. The number and frequency of field QC samples to be collected are presented in Table 13-1. Field QC samples will be submitted blind to the analytical laboratory. For laboratory replicates, additional sample volumes will be collected if needed.

13.2 Field Quality Control Samples

Field Blanks

Field blanks are samples of reagent-grade, analyte-free, deionized water collected in the field to verify the field conditions and air deposition are non-contaminating during field sampling activities. Field blanks will be analyzed for the same suite of analyses as regular samples. The project frequency for field blanks is 5 percent of the total sample count. Concentrations of field blanks should be below the Reporting Limit (RL) for each analyte.

Field Duplicates

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

Table 13-1.
Field QC

Field QC	Frequency	Acceptance Limits
Field Blank	5% of all project samples	Concentrations should be below the RL.
Field Duplicate	5% of all project samples	RPD range of 0-25% [(a) (b)]

Notes:
[(a)] For coliforms: within 95% confidence interval as defined by IDEXX Laboratories
[(b)] NA if native concentration of either sample is less than the reporting limit.

13.3 Laboratory Quality Control

Laboratory QC samples include laboratory duplicates, positive and negative controls as described below. Laboratory QC sample results will be provided in a laboratory report and SWAMP compatible electronic data deliverable (EDD) with a batch ID number to correlate with the corresponding environmental sample data set. Table 13-2 describes the frequency and types of quality control samples for each constituent category.

- **Laboratory Replicate –** For a laboratory replicate, a sample is prepared and analyzed twice to assess the repeatability (precision). The results are evaluated by calculating the RPD between the two sets of results. This serves as a measure of the reproducibility, or precision, of the sample analysis. A minimum of one laboratory replicate will be analyzed per batch.
- **Positive and Negative Controls –** A negative control is created as a separate plate count after the buffered rinse water is filtered and incubated the same way as a sample. There should be no bacteria growth on the filter after incubation. It is used to detect laboratory bacterial contamination of the sample. A positive control is created as a separate plate count after a water sample known to contain bacteria (such as wastewater treatment plant influent) is filtered and incubated the same way as a sample. There should be bacteria growth on the filter after incubation. It is used to detect procedural errors or the presence of contaminants in the laboratory analysis that might inhibit bacteria growth (USEPA, 2012).

Table 13-2.
Laboratory QC

Constituent Category	Method Blanks	
	Frequency	Acceptance Limits
Laboratory Replicate	One per 20 samples or analytical batch, whichever is more frequent	RPD<25%[(a)]
Positive and Negative Controls	Per batch of bottles or reagents	Positive Control = 80-120% Recovery; Negative Control = No growth on filter

Note:
[(a)] Not applicable if native concentration of either sample is less than reporting limit.

14.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

If optional monitoring is conducted, all field equipment will be tested, inspected, and maintained according to manufacturer specifications. Sample equipment testing, inspection, and maintenance shall be performed on a general schedule of semi-annually or on an event basis as-needed, no more than seven days before a monitoring event. Replacement parts will be installed as necessary and may be stored on site in the monitoring shed or brought to the site with field crews. General descriptions of field equipment to be used for the monitoring programs covered under this QAPP are presented in Table 14-1.

Table 14-1.
Testing, Inspection, Maintenance of Sampling Equipment and Analytical Instruments.

Equipment/Instrument	Maintenance Activity, Testing Activity, or Inspection Activity	Responsible Person	Frequency	SOP Reference
Handheld Flow Meter	Maintenance and Inspection	Sampling Agency	Daily	Manufacturer O&M Manual
Field Water Quality Meter(s)	Maintenance and Inspection	Sampling Agency	Daily	Manufacturer(s) O&M Manual(s)

Note:
O&M Operations and Maintenance

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15.0 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Calibration of field meters will be performed every day prior to a sampling event, or as-needed. A calibration log will be maintained for all meters used in the field. All meters will be calibrated according to the manufacturer's operations and maintenance manual. Any parameters that do not require frequent calibration per manufacturer recommendation will be checked in a known standard for verification and documentation purposes. Calibration for all flow meters will be conducted prior to each monitoring event per the manufacturer's operations and maintenance manual. All field instrument calibration frequencies are consistent with the Electronic Template for SWAMP Comparable Quality Assurance Project Plan (SDRWQCB, 2008) and are presented in Table 15-1 below. Calibration logs will be kept on file at the Sampling Agency.

All laboratory equipment is calibrated based on manufacturer recommendations and accepted laboratory protocols. The laboratories maintain calibration practices as part of their method SOPs. Laboratory calibration documentation is maintained by the Laboratory Director/QA Officer and can be provided upon request.

Table 15-1.
Instrument/Equipment Calibration and Frequency

Equipment/Instrument	SOP Reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Party
Handheld Flow Meter	Manufacturer O&M Manual	Manufacturer O&M Manual	Semi-annually or as needed	Sampling Agency
Field Water Quality Meter(s)	Manufacturer(s) O&M Manual(s)	Manufacturer(s) O&M Manual(s)	Before use or per manufacturer instructions	Sampling Agency

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16.0 INSPECTION/ACCEPTANCE OF CONSUMABLES AND SUPPLIES

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

The Sampling Agency will ensure sufficient field supplies are on hand prior to the start of sampling for each period. Field supplies will be stored at the Sampling Agency's offices. Laboratory supplies will be stored at the laboratories conducting the work. Table 16-1 presents the acceptance criteria for consumables and supplies that will be used for this study.

Table 16-1.
Inspection/Acceptance Testing Requirements for Consumables and Supplies

Project-Related Supplies/Consumables	Inspection/Testing Specifications	Acceptance Criteria	Frequency	Responsible Individual
Pre-cleaned sample containers	Open container	Lids screwed on bottles	100%	Sampling Agency
Laboratory glassware	Dirty	Clean	100%	Laboratories

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17.0 NON-DIRECT MEASUREMENTS

There are no non-direct measurements that will be fundamental to the success of this study.

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18.0 DATA MANAGEMENT

Data will be submitted in a standardized SWAMP-compatible format. The sampling agency will compile the monitoring data and the laboratory will compile the analytical data. A final data deliverable will be provided to the Responsible Parties.

18.1 Field Observations and In-Situ Measurements

The Sampling Agency will review all field data sheets for completeness, maintain the original hardcopies, and scan electronic copies to Portable Document Format (*.pdf) for storage in the project file. Field data sheets will be transcribed into an electronic spreadsheet. Photographs of the monitoring sites taken by field personnel will be uploaded into the project file within three business days of field visits. Field team members will name the photographs using the site ID and the date the photo was taken. Copies of field data sheets and photographs for each event will be submitted to the Project Manager with the quarterly sampling summary.

18.2 Analytical Data

Laboratories will provide data in *.pdf, hardcopy, and SWAMP-compatible EDD. A SWAMP-compatible EDD will ensure that the data files can be uploaded to the SWAMP regional database. The Project Manager will review all lab reports and EDDs for accuracy, completeness, and SWAMP compatibility. Analytical results will be submitted to the Project Manager within three weeks of submittal of samples.

Within two weeks of receipt of data, the Project Manager or designee will check data deliverables for the following major items:

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

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GROUP C: ASSESSMENT AND OVERSIGHT

19.0 ASSESSMENT AND RESPONSE ACTIONS

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

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

- **Surveillance of Sample Collection Activities:** The Sampling Agency's Project Manager will be responsible for oversight of sampling activities and will review field data sheets to verify that the samples were collected in accordance with QAPP requirements. If the Sampling Agency identifies any of the field activities to be in violation of QAPP requirements, the Project Manager will be contacted immediately. The Project Manager has the authority to stop field activities until corrective actions are successfully implemented. Corrective actions may include additional training to improve field team performance and QAPP compliance, or appropriate re-sampling of monitoring locations, as needed. Any corrective actions will be documented. Any actions necessary will be communicated to the Project Manager. Assessment of wet weather sample collection will be conducted by the Sampling Agency's Project Manager once per field season; while assessment of dry weather sample collection will be conducted at the beginning and end of dry weather collection.
- **Data Quality Assessment:** Each Laboratory Manager will be responsible for providing a summary of QC data to the Sampling Agency's Project Manager. If it is determined that the precision and accuracy objectives were not met, the Sampling Agency's Project Manager will notify the Laboratory Manager. Laboratory techniques will be reviewed to minimize errors, and samples will be re-analyzed, if possible.
- **Assessment of Data Entry:** Once the performance criteria are met, the Sampling Agency's Project Manager will review data files to ensure that errors are detected and corrected. The Project Manager will retain original data files and qualified data will be retained in the Stakeholder's database. Data will be qualified in the database according to SWAMP protocols.

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20.0 REPORTS TO MANAGEMENT

The Sampling Agency will provide quarterly sampling summaries to the Contract Manager or Project Manager as a status of monitoring activities. The Lead Agency will provide quarterly updates to the other participating Responsible Parties during regularly scheduled Watershed Workgroup meetings.

The Lead Agency will generate an Annual CLRP Monitoring Summary, which will be included in the following WURMP Annual Report as an appendix.

The project reports are detailed within the Monitoring Plan. Table 20-1 presents the QA criteria for reports to management.

Table 20-1.
Management Reports

Type of Report	Frequency (Daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Dates	Person(s) Responsible for Report Preparation	Report Recipients
Sampling Summary	Quarterly	Each Quarter	Project Manager, Sampling Agency	Lead Agency
CLRP Monitoring Summary	Annual	June 30, 2014	Project Manager, Sampling Agency	Lead Agency

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GROUP D: DATA VALIDATION AND USABILITY

21.0 DATA REVIEW, VERIFICATION, AND VALIDATION

All analytical data will be reviewed and compared to the DQOs described in Section 6 of this QAPP, along with the applicable QA/QC practices. If results fail to meet any DQO, the Sampling Agency's Project Manager will flag them for further review. Batch QC samples will be reviewed to determine the potential cause of failure to meet the DQO. Data will be separated into three categories: data meeting all DQOs (acceptable data), data failing precision or recovery criteria (further investigation warranted), and data failing to meet accuracy criteria (further investigation warranted).

If further investigation is warranted based on data failing precision or recovery criteria, all aspects of the data will be assessed for data quality by the Project Manager. At that point, the data will either be accepted or rejected. If accepted, the data will be flagged with a "J" qualifier per the United States Environmental Protection Agency (USEPA) specifications (USEPA, 2002). If data fails to meet accuracy criteria, or the cause of the failure cannot be identified and rectified, the data will be excluded from the results. All rejected data will be retained in the project database, and qualified as "rejected". The ultimate decision of whether to accept or reject a data point will be made by the Project Manager in consultation with the Project QA Officer.

If the analysis for more than ten percent of data fails to meet the DQO, the Project Manager and Project QA Officer will meet to discuss the appropriateness of the DQO and any potential modifications. All proposed modifications of DQOs will require a reissuance of the QAPP.

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22.0 VERIFICATION AND VALIDATION METHODS

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

22.1 Data Verification and Validation Responsibilities

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

Verification and validation of laboratory data is the responsibility of the laboratory section supervisor and Project Manager. Laboratories will maintain analytical reports including QC documentation. The Laboratory QA Officer will perform checks of all of its records.

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

Reconciliation and correction of any data that fails to meet the DQOs will be done by the Project Manager in consultation with the Laboratory QA Officer and/or Sampling Agency's Project Manager. Any corrections require a unanimous agreement that the correction is appropriate.

22.2 Process for Data Verification and Validation

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

- Verification that the sampling activities, sample locations, number of samples collected, and type of analysis performed is in accordance with QAPP requirements.
- Documentation of any field changes or discrepancies.
- Verification that the field activities and field data (including sample location, sample type, sample date and time, name of field personnel, etc.) were properly documented.
- Verification of proper completion of sample labels and COC forms, and secure storage of samples.
- Verification that all samples recorded on COC forms were received by the laboratory.

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

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

Verification and validation of data entry includes:

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

23.0 RECONCILIATION WITH USER REQUIREMENTS

Water quality data collected during this project will provide a means of determining compliance with the Bacteria TMDL. The results of this project will provide valuable information for evaluating compliance with numeric targets and load allocations defined in the TMDL. Data from this study will also be used to support decisions regarding possible amendments to the TMDL and implementation of management measures and BMPs.

The data will be qualified if QA issues are identified. Statistics and reporting of standard deviation and relative error will be used to quantify the uncertainty associated with the data. Uncertainty and limitations on data use will be described in the Annual CLRP Monitoring Summary.

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24.0 REFERENCES

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Appendix D Shelter Island Yacht Basin TMDL Monitoring Plan

Appendix D

Shelter Island Yacht Basin TMDL Monitoring Plan

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FINAL
SHELTER ISLAND DISSOLVED COPPER TMDL 2014-2015 MONITORING PLAN

Submitted to:
City of San Diego

Submitted by:
AMEC Environment and Infrastructure, Inc.
San Diego, California

November 2014

AMEC Project No. 5025-14-1083

IMPORTANT NOTICE

This monitoring plan was prepared exclusively for the City of San Diego by AMEC, Inc. The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in AMEC's services and based on: i) information available at the time of preparation, ii) data supplied by outside sources and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used by only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

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ACRONYMS AND ABBREVIATIONS

^{o}C	degrees Celsius
ac	acres
AMEC	AMEC Environment and Infrastructure, Inc.
ASAP	as soon as possible
ASBS	Area of Special Biological Significance
AVB	area velocity bubbler
Basin Plan	Water Quality Control Plan for the San Diego Basin
CD	compact disk
cfs	cubic feet per second
Chambers	Chambers Group, Inc.
City	City of San Diego
cm	centimetres
COC	chain of custody
DQO	data quality objective
e.g.	example given
GIS	geographic information system
HEC-HMS	Hydrologic Engineering Center - Hydrologic Modeling System
HVF	head versus flow
kg	kilograms
L	litre
LCS	laboratory control sample
Ln	Lane
No.	number
MDL	method detection limit
mg	milligrams
MOS	margin of safety
MS	matrix spike
mS	milli Siemens
MSD	matrix spike duplicate
MS4	municipal separate storm sewer system
NA	not applicable
ND	non detect
NWS	National Weather Service
O&M	operations and maintenance
POSD	Unified Port District of San Diego
QA	quality assurance
QC	quality control
RL	reporting limit
RPD	relative percent difference
SDRWQCB	San Diego Regional Water Quality Control Board
SIYB	Shelter Island Yacht Basin
SOP	Standard Operating Procedure
St.	Street
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TMDL	total maximum daily load

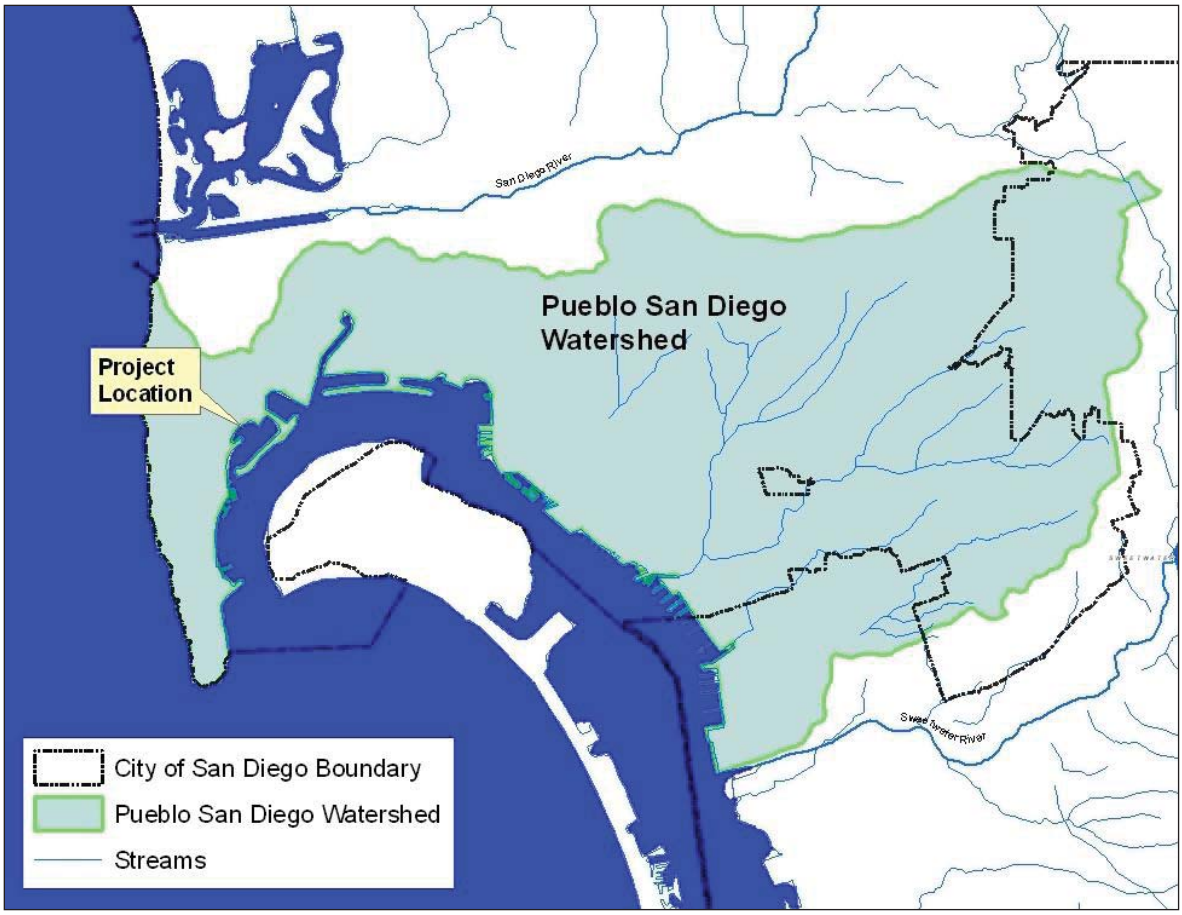
µS	micro Siemens
µg	micrograms
USEPA	United States Environmental Protection Agency
VDC	volts direct current
Weck	Weck Laboratories, Inc.
Weston	Weston Solutions, Inc.
WLA	waste load allocation
yr	year

1.0 INTRODUCTION

Shelter Island Yacht Basin (SIYB) is a semi-enclosed recreational yacht basin located in the north-western end of San Diego Bay in San Diego, California. The SIYB drainage area is contained within the Point Loma Hydrologic Area (908.10), which is within the Pueblo San Diego Hydrologic Unit (Figure 1-1). The Pueblo San Diego Hydrologic Unit is one of three sub-watersheds within the San Diego Bay Watershed. The SIYB drainage area is approximately 673 acres and consists of three sub-drainage areas that discharge via municipal separate storm sewer system (MS4) outfalls into the SIYB.

A total maximum daily load (TMDL) for dissolved copper was established for the SIYB and was added as an amendment to the San Diego Regional Water Quality Control Board (SDRWQCB) Water Quality Control Plan for the San Diego Basin (Basin Plan) on February 9, 2005 (SDRWQCB, 2005b).

Figure 1-1. Project Location



1.1 Background and Objectives

The SIYB is part of San Diego Bay. Thus, the same beneficial uses detailed in the Basin Plan that apply to San Diego Bay are applicable to the SIYB. Table 1-1 details the beneficial uses for San Diego Bay stated in the Basin Plan.

Table 1-1. San Diego Bay Beneficial Uses

Designation[1]	Description[1]
Industrial Service Supply (IND)	*Includes uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.*
Navigation (NAV)	*Includes uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.*
Contact Water Recreation (REC1)	*Includes uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and SCUBA diving, surfing, white water activities, fishing, or use of natural hot springs.*
Non-Contact Water Recreation (REC2)	*Includes the uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.*
Commercial and Sport Fishing (COMM)	*Includes the uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.*
Preservation of Biological Habitats of Special Significance (BIOL)	*Includes uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.*
Estuarine Habitat (EST)	*Includes uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).*
Wildlife Habitat (WILD)	*Includes uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.*
Rare, Threatened, or Endangered Species (RARE)	*Includes uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.*
Marine Habitat (MAR)	*Includes uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).*
Migration of Aquatic Organisms (MIGR)	*Includes uses of water that support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.*
Spawning, Reproduction, and/or Early Development (SPWN)	*Includes uses of water that support high quality habitats suitable for reproduction, early development and sustenance of marine fish and/or cold freshwater fish.*
Shellfish Harvesting (SHELL)	*Includes uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters and mussels) for human consumption, commercial, or sport purposes.*

The most sensitive beneficial uses are those designated for protection of marine aquatic life and aquatic dependent wildlife. These beneficial uses are considered threatened or impaired due to elevated levels of dissolved copper in the water column (SDRWQCB, 2005b).

In 1996, the SIYB was placed on the Clean Water Act, Section 303(d) list of impaired waters due to the elevated levels of dissolved copper in the water column. To address this impairment the SDRWQCB issued a resolution on February 9, 2005 adopting an amendment to the Basin Plan to incorporate a TMDL for dissolved copper specific to the SIYB (SDRWQCB Resolution No. R9-2005-0019). The TMDL states that the loading capacity for dissolved copper discharges into the SIYB is 1.6 kilograms per day or 567 kilograms per year (kg/yr).

[1] California Regional Water Quality Control Board, 2011. Water Quality Control Plan for the San Diego Basin. September 8, 1994, revised April 4, 2011.

This allowable load is composed of a Waste Load Allocation (WLA) that has been distributed among the known potential sources of dissolved copper into the SIYB. Approximately 98 percent (%) of the total copper loading to SIYB was determined to originate from copper-based antifouling paints applied to the hulls of recreational vessels moored in the SIYB marinas. Of this total, 93% was determined to be attributable to copper entering the water column through passive leaching of copper from antifouling paints. The remaining 5% was attributed to antifouling paints sourced from underwater hull cleaning operations in the SIYB. Four additional sources of copper were identified: urban runoff, direct atmospheric deposition, marine sediment, and background levels (SDRWQCB, 2005b). The SIYB is under the jurisdiction of the Unified Port of San Diego (POSD) and is stated in the TMDL as the primary source of dissolved copper loading to the SIYB.

The City of San Diego (City) is also named as a discharger under the TMDL and is responsible for the urban runoff contribution to the SIYB from its MS4; however, the contribution from the City's MS4, as reported in previous monitoring years, has historically been relatively minor. The TMDL provides a source analysis, which assigned a WLA for urban runoff from the MS4 of 30 kg/yr, which represents 1% of the current estimated dissolved copper load to SIYB of 2,163 kg/yr (Table 1-2). Based on the historical monitoring results, urban runoff from the City's MS4 is below the City's WLA and was not assigned a load reduction in the TMDL.

Table 1-2 presents a detailed breakdown of the TMDL and WLA.

Table 1-2. TMDL and WLA Summary

Source	Current Load (kg/yr of Copper)	Percent Contribution (% Copper)	WLA (kg/yr of Copper)	Percent Reduction From Current Source Load (%)	Percent Reduction from Total Loading to SIYB (%)
Passive Leaching	2,000	93	375	81	75
Hull Cleaning	100	5	72	28	1
Urban Runoff **(City of San Diego)**	30	1	30	0	0
Background	30	1	30	0	0
Direct Atmospheric Deposition	3	<1	3	0	0
Sediment	0	0	0	0	0
Current Mass Load	2,163	100	NA	NA	0
MOS	NA	NA	57	NA	0
TMDL	NA	NA	567	NA	0
Total Load Reduction					**76**

Notes:

kg/yr = kilograms per year
MOS = Margin of Safety
NA = Not Applicable
TMDL = Total Maximum Daily Load
SIYB = Shelter Island Yacht Basin
WLA = Waste Load Allocation

Source: SDRWQCB, Total Maximum Daily Load for Dissolved Copper In Shelter Island Yacht Basin, San Diego Bay Technical Report (SDRWQCB, 2005c).

The primary objectives of this study are to address two main questions:

1. What is the estimated annual dissolved copper load from the City's MS4 into the SIYB and how does it compare to the TMDL urban runoff WLA of 30 kg/yr?

2. Is there evidence of a trend in the historical dataset?

These two questions can be further broken down as follows:

- What are the dry weather and wet weather estimated pollutant loadings of dissolved copper from the City's MS4 into the SIYB?
- Does the estimated annual dissolved copper load from the City's MS4 exceed the TMDL WLA for urban runoff?
- How does the 2014-2015 monitoring season estimated annual dissolved copper load from the City's MS4 compare to historical results?

1.2 Previous Studies

The monitored drainage area that discharges into the SIYB under the City's jurisdiction consists of three sub-drainage areas, each of which have separate outfalls (Outfall 1, Outfall 2, and Outfall 3). Monitoring and sampling of the City's MS4 that connects to these three outfalls began in February 2008.

During a preliminary site investigation conducted in 2007, it was determined that flow monitoring and sampling was only feasible at Outfall 2. Outfall 2 represents the largest of the three drainage areas (Weston Solutions, Inc. [Weston], 2009). Monitoring of Outfall 1 and Outfall 3 was determined to be infeasible due to tidal influences. Flows for Outfall 1 and Outfall 3 were estimated through modeling and the results are documented in the 2011 Monitoring Report (Weston, 2011c).

A total of 10 wet weather monitoring events and seven dry weather monitoring events were conducted by Weston from 2008 to 2011 to assess dissolved copper loading from the City's MS4 to the SIYB (Weston, 2011c). Beginning in July 2011, AMEC Environment & Infrastructure, Inc. (AMEC) was contracted by the City to continue monitoring and sampling of the City's MS4 that discharges into the SIYB. In an effort to gather additional information to further characterize and estimate the dissolved copper load from the City's MS4 into SIYB, AMEC also began wet weather monitoring at a location upstream from Outfall 3[2] during the 2011-2012 monitoring season. Table 1-3 presents a summary of monitoring events conducted to date.

Table 1-3. Summary of Monitoring Events Conducted to Date

Event Type	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013
Wet Weather	1	3	3	3	3	3
Dry Weather	0	1	3	3	3	3

This Monitoring Plan presents information, protocols, and procedures relative to the monitoring and sampling of the selected sites by AMEC for the 2014-2015 season.

1.3 Project Organization

The City is the municipal government agency overseeing this project. Ruth Kolb is the Program Manager with the City storm water department. Andre Sonksen is the City Project Manager. The Shelter Island TMDL organization structure is provided in Figure 1-2.

AMEC is the consultant hired by the City to perform work for the Shelter Island Monitoring Program. Tommy Wells is the Project Manager for AMEC and will be responsible for project coordination, scheduling, budget management, and oversight of project plans and deliverable development. Claire Johnson is the AMEC Sampling Manager and Laboratory Coordinator. She will be responsible for developing the monitoring approach and for preparing and implementing the monitoring activities. John Brandt is the AMEC Quality Assurance Officer and will be responsible for the project quality assurance and quality control procedures implemented during sampling, laboratory analysis, data management, and data analysis. Jesse Davis is the AMEC Health and Safety Officer and will be responsible for implementation of the project Health and Safety Plan and practices. William Szafranski will be responsible for developing and maintaining a database of project data and Darcy Ebentier is the AMEC Reporting Manager.

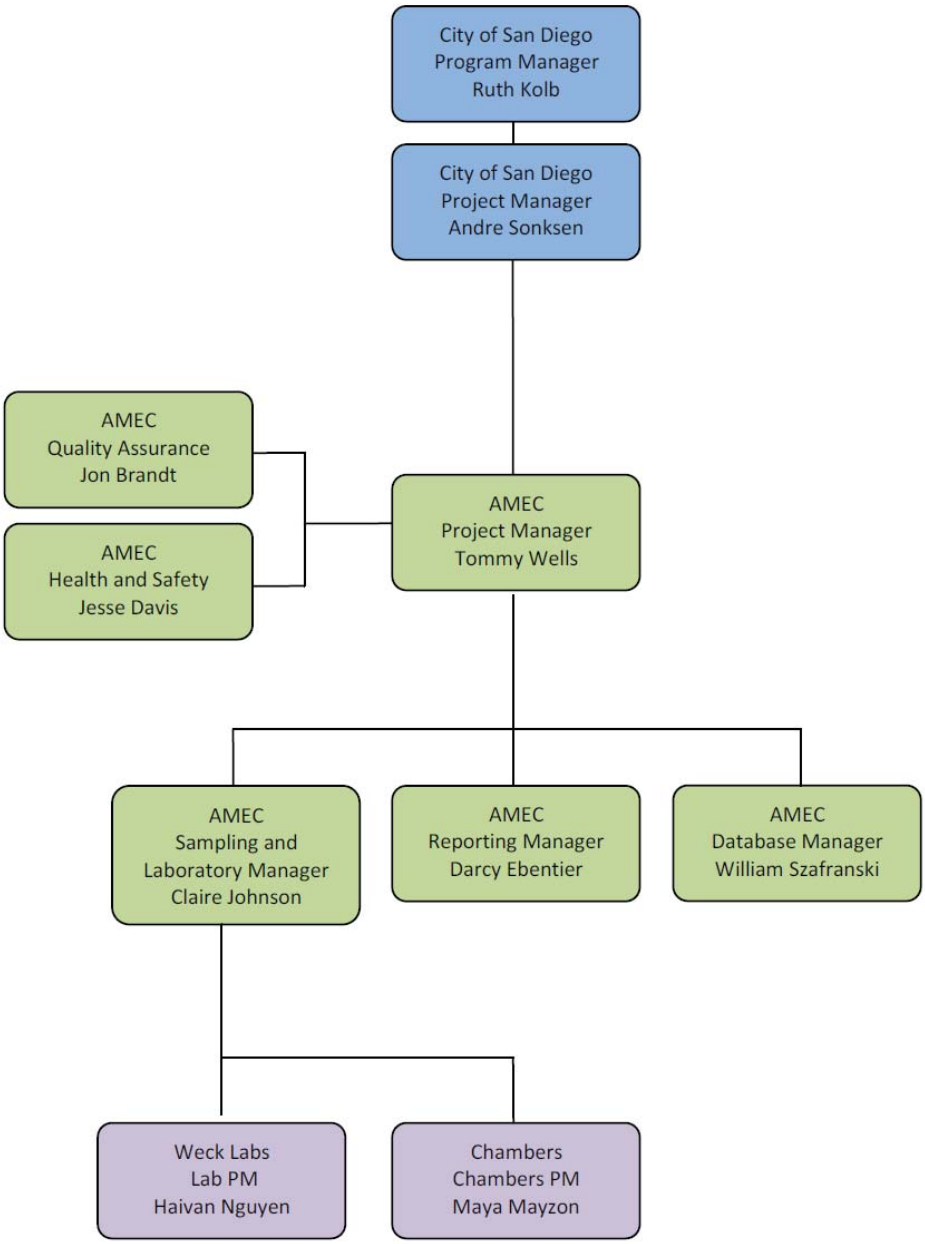
Weck Laboratories, Inc. (Weck) will be responsible for the analysis of the water quality samples. Haivan Nguyen is the Weck Laboratory Project Manager and will be responsible for the proper

[2] Flow monitoring was conducted during the 2011-2012 monitoring season. However, tidal influence limited its effectiveness and it was discontinued. During the 2012-2013 monitoring season samples were collected at Outfall 3 based on the flows and rainfall observed at the Outfall 2 monitoring location. Modeling was utilized to estimate the flows for Outfall 3.

analysis of samples in accordance with the methods and quality assurance requirements outlined in this monitoring plan.

Chambers Group, Inc. (Chambers) will be responsible for providing field support during equipment installation and removal, maintenance, and storm event monitoring. Maya Mazon is the Chambers Project Manager and will be responsible for coordination of field support staff.

Figure 1-2. Organizational Chart



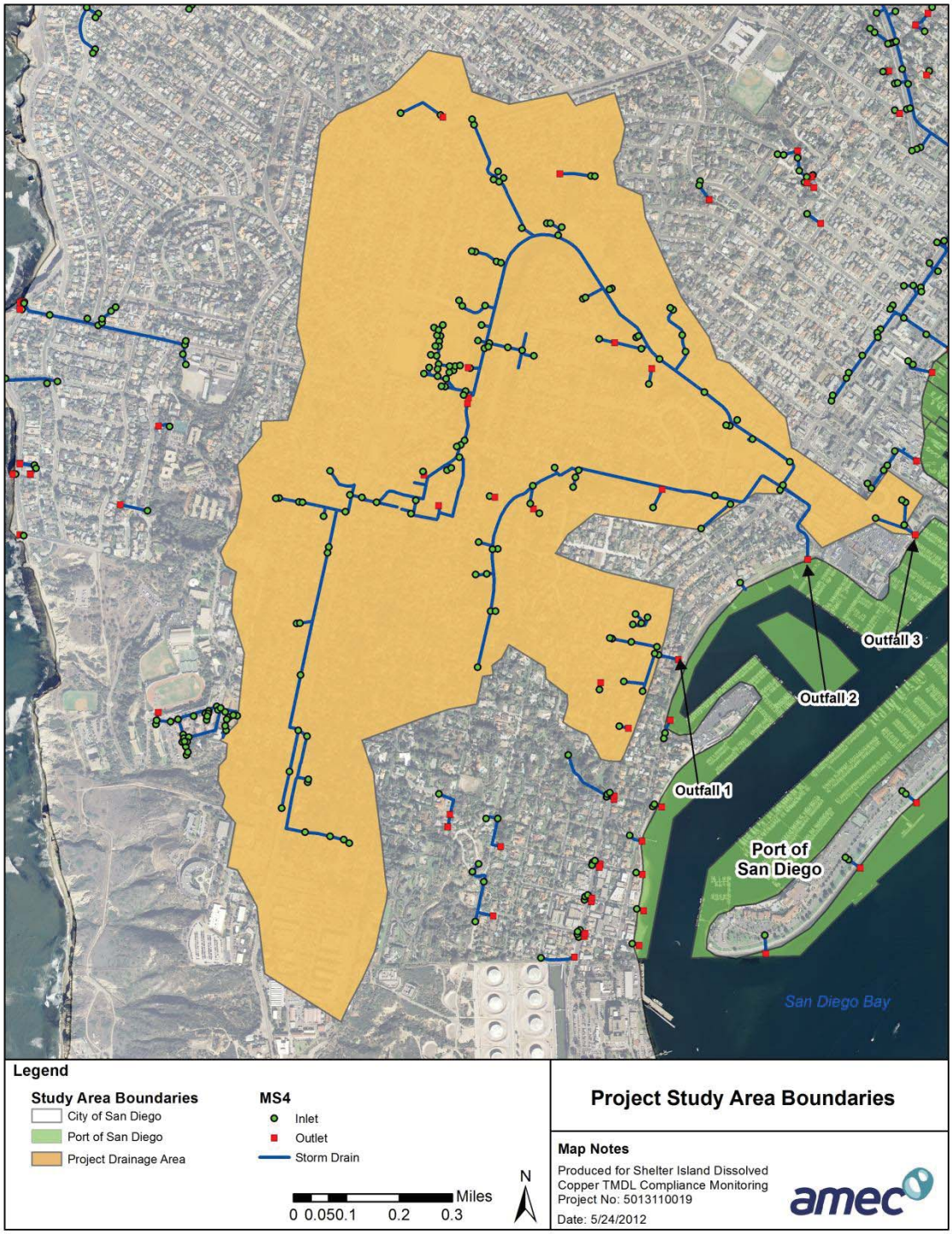
2.0 MONITORING APPROACH

The questions outlined in Section 1.1 will be addressed by estimating wet weather and dry weather flows (monitoring and modeling) and analyzing copper concentrations in runoff samples. The estimated annual dissolved copper load will be calculated based on study results and will be compared to the TMDL load allocation.

2.1 Study Area

The study area for this project consists of the drainage area that discharges into SIYB through the MS4 within the City's boundary and does not encompass the tidelands, which are under the jurisdiction of POSD. The boundaries of the City of San Diego and POSD in the vicinity of the project study area are presented in Figure 2-1. The drainage area that discharges into the SIYB from the City's jurisdiction is approximately 673 acres. It consists of three sub-drainage areas, each with a separate primary outfall (Outfall 1, Outfall 2, and Outfall 3).

Figure 2-1. Project Study Area Boundaries



2.2 Monitoring Site Locations

Prior to the beginning of the 2011-2012 monitoring season, Outfall 2 had been annually monitored and sampled as part of this monitoring program. For Outfall 1 and Outfall 3, dissolved copper load was calculated using modeled flow estimations and dissolved copper concentration data from Outfall 2 (Weston, 2011c).

In August 2011, AMEC conducted a site reconnaissance to re-evaluate the previous monitoring locations. Based on the re-evaluation:

- Outfall 1 – monitoring and sampling activities would likely require encroachment onto POSD land and/or California Department of Transportation (Caltrans) right-of-way; therefore, monitoring was not considered feasible.
- Outfall 2 – the monitoring location remained the same (i.e., Upshur Street at Rosecrans Street).
- Outfall 3 – the outfall is located on private property; however, an inlet upstream at the intersection of Anchorage Lane and Canon Street was observed not to be tidally influenced during low tide (i.e., below three to four feet (ft) tide level) (AMEC, 2011a). However, during the 2011-2012 monitoring season, it was determined that this location was frequently tidally influenced and was not considered a reliably feasible monitoring location.

The locations of these outfalls and monitoring sites are shown in Figure 2-2 and summarized in Table 2-1.

Figure 2-2: Outfalls and Monitoring Locations

Table 2-1: Summary of Outfalls and Monitoring Locations

Site ID/Name	Location	Description	Drainage Area (ac.)	Photo
Outfall 1	32°42'57.71"N 117°14'7.80"W	A 24-inch concrete pipe with a concrete head wall discharging to SIYB.	44.7[(a)]	
Outfall 2	32°43'8.08"N 117°13'53.11"W	A 66-inch concrete pipe discharging to SIYB.	613[(a)]	
Outfall 2 Flow Monitoring and Sampling Location	32°43'14.89"N 117°13'55.80"W (Intersection of Rosecrans St. and Upshur St.)	An underground vault with three inlet pipes and one 66-inch outlet pipe.	613[(a)]	
Outfall 3	32°43'9.88"N 117°13'40.64"W	A 24-inch concrete pipe discharging to SIYB.	15.0[(a)]	Not Available (on private property)
Outfall 3 Sampling Location	32°43'11.69"N 117°13'45.22"W (Intersection of Anchorage Ln. and Canon St.	A rectangular vault with a 24-inch inlet pipe and outlet pipe.	10.2[(b)]	

(a) Estimated based on previous Weston reports and available GIS information.
(b) Estimated based on GIS data.

2.3 Monitoring Equipment

This section describes the type of equipment that is proposed to be used to complete the Shelter Island Monitoring Program, as well as the installation and maintenance procedures. Flow and water quality water monitoring are dynamic processes that may require modification based on current site and channel conditions. Thus, the methodologies presented are subject to modification or change in order to meet the objectives of this monitoring program.

2.3.1 Selected Equipment

The water quality sampling equipment selected is designed to measure flow and collect water quality samples of runoff. The selected equipment has been found to be appropriate to meet the project objectives and has been successfully utilized in other regional water quality monitoring studies. The equipment is automated and can be accessed remotely via telemetry if properly equipped[3]. These features allow reductions in operating effort and increase the reliability and quality of the storm water monitoring data. Table 2-2 summarizes monitoring equipment selected for deployment during the 2014-2015 monitoring season.

Table 2-2. Monitoring Equipment

Equipment	Description
American Sigma 950 AVB Flow Meter	American Sigma 950 AVB flow meters log and calculate flow based on measured parameters. Water stage and velocity are measured with a stainless steel bubbler pressure transducer and low profile velocity sensor installed in the conveyance. A pressure transducer translates the proportional relationship of the hydrostatic pressure on a pressure plate compare to an atmospheric vent to estimate water level. Water velocity is measured using Doppler technology, which rates the velocity of particles in the water. The water must have sufficient suspended solids in order for a velocity reading to be obtained.
Hach SD900 Automated Sampler	The Hach SD900 automated sampling system consists of an intake strainer, Teflon-lined intake tubing, flexible silicon pump tubing, a peristaltic pump, sample bottle(s), a distributor arm, and a controller.
American Sigma Tipping Bucket Rain Gauge	The rain gauge measures 0.01 inches of rain each time the tipping bucket fills and closes a switch. The data logger/controller counts each switch closure to calculate rainfall totals.
12-VDC Rechargeable Gel Cell Power Supply	The Hach SD900 automated samplers and American Sigma 950 AVB flow meters will be powered by a 12-VDC rechargeable gel cell power source.

2.3.2 Installation, Calibration, and Maintenance of Monitoring Equipment

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 location. Exposed conduit, intakes, and sensors will be securely

[3] The use of telemetry is not proposed during the 2013-2014 monitoring season due to manufacturer upgrades currently being conducted to the telemetry system which have been determined to not currently be reliable by AMEC.

fastened using stainless steel brackets, screws, and anchors. Once the study is completed, monitoring equipment will be removed. Maintenance and calibration of monitoring equipment will be performed during installation and prior to monitoring events if necessary. A calibration log will be maintained for calibrations performed in the field. Prior to monitoring events, field teams will verify that the batteries are sufficiently charged.

2.3.3 Site Specific Equipment

Outfall 1

No flow or water quality sampling will be undertaken for Outfall 1. Thus, no equipment will be utilized.

Outfall 2

The monitoring location for Outfall 2 is approximately two blocks upstream of the outfall in an underground vault with an access manhole on Upshur Street. There are three pipes entering (inlet) the vault and one 66 inch pipe exiting (outlet) the vault. Rainfall (during the three monitored wet weather events only) and flow (continuously for the season) will be measured using a Sigma 950 area-velocity bubbler (AVB) flow meter with a low profile velocity sensor and bubbler pressure transducer installed downstream in the outlet pipe. A Sigma SD900 automatic sampler will be used to manually collect water quality grab samples with the intake strainer collocated with the flow sensors in the outlet pipe.

Based on historical observations, AVB flow meter/sensor combinations are less accurate in low-level/low-flow conditions (i.e., when water level is less than one inch), where a primary device such as a weir or flume is typically more accurate. However, due to limitations at the site, long-term installation of a weir or flume is not considered feasible.

In order to collect more accurate flow data in low-flow conditions using the flow meter/sensor combination a flow calibration monitoring was conducted during September and October of 2011. During the calibration period, two separate sets of flow monitoring equipment were installed to measure dry weather flow in the effluent pipe: one was a Sigma 950 AVB flow meter with an AVB sensor; the other was a Sigma 950 AVB flow meter with the bubbler line in combination with a 90° V-notch weir installed in the pipe upstream from the AVB sensor. The two flow meters were deployed simultaneously to record water level and flow during the calibration period. The recorded flow data from the flow meter and weir combination was used to develop a head-versus-flow (HVF) table, which will be applied to low-flow data (when the level is $\leq$ 1.2 inches) measured by the AVB flow meter/sensor combination. Table 2-3 presents the developed HVF table.

Table 2-3. Head versus Flow Table for Outfall 2

Level (inches)	Estimated Flow (cfs)
0.73[(a)]	0.030
0.80	0.036
0.90	0.047
1.00	0.083
1.10	0.103
1.20[(b)]	0.122

(a): Level less than 0.73 inches were not recorded during the calibration period.
(b): Flow for levels greater than 1.2 inches are calculated via area and velocity.
cfs = cubic feet per second.

Outfall 3

The monitoring location for Outfall 3 is an inlet at the intersection of Anchorage Lane and Canon Street. It is approximately 400 feet upstream from Outfall 3. The inlet is approximately three feet deep with no upstream inlet pipes and a single 24 inch downstream outlet pipe. Due to the tidally influenced conditions (especially during storm surge conditions) encountered during the 2011-2012 monitoring season no equipment will be installed within the downstream pipe during the 2014-2015 monitoring season. Water quality samples will be collected directly from the road surface immediately prior to storm water runoff entering the catch basin.

3.0 MONITORING AND MODELING METHODOLOGY

3.1 Monitoring Preparation

3.1.1 Training

Field personnel will be trained in the use of the monitoring equipment and clean sampling techniques (Appendix D) along with appropriate health and safety protocols (Appendix B).

Each field team member will review the Health and Safety Plan and consult with the Sampling Manager if they have any questions before mobilization. The Sampling Manager will train field personnel in sampling protocols and procedures in accordance with this Monitoring Plan. Field training also will be provided before the beginning of the wet season to make field personnel aware of the project-specific goals and objectives.

3.1.2 Personnel

Water quality monitoring tasks require a variety of skills and positions. The required personnel include:

- Project Manager.
- Sampling Manager.
- Field Technicians.

- ***Project Manager*** – During monitoring events, the Project Manager will monitor the status of the monitoring stations via communication with field crews. The Project Manager must be able to obtain and interpret the most recent weather forecasts to provide guidance to field technicians on when samples should be collected. It is also the responsibility of the Project Manager to notify personnel of shift start- and end-time changes.

  The Project Manager must have excellent decision-making and dispatch skills as well as a thorough understanding of the project requirements. If an assistant fills this position, the consultant's Project Manager should be available to answer questions.

- ***Sampling Manager*** – The Sampling Manager is a technically-skilled, experienced field supervisor and is the most experienced member of the field team. This position requires a thorough understanding of project requirements, sampling procedures, and equipment operations. The Sampling Manager will communicate frequently with the Project Manager to determine task priorities. The Sampling Manager will also monitor the ability of field teams to complete their shifts safely and effectively, and will notify the Project Manager of the need for relief teams. The Sampling Manager must be able to troubleshoot the common problems that could be experienced by any of the field teams, and will be responsible for directing the procedures at each site visit and for making sure that data are recorded properly. The Sampling Manager will also provide on-site weather observations for the Project Manager.

- ***Field Technicians*** – The Sampling Manager will usually have one to three field technicians assisting. This will be dependent on the number of sites being monitored for a given storm event. Field technicians are field personnel trained in water quality sample collection and Health and Safety issues. Field technicians may also be used as couriers.

3.1.3 Monitoring Event Preparation Activities

Monitoring for flow and water quality of runoff requires considerable planning prior to an actual monitoring event occurring. Obtaining representative samples and complete flow data is only possible using well-trained and alert field teams. The uncertainty of weather forecasts coupled with abrupt changes in the weather can greatly alter the expected workload. It is critical to plan and prepare for numerous aspects of the field effort well in advance of a storm event. Each pre- and post-event mobilization team should be made up of two field individuals. A Staffing Plan, which designates personnel and equipment required for each facet of monitoring, will be completed for each potential monitoring event.

The Staffing Plan should include the following:

- Personnel assigned for monitoring.
- Shift (e.g., start-up and relief).
- Equipment mobilization.
- Communication channels.

Field teams will not be mobilized during or near certain holidays if either the mobilization or the laboratory analysis is projected to continue through that holiday. This includes the following holidays and dates:

- Thanksgiving: November 27 and 28, 2014.
- Christmas: December 24 and 25, 2014.
- New Year's: December 31, 2014, and January 1, 2015.

3.1.4 Station Preparation

Prior to a monitoring event, stations must be made ready for monitoring. These preparations include verifying that the automated samplers and flow monitoring equipment are calibrated and active, and that the system pumps are functioning as designed. The flow sensors should be cleared of debris. Additional preparation for monitoring events includes performing general equipment inspections to confirm that the sites are operational.

A complete maintenance program will be performed for monitoring equipment before each wet weather event. Maintenance will include checking the performance of the equipment, checking power supplies and replacing batteries as required, inspecting and clearing intake structures, checking the status of instrumentation desiccant, and performing any necessary equipment repairs to keep the monitoring equipment operational.

Field teams must verify that the automated sampler has been reset and that it has been programmed to allow collection of samples manually.

The general functionality of the surrounding site will be inspected. It should be verified that no debris is located in the water sampling areas, and the areas should be inspected for trash to prevent clogging of equipment.

The equipment will be physically inspected to make certain that there are no obvious problems, such as damaged cables or a kinked hose. Intake strainers and flow sensors are to be visually inspected when access allows and cleared of debris if necessary.

3.1.5 Equipment Mobilization

Equipment needed for water quality sampling includes: sampling equipment and containers, safety equipment, personal rain gear, storm kits, mobile phones, and vehicles equipped with safety equipment (See Table 6-1). The necessary equipment should be loaded into the appropriate vehicles early in the preparation sequence. During the monitoring season, field crews will utilize the safety equipment, personal rain gear, and other site maintenance equipment listed below.

Table 3-1.
Storm Kit Equipment and Mobilization List

Storm Kit Equipment List	Mobilization List
Flashlights (2) Maps High-quality alkaline D-cell batteries Spare sample labels Pencils and indelible markers Desiccant (packages and jar) Diagonal clipper Electrical tape Cable ties (assorted sizes) Utility knife Ziploc bags (assorted sizes) Nitrile gloves Keys Sampling pole for grab samples Manhole lifter	Field notebook (including JHA and Tailgate Safety Meeting Forms) Paper towels Spare chains of custody Sample control paperwork Extra-fine indelible markers Sample bottles Reagent-grade, analyte-free deionized water (3-gallon jug) from the laboratory Cellular phone Personal rain gear Digital or disposable camera Necessary safety gear (see Appendix B - *Health and Safety Plan*)

3.1.6 Communication Channels

Communication channels must be established for personnel to contact each other before and during the event. Cellular telephone communication links to field teams are essential for efficient water quality monitoring because the Project Manager and the Sampling Manager will need to track the location and workload of each field team and direct them to priority tasks. The project field notebook will include phone lists with home, work, and cellular numbers of the AMEC field team, and work numbers for primary laboratory contacts and City personnel to aid in communication.

3.1.7 Documentation

During each monitored event, records of the event should be recorded accurately on a field data sheet. A blank project specific field data sheet is provided in Appendix C.

The following general information should be entered during each monitored storm event:

- Alphanumeric Site ID
- Date
- Time
- Monitoring Program
- Field Team
- Field Measurements
- Weather Conditions
- Runoff Characteristics
- Equipment Condition
- Grab Sample Collection Times
- Miscellaneous Comments

3.1.8 Iced Coolers

Once a sample is collected it should be sealed and placed directly into a cooler with wet ice sufficient to maintain a sample temperature of four degrees Celsius or less.

3.1.9 Post Storm Activities

After each successful water quality monitoring event, flow and rainfall data will be downloaded from the flow meter. Water quality samples will be transported on ice under chain-of-custody (COC) to Weck in the City of Industry, California for analysis.

3.2 Wet Weather Monitoring

Weather will be tracked during the 2014-2015 wet weather season from October 1, 2014, to April 30, 2015. The weather forecast, forecast discussion, and quantitative precipitation forecast produced by the National Weather Service (NWS) and publicly available at: http://www.wrh.noaa.gov/sgx/ will be used to determine if a storm event should be mobilized for. Antecedent rainfall conditions will be determined by review of NWS publicly available rain gauge data.

The sampling criteria are:

- Rainfall of a least one-tenth (0.1) of an inch in the drainage area within a 24 hour period.
- An antecedent dry period of at least 72 hours prior to the sampled event.
- A storm event within plus or minus 50% of the average or median storm volume and duration for the region.

Communication with the City's project manager will be made within 48 hours of the intent to monitor a storm via either phone or email. Storm event monitoring will be conducted from the onset of rainfall until stream flow returns to within approximately 10% of base flow or a maximum of 24 hours from the first sample collection time.

3.2.1 Monitoring Locations

Wet weather monitoring will be conducted at Outfall 2 and Outfall 3 monitoring locations for three storm events during the 2014-2015 monitoring season. Outfall 1 will not be monitored due to the jurisdictional boundaries described previously.

3.2.2 Determination of Pollutograph Sample Collection

Pollutograph sampling requires interpretation of rainfall forecasts prior to a storm event to determine when samples should be collected. Ideally, at least eight samples will be collected from Outfall 2 and Outfall 3 during storm event monitoring. Further interpretation by the Project Manager of satellite, radar, and rain gauge data during storm events is generally required to guide field teams on when samples should be collected. Peak flows are typically targeted for sampling. This is a dynamic process that will occur as the storm event is unfolding.

3.2.3 Water Quality Sampling

Due to the Outfall 2 sampling point being located in a confined space, a Sigma SD900 automated sampler will be used to manually collect water quality grab samples during monitored storm events. Samples should be collected to target peak flows and also to provide a representative sample of water quality for a range of flow conditions. A field crew will visit the site during the course of monitored storm events to oversee the sampling equipment.

As previously discussed, the Outfall 3 monitoring location is tidally influenced during high tides; therefore, pollutograph sampling will be conducted by manually collecting samples directly from the road surface immediately prior to storm water runoff entering the catch basin. Samples will be collected based on rainfall intensity, flow data from Outfall 2, and observed road surface runoff volume.

3.3 Dry Weather Monitoring

Three dry weather sampling events will be conducted at the Outfall 2 monitoring location during the 2014-2015 monitoring season.

- Pollutograph sampling will not be conducted during dry weather monitoring event. Historical flow data has shown little variation in dry weather flows and concentrations over a 24-hour period. Thus, automated time-weighted composite sampling will be used to collect dry weather samples over a 24-hour period during each dry weather monitoring event.
- The composite sample at Outfall 2 will be collected using an automated sampler, which will be connected to the sampler intake tubing pre-installed in the 66 inch pipe.
- A composite sample aliquot will be collected once every two hours during a dry weather monitoring event.

Dry weather sampling will not be conducted for Outfall 1 or Outfall 3 due to historic and current lack of observed dry weather flows, as well as the previously described jurisdictional boundaries at Outfall 1.

3.4 Long Term Flow Monitoring

Continuous flow monitoring at 15-minute intervals will be conducted from October 1, 2014 to April 30, 2015 at the Outfall 2 monitoring location. A Sigma 950 AVB flow meter, bubbler, and low profile velocity sensor will be used to determine and record velocity and water level, which will be subsequently used to calculate flow.

Prior to each monitored storm event at the Outfall 2 monitoring location, the flow meter will be programmed to record water level, velocity, flow, and rainfall data at one minute intervals. Following completion of storm monitoring events, the flow meter will be programmed to collect data at 15-minute intervals.

Flow monitoring will not be conducted at Outfall 1 or Outfall 3 due to jurisdictional boundaries and tidal influence, respectively.

3.5 Flow Modeling

HEC-HMS modeling will be used to estimate wet weather runoff for Outfall 1 and Outfall 3 since monitoring of flows for these outfalls is considered infeasible.

A HEC-HMS model was developed for each of the three outfalls by Weston in 2010. The models were modified by AMEC in 2012 based on the following:

- AMEC's review of historical data and reports.
- Updated geographic information system (GIS) information.
- Model calibration results using the recorded flow data during the three monitored storm events for Outfall 2 and Outfall 3[4].

The modified model parameters were area and percent imperviousness for each respective sub-drainage according to available information. Figures 3-1 through 3-3 show the schematics of the modified model setups that will likely be used for the 2014-2015 monitoring season. The calibrated models will be used to estimate flows for the following scenarios from October 1, 2014 to April 30, 2015:

- Storm events for Outfall 1.
- Storm events for Outfall 3.
- Data gaps due to non-monitored periods or equipment malfunctions for Outfall 2.

[4] Flow data obtained at Outfall 3 during the 2011-2012 monitoring season during non tidally influenced periods.

Figure 3-1. HEC-HMS Model Schematic for Outfall 1 Drainage

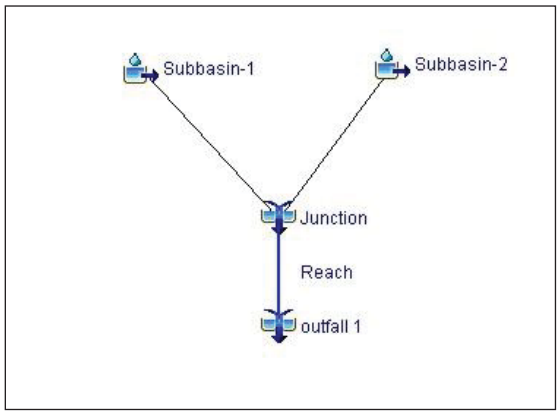


Figure 3-2. HEC-HMS Model Schematic for Outfall 2 Drainage

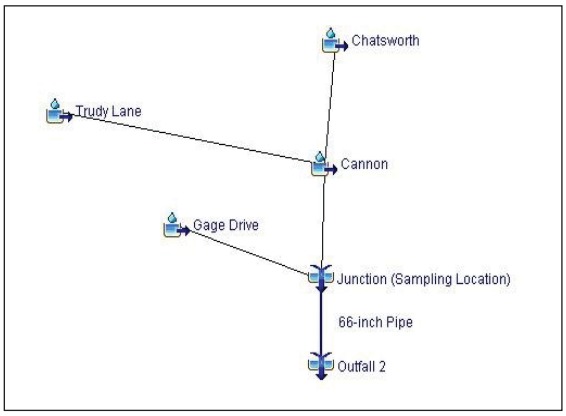
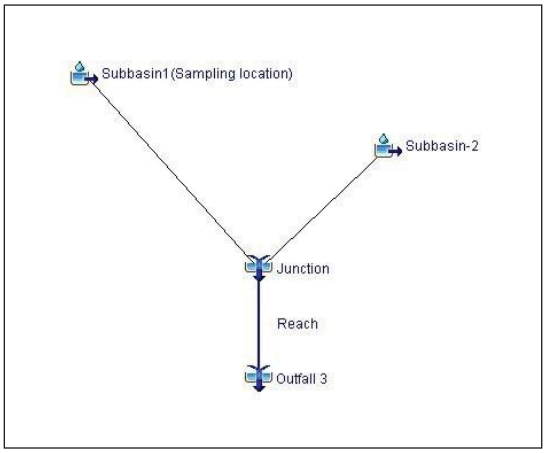


Figure 3-3. HEC-HMS Model Schematic for Outfall 3 Drainage



4.0 SAMPLE ANALYSIS

Water quality samples collected at the Shelter Island monitoring sites will be analyzed for total and dissolved copper and total hardness. Additionally, *in-situ* field measurements will be collected for pH, conductivity, and temperature.

4.1 Holding Times, Sample Times, and Preservation Requirements

Sample containers and preservation methods have been confirmed with the laboratories and are presented in Table 4-1.

Table 4-1.
Holding Times, Sample Volumes, Containers, and Preservations Recommendations

Analyte	Container	Sample Volume	Preservation	Holding Time
General Chemistry				
Total Hardness	1-L poly bottle	1 L	<4°C	6 months
Total and Dissolved Metals				
Copper	1-L poly bottle	1 L	<4°C; store in the dark; Acidify to pH<2 with pre-tested HNO_3 ASAP	48 hours to filter and preserve/ 6 months to analyze

Notes:
[a.] Additional sample volume may be required for QC samples.

COCs will be pre-printed along with the bottle labels. The COCs will contain at a minimum the same data as the sample labels. The COCs will be completed in the field with dates, times, and sample team names, and will be cross-checked with the bottle labels. For composite samples, the start of the holding time will be considered to be the time that the last sample aliquot was collected.

Transport of the samples will be coordinated with the laboratories by the Sampling Manager. The COCs will be reviewed by personnel at the receiving laboratory to verify that stated samples are accounted for, preservation requirements have been met, analysis requirements are clearly detailed, and the holding time remaining.

Analytical constituents, methods, method detection limits (MDLs), and target reporting limits (RLs) are provided in Table 4-2. If samples are non-detect for total copper and dissolved copper by United States Environmental Protection Agency (USEPA) 200.8, then the more sensitive method USEPA 1640[5] will be used. *In-situ* field measurements are presented in Table 4-3.

[5] USEPA 1640 typically requires use of clean hands sampling protocol which is not proposed as the sample collection technique for this project. This sampling protocol requires the use of specially prepared double bagged bottles and two people to perform the sampling. Auto samplers, which are utilized for this project, are typically not considered viable for the clean hands sampling technique. Thus, if results are ND using USEPA 200.8, results obtained by analyzing with USEPA 1640 will be qualified.

Table 4-2: Analytical Constituents and Methods for Dry Weather Water Sampling

Analyte	Method	Minimum Detection Limit	Reporting Limit	Units
Total hardness	USEPA 200.7	0.016	0.10	mg/L
Total and dissolved copper (Cu)	USEPA 200.8	0.022	0.50	µg/L
Total and dissolved copper (Cu)	USEPA 1640	0.0038	0.010	µg/L

Table 4-3. Field Measurements

Constituent	Method	Range	Units
Conductivity	Field Meter	0 to 200 miliSiemens per centimeter (mS/cm)	microSiemens per centimeter (µS/cm)
pH	Field Meter	0 to 14	pH units
Temperature	Field Meter	-5 to +75 °C	Degrees Celsius (°C)

4.2 Sample Labelling

Water quality sample bottles will be pre-labeled, to the extent possible, before each monitoring event. Pre-labelling bottles simplifies field activities and leaves only date, time, sample ID, and sampling personnel names to be filled out in the field. Each sample collected will be labelled with the following information:

- Project Name
- Monitoring Program
- Event Number
- Date and Time
- Site ID Number
- Bottle __ of __ (for multi-bottle samples)
- Collected by
- Analysis

Field samples will be labelled as described below. These samples will be labeled, recorded on the COC form, and then transported to the analytical laboratory.

Each water sample collected will receive a unique alphanumeric code (Sample ID Number) for tracking. This code will be standardized for water quality samples and will contain information as it relates to the site, event, and type of sample. The required sample identification numbers, applicable to water quality samples, are listed below.

An example Sample ID is shown in Table 4-4:

- Monitoring Year
  - 2014 = 2014-2015 Monitoring Season
- Event Number
  - W1 = Wet Weather Event 1
  - W2 = Wet Weather Event 2
  - W3 = Wet Weather Event 3
  - D1 = Dry Weather Event 1
  - D2 = Dry Weather Event 2
  - D3 = Dry Weather Event 3
- Site ID
  - OF001
  - OF002
  - OF003
- Sample Code
  - C = Composite sample
  - G = Grab sample (pollutograph)
- Sample Type
  - 01 = Primary sample
  - D = Duplicate Sample
  - FB = Field Blank

Table 4-4. Example Sample Identification Numbers

Sample ID	Description			
	Sample Type	Site ID	Event	Sample Type
2014-W1-OF002-G-01	Grab Sample	Outfall 2	2014-2015 Wet Weather Event 1	Primary Sample

4.3 Laboratory Data Package Deliverables

The laboratory will aim to provide a three-week turnaround on the deliverable package per event. The deliverable package will include a hard copy and electronic data files. The hard copy will include standard narratives identifying analytical inconsistencies, Quality Assurance / Quality Control (QA/QC) exceedances, and corrective actions. The electronic data files will be submitted in a Surface Water Ambient Monitoring Program (SWAMP) compatible format (SWRCB, 2008) and will contain the same information found in the hard copy reports submitted by the laboratory. Individual data sets may be submitted to the consultant as either Microsoft Excel workbook files or as Microsoft Access database files.

4.4 Laboratory Selection

Weck Laboratories, Inc., located in the City of Industry, California, will be providing laboratory services for this project.

Weck Laboratories Inc.
14859 East Clark Avenue
City of Industry, California 91745
Office: (626) 336-2139
Fax: (626) 336-2634

5.0 QUALITY CONTROL/DATA QUALITY OBJECTIVES

5.1 Field Quality Assurance/Quality Control

This section presents quality assurance/quality control (QA/QC) activities associated with field sampling. Field QA/QC samples will be used to evaluate potential contamination and sampling errors applicable to automated composite samples and grab samples that may be introduced prior to submittal of the samples to the analytical laboratory.

The field QA/QC samples that will be utilized are field blanks and field duplicates. Sample types, measurement objectives, and frequencies are summarized in Table 5-1.

Table 5-1.
Field Quality Control Samples

Analyte Category	Measurement Quality Objective		Frequency of Analysis[(a)]
	Field Duplicate	Field Blank	
Metals	RPD<30%[(b)]	<RL for target analyte	≥ 5%

Notes:
RL = reporting limit.
RPD = relative percent difference.
(a) No field duplicate or field blank will be collected for dry weather monitoring events as samples will be collected via time-weighted composite sampling.
(b) Relative percent difference (RPD) is not available if native concentration of either sample is less than reporting limit (RL).

5.2 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 QA for this program consisted of the following:

- Employing analytical chemists trained in the procedures to be followed.
- Adherence to documented procedures, United States Environmental Protection Agency approved methods, and written Standard Operating Procedures (SOPs).
- Calibration of analytical instruments.
- Use of QC samples, internal standards and surrogates.
- Documentation of sample tracking and analysis.

Internal laboratory QC checks will consist of the use of laboratory replicates, method blanks, matrix spikes/matrix spike duplicates (MS/MSDs), and laboratory control samples (LCSs). The QC check performed on each constituent is presented in Table 5-2. The frequency of the laboratory QA/QC samples is presented in Table 5-3 and the laboratory QC objectives are presented in Table 5-4.

Table 5-2.
Laboratory Quality Control Samples by Constituent

Analyte	Laboratory Replicate	Method Blank	MS/MSD	LCS
General Chemistry				
Total Hardness	—	✓	✓	✓
Total and Dissolved Metals				
Copper, Total	—	✓	✓	✓
Copper, Dissolved	—	✓	✓	✓

Notes:
LCS = laboratory control sample.
MS = matrix spike.
MSD = matrix spike duplicate.

Table 5-3.
Laboratory Quality Control Sample Frequency

QA/QC Sample Type	Minimum Sampling Frequency
	General Chemistry
Method Blank	One per batch or per 20 samples
MS/MSD	One per batch or per 20 samples
LCS	One per batch or per 20 samples
Laboratory Duplicate	One per batch or per 20 samples

Notes:
LCS = laboratory control sample.
MS = matrix spike.
MSD = matrix spike duplicate.
QA/QC = quality assurance/quality control.

Table 5-4.
Laboratory Quality Control Sample Objectives

QC Sample Type	General Chemistry	Metals
Method Blank	<RL for target analyte	<RL for target analyte
Laboratory Duplicate	NA	NA
LCS	70-130% recovery	70-130% recovery
MS/MSD	70-130% recovery; RPD<30%[(a)]	70-130% recovery; RPD<30%[(a)]

Notes:
LCS = laboratory control sample.
MS = matrix spike.
MSD = matrix spike duplicate.
NA = not applicable.
QC = quality control.
RL = reporting limit.
RPD = relative percent difference.
(a) Relative percent difference (RPD) is not available if native concentration of either sample is less than RL

5.3 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 for this project consisted of the following:

- Accuracy.
- Precision.

- 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 specified in Table 5-1 for field QC samples and Table 5-4 for laboratory QC samples.

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 specified in Table 5-1 for field control samples and Table 5-4 for laboratory QC samples. Relative Percent Differences (RPDs) will be calculated to determine the precision between duplicate samples. This calculation is presented in Equation 1.

Equation 1.

$$RPD = \frac{abs[x_1 - x_2]}{0.5 * (x_1 + x_2)}$$

Where:

abs is the absolute value.
x_1 is measurement 1.
x_2 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.

Equation 2.

$$Completeness = \frac{Actual\ number\ of\ samples\ collected}{Project\ required\ total\ samples\ to\ be\ collected} * 100$$

5.3.1 Accuracy, Precision, and Completeness

Analytical method DQOs for accuracy, precision and completeness are summarized in Table 5-5.

Table 5-5.
Laboratory Quality Control Data Quality Objectives

Constituent Category	Accuracy	Precision	Completeness
General Chemistry	70-130%	RPD<30%[(a)]	90%
Metals	70-130% recovery	RPD<30%[(a)]	90%

Notes:
RPD = relative percent difference.
(a) Relative percent difference (RPD) is not available if native concentration of either sample is less than the reporting limit (RL).

5.3.2 Composite Sample Representativeness

Time-weighted composite sampling will be utilized to collect dry weather samples. Historical monitoring data has shown little variation in dry weather flows and concentrations over a 24-hour period. During each of the three dry weather monitoring events at the Outfall 2 monitoring site conducted during the 2014-2015 monitoring season, composite sample aliquots will be collected once every two hours. This frequency will be utilized in an effort to adequately represent dissolved copper concentrations during the 24-hour period.

5.3.3 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.

The Sigma 950 AVB flow meters will be calibrated using the procedures described in the Sigma 950 operations and maintenance (O&M) manual (Hach Catalogue No. 3314). For flow meter calibration, the recorded water level will be checked by operation of the flow meter while the bubbler will be submersed in water of a known level. Level adjustments can be made directly on the flow meter. Results that deviate significantly from the known level and do not maintain an adjusted offset will be documented and the equipment will be replaced or repaired. Velocity cannot be calibrated; therefore, if a low profile velocity sensor reports erroneous velocity measurements it will be replaced.

The Sigma SD900 sampler will be calibrated using the procedures described in the Sigma SD900 O&M manual (Hach Catalogue No. DOC026.53.00742). For automated sampler calibration, the aliquot volume will be calibrated using a graduated flask or beaker.

Rain gauges are not adjustable and cannot be calibrated. If a rain gauge fails to record simulated rainfall, the instrument will be repaired or replaced.

Calibration of flow meters and automated samplers will be conducted prior to installation, and per the calibration frequencies discussed in Table 5-6.

Table 5-6.
Calibration of Field Sampling Equipment and Monitoring Instruments

Equipment	Calibration Description	Responsible Person	Frequency	SOP Reference
Sigma 950 AVB flow meter (level only)	Water level check against known levels	AMEC technical staff	Semi-annually	Sigma 950 O&M Manual 3314
Sigma SD900 automated sampler	Aliquot calibration	AMEC technical staff	Semi-annually	Sigma SD900 Sampler O&M Manual DOC026.53.00742
American Sigma rain gauge	NA	AMEC technical staff	Semi-annually	NA

Notes:
AVB = area-velocity bubbler.
NA = Not Applicable.
O&M = operations and maintenance.
SOP = standard operating procedure.

5.3.4 Inspection/Acceptance of Supplies and Consumables

Sample bottles (provided by Weck) and collection equipment will be inspected prior to their use. Procured supplies will be examined for damage prior to use per Table 5-7.

Field supplies will be stored at AMEC offices; laboratory supplies will be stored at Weck. Inspection and testing requirements for laboratory supplies are covered in the laboratory's QA/QC procedures.

Table 5-7.
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%	AMEC
Composite sample bottles	Laboratory cleaned	Pass blanking analysis	Clean bottles each monitoring event	Weck/AMEC
Silicone tubing	Laboratory cleaned	Pass blanking analysis	New tubing each season	Weck/AMEC
Teflon tubing	Laboratory cleaned	Pass blanking analysis	New tubing each season	Weck/AMEC
Gloves	New box (Grainger)	New box	As needed	AMEC

5.3.5 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 stored at AMEC. 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.

6.0 DATA MANAGEMENT AND DATA REPORTING PROCEDURES

6.1 Data Management

The responsibility for hydrologic data management and laboratory data management will be led by the Project Manager. The laboratory will be requested to provide data in both hard copy and electronic formats.

The Reporting and Laboratory Coordinator will be responsible for tracking the analytical process to make sure that laboratories are meeting the required turnaround times and are providing a complete deliverable package. The Reporting and Laboratory Coordinator will receive the original hard copy from the laboratory, verify completeness, and log the date of receipt. The hard copy originals then will be transferred to the Project Manager and filed with other original project documentation in order to maintain complete project records.

The electronic submittals will conform to reporting protocols that are compatible with the Surface Water Ambient Monitoring Program (SWRCB, 2009). A relational database will be developed by the Database Coordinator and used for data management and analysis. Laboratory data will be maintained and managed with Microsoft Excel and/or Microsoft Access by the Database Coordinator. Data from the monitoring site flow meters/data loggers will also be stored in the same database system and linked to the laboratory database. The data logger files will include rainfall and discharge (velocity, stage, and instantaneous flow) data.

6.2 Monitoring Report

The data collected under the Shelter Island Monitoring Program will be compiled and analyzed, with the findings presented in a draft Monitoring Report. The draft report will be completed once flows have been monitored through April 30, 2015 at Outfall 2 to provide annual estimated loading estimates within the draft monitoring report for review and to provide comments.

The report will summarize the sample collection methods and events, present the findings of the analytical results, and provide estimated loading information from the three outfalls. Any deviations from protocols listed in the Monitoring Plan and the implications of those deviations on the interpretation of the data will be included in the report. Raw data will be provided as an appendix on CDs.

Comments on the 2014-2015 Draft Monitoring Report will be compiled and tabulated in a response to comments letter for inclusion in the final report. The report will be finalized per the recommendations during the 2015-2016 monitoring season.

7.0 REFERENCES

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APPENDIX A
WECK LABORATORY'S
QUALITY ASSURANCE PROGRAM MANUAL

APPENDIX B
HEALTH AND SAFETY PLAN

APPENDIX C
FIELD DATA SHEET

APPENDIX D
CLEAN SAMPLING TECHNIQUE

Appendix E Shelter Island Shoreline Park Bacteriological Monitoring

Appendix D

Shelter Island Shoreline Park Bacteriological Monitoring

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Shelter Island Shoreline Park Bacteriological Monitoring

Final Work Plan

The Port of San Diego
3165 Pacific Highway
San Diego, CA 92101

November 2012

Shelter Island Shoreline Park Bacteriological Monitoring

Final Work Plan

The Port of San Diego
3165 Pacific Highway
San Diego, CA 92101

November 6, 2012

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LIST OF ACRONYMS

AB411	Assembly Bill 411
Basin Plan	Water Quality Control Plan for the San Diego Basin (9)
DEH	San Diego County Department of Environmental Health
COC	chain of custody
CSDM	Coastal Storm Drain Monitoring
HA	Hydrologic Area
HSA	Hydrologic Sub-Area
HU	Hydrologic Unit
NWS	National Weather Service
PID	photoionization detector
Port	Port of San Diego
QA Manual	Quality Assurance Program Manual
QA/QC	quality assurance/quality control
QPF	quantitative precipitation forecast
RWQCB	Regional Water Quality Control Board
SISP	Shelter Island Shoreline Park
SWRCB	State Water Resources Control Board
TMDL	total maximum daily load
WQO	water quality objective

1.0 INTRODUCTION

In 1997, the California State Assembly passed a resolution to amend the state's Health and Safety Code Section 115880. The amendment, known as Assembly Bill 411 (AB411), required the testing of the ocean receiving waters adjacent to all public beaches for microbiological contamination, including total coliform, fecal coliform, and *Enterococcus* bacteria. AB411 criteria established a monitoring program whereby receiving waters at public beaches were required to be sampled weekly from April 1 through October 31 within a given calendar year. The law also required the California State Department of Health Services to adopt regulations establishing minimum standards for the sanitation of public beaches.

In order to meet the requirements of the AB411 regulations, the San Diego County Department of Environmental Health (DEH) has monitored water quality at several sites along the coastline of San Diego Bay since 1999. In addition, the San Diego Unified Port District (Port) has monitored ocean receiving waters at several sites in San Diego Bay as part of the Coastal Storm Drain Monitoring (CSDM) Program. One of these sites (Site EH-200) is located in Shelter Island Shoreline Park (SISP) – a mile-long park and promenade that spans the bayside length of Shelter Island in San Diego Bay (Figure 1). Compliance Monitoring Site EH-200 represents a 0.4 mile long section of the Park that has been identified since 2002 as a water quality limited segment due to exceedances of water quality objectives (WQOs) for three indicator bacteria: total coliform, fecal coliform, and *Enterococcus*. The site has been placed on the State Water Resources Control Board (SWRCB) Section 303(d) List of Water Quality Limited Segments in accordance with the Clean Water Act. A summary of the 303(d) listing for SISP is presented in Table 1. Shelter Island Shoreline Park and the EH-200 compliance monitoring site are shown on Figure 1.

Table 1. Summary of 303(d) Listings for Shelter Island Shoreline Park

Waterbody Name	HA[1]	HSA[2]	HSA Number	Pollutant
Shelter Island Shoreline Park	Point Loma 908.1	Lindbergh	908.11	Total Coliform
				Fecal Coliform
				Enterococcus

[1] HA = Hydrologic Area
[2] HSA = Hydrologic Sub-Area

SISP is located in San Diego Bay within San Diego County. Historically, concentrations of indicator bacteria (total coliform, fecal coliform, and *Enterococcus*) have exceeded REC-1 WQOs as defined in the AB411 criteria and the San Diego Regional Water Quality Control Board's (RWQCB) Water Quality Control Plan for the San Diego Basin (9) (Basin Plan) (RWQCB, 1994). In the Basin Plan, the REC-1 Beneficial Use definition includes uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible (*e.g.*, swimming, wading, water-skiing, surfing, fishing and SCUBA diving).

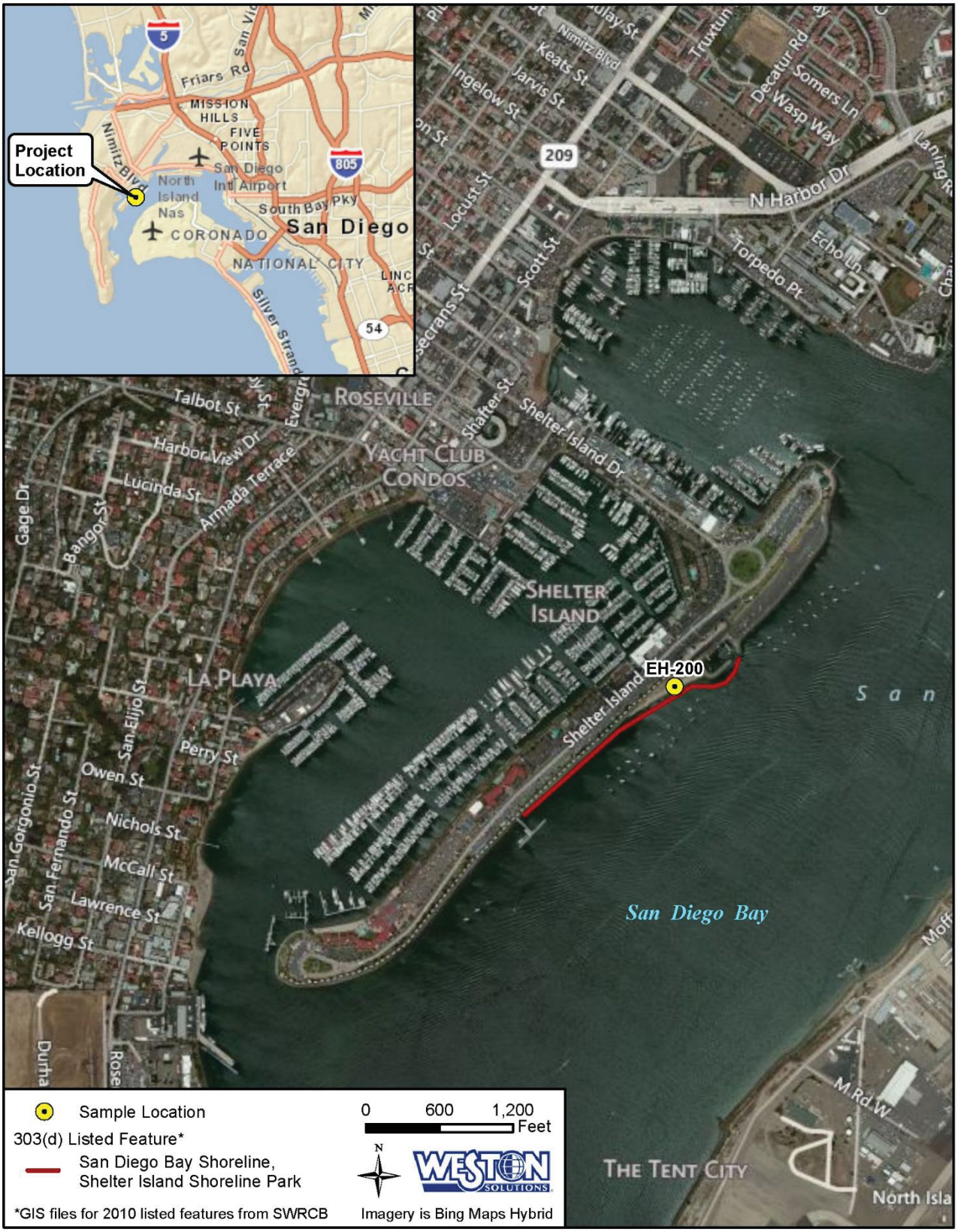

Figure 1. Map of Shelter Island Shoreline Park and EH-200 Monitoring Site in San Diego Bay

In 2000, DEH reported that beach closure and/or health risk advisory signs were posted at SISP for 24 days. Based on this information, SISP was placed on the 2002 Section 303(d) List by the SWRCB as impaired for the REC-1 beneficial use for all three indicator bacteria. In June, 2008, a Total Maximum Daily Load (TMDL) for indicator bacteria was produced for SISP and approved by the United States Environmental Protection Agency (RWQCB, 2008).

The TMDL was based on analytical data made available from the Port and DEH from samples collected at SISP between March, 1999 and February, 2004. Since that time, the Port and the City of San Diego have made significant improvements to SISP to reduce indicator bacteria levels at Site EH-200. Monitoring data collected at Site EH-200 have shown a significant reduction in bacterial levels since 2004 and the site is currently being considered for removal from the 303(d) List (de-listing) for all three indicator bacteria.

According to the Implementation Plan of the TMDL, submittal of a request for de-listing of Site EH-200 for indicator bacteria is the final step in the Compliance Schedule, which is to be completed in 2012. The stated goal of the Implementation Plan is:

> "to ensure that WQOs for indicator bacteria for the shoreline segments of SISP are attained and maintained throughout the waterbody and in all seasons of the year. WQOs are considered "attained" when the waterbody can be removed from the Clean Water Action Section 303(d) List of Water Quality Limited Segments. WQOs are considered "maintained" when, upon subsequent listing cycles, the waterbody has not returned to an impaired condition and been put back on the List."

The purpose of this Work Plan is to describe the procedures and protocols for verifying that WQOs for indicator bacteria are maintained at SISP (as defined above), through a consistent, on-going monitoring program.

1.1 Project Objectives

This Work Plan has been designed to answer the following Key Questions:

1. **What are the concentrations of indicator bacteria in the ocean receiving waters at SISP Site EH-200 during dry and wet weather conditions over time?**

2. **Are the WQOs for indicator bacteria being maintained over time at SISP Site EH-200, in accordance with the TMDL?**

To answer these questions, water quality will be monitored at Site EH-200 during both dry and wet weather conditions as part of a routine monitoring program for SISP.

1.2 Monitoring Site Location

The SISP monitoring location is in the Point Loma Hydrologic Area (HA) (908.1), which is within the Pueblo San Diego Hydrologic Unit (HU). The Pueblo San Diego HU is approximately 70 square miles, covering 44,368 acres, and does not have a major stream system (RWQCB, 1994). Site coordinates and location description are provided in Table 2. Photographs of the EH-200 monitoring site are presented in Figure 2 and a map of the site showing area storm drains and approximate sub-basin boundaries is provided in Figure 3.

Table 2. Shelter Island Shoreline Park Site EH-200 Coordinates and Site Description

Site ID	Coordinates		Site Description
	Latitude	Longitude	
EH-200	32.714668	-117.224461	Site EH-200 is located on Shelter Island in San Diego Bay within Shelter Island Shoreline Park (SISP), a mile-long park and promenade that spans the bayside length of Shelter Island. Compliance Monitoring Site EH-200 is located on the sandy beach adjacent to the boat ramp at SISP and represents a 0.4 mile long section of the Park.

Figure 2. Photographs of Shelter Island Shoreline Park Monitoring Location

Figure 3. Shelter Island Shoreline Park in San Diego Bay Showing the EH-200 Compliance Monitoring Site and Approximate Sub-drainage Boundaries

2.0 SAMPLING AND ANALYSIS PROCEDURES

2.1 Dry Weather Monitoring

2.1.1 Sample Collection

Field scientists wearing clean, disposable gloves will collect bacterial grab samples in sterile, plastic, 100-mL containers. Sampling containers will be kept in clear Ziploc™ bags until use. The bag will be opened, and the sampling container will be opened with the lid held face-down to prevent any airborne contamination. Samples will be collected directly from the ocean in ankle to knee-deep water at Site EH-200 during an incoming wave. The bottle will be submerged open-end down approximately 6 inches below the water's surface. The bottle will then be turned face-up and allowed to fill. As sampling containers contain trace amounts of sodium thiosulfate (a chlorine neutralizer), the bottle should be filled once and drained to the desired volume. The bottle will then be closed and placed back in the Ziploc™ bag, and the bag will be sealed. Samples will be stored on ice in a covered cooler in the field and during pick-up and delivery to the laboratory. All samples will be labeled and transported according to the Sample Handling and Tracking procedures discussed in Section 3.0. Laboratory analysis will begin as quickly as possible and always within the maximum holding time of six hours.

Samples will be transported on ice under chain of custody (COC) from collection in the field and will be delivered to the appropriate certified analytical laboratory for further processing. The Quality Assurance Program Manual (QA Manual) for chemistry analyses (Appendix A) outlines the practices used by the laboratory to ensure reliable, high-quality results for the bacteriological analyses.

A field data log (Appendix B) will be filled out by the field team over the course of each dry weather sampling event. The field data log includes empirical observations regarding the site and its current conditions (*e.g.*, meteorological conditions, odor, color, turbidity, floating materials, and trash).

2.1.2 Sample Frequency

Dry weather monitoring will be conducted at Site EH-200 during two distinct Dry Weather Monitoring Seasons: Summer Dry Weather and Winter Dry Weather. The Summer Dry Weather monitoring will be conducted between April 1 and October 31 of a given calendar year as part of the AB411 Monitoring Program. During this period, a single sample will be collected by DEH staff one time per week during the daylight hours between 7:00 a.m. and 4:00 p.m.

Winter Dry Weather monitoring may be conducted by the Port between November 1 and March 31 of a given calendar year. During this timeframe, samples may be collected from Site EH-200 approximately once every month, depending on storm frequency during the winter months. If needed, Winter Dry Weather samples will be collected at least 72 hours after a storm event using the sample collection techniques discussed above.

2.2 Wet Weather Monitoring

The Port will conduct three wet weather monitoring events per storm season to verify that WQOs for indicator bacteria are being maintained at SISP. Criteria for wet weather events include a minimum of 72 hours of antecedent dry weather and a minimum of 0.10 inch of rain forecasted within the runoff area. Staff will monitor the National Weather Service (NWS) website (http://www.wrh.noaa.gov/sgx/) for forecasted storms. The posted forecasts, discussions, and quantitative precipitation forecast (QPF) are used to determine if a storm meets the criteria for a potential wet weather event. If the QPF predicts measurable rain greater than 0.10 inch at the coast the day prior to a rain event or within 48 hours of a weekend event, storm event staffing will be notified to be on call and ready to perform monitoring. Staff will also use infrared satellite imagery, live streaming NEXRAD radar, and pressure gradient maps to verify the QPF.

2.2.1 Sample Collection

Wet weather samples will be collected for bacterial analyses in the same manner as that described for dry weather (see Section 2.1.1). A single grab will be collected near the peak of the storm in the ocean receiving waters for a total of three storms per storm season. (Note: Due to the small size of the watershed, runoff response time is short at SISP.)

All samples will be labeled and transported according to the Sample Handling and Tracking procedures discussion in Section 3.0. Laboratory analysis will begin as quickly as possible and always within the maximum holding time of six hours. As with Dry Weather Monitoring, a field data log (Appendix B) will be filled out by the field team over the course of each wet weather sampling event. The field data log includes empirical observations regarding the site and its current conditions (*e.g.*, meteorological conditions, odor, color, turbidity, floating materials, and trash).

Samples will be transported on ice under COC from collection in the field and will be delivered to the appropriate certified analytical laboratory for further processing. The QA Manual for chemistry analyses (Appendix A) outlines the practices used by the laboratory to ensure reliable, high-quality results for the bacteriological analyses.

2.2.2 Sample Frequency

The Port will conduct three wet weather monitoring events per storm season, between October 1 and April 30 for a given storm season.

For official rainfall statistics, staff will use NWS information from the San Diego Lindbergh Field. In the event of an equipment malfunction, other rain gauges in close proximity to the SISP site which may be used for official rainfall statistics are presented in Table 3. Data may be obtained from the Weather Underground website: <http://www.wunderground.com>.

Table 3. Rain Gauges in Close Proximity to the Shelter Island Shoreline Park Site EH-200

Weather Underground Site ID	Coordinates		Site Description
	Latitude	Longitude	
KNZY	32.70	-117.21	NORTH ISLAND GAUGE (ELEVATION: 23-ft) North of SISP, at the San Diego Naval Supply Center.
MAS414	32.67	-117.17	CORONADO GAUGE (ELEVATION: 13-ft) East of SISP, on North Island at State Highway 75.
KCASANDI129	32.69	-117.17	C AVENUE GAUGE (ELEVATION: 39-ft) East of SISP, at Tidelands Park.

2.2.3 Quality Control

Quality assurance and quality control for sampling processes begin with proper collection of the samples in order to minimize the possibility of contamination. All water samples are first collected in laboratory-certified, contaminant-free bottles. For bacterial sampling, sterile bacteria-free containers, containing sodium thiosulfate (which neutralizes chlorine) will be used.

Field blanks will be collected at a rate of one sample per sampling event. Field blanks are check samples that monitor contamination originating from the collection, transport or storage of environmental samples. A field blank is analyte-free water that is poured into the sample collection device and sub-sampled for analyses to verify that field cleansing procedures are adequate and sample handling and transportation does not introduce any analytes of interest. Field blanks will be collected and analyzed for total coliforms, fecal coliforms, and enterococci.

2.3 Sample Analysis

All dry and wet weather samples will be analyzed for total coliforms, fecal coliforms, and enterococci. Table 4 outlines the methods, minimum detection limits, and reporting limits of each analysis.

Table 4. Analytical Methods for Quantifying Indicator Bacteria Concentrations

Analyte	Method	Minimum Detection Limit	Reporting Limit	Units
Total coliform	SM9221B	<2	<20	MPN/100 mL
Fecal coliform	SM 9221E	<2	<20	MPN/100 mL
Enterococcus	SM 9230B or Enterolert	<2 or <1	<20 or <10	MPN/100 mL

3.0 SAMPLE HANDLING AND TRACKING

3.1 Sample Identification

Each sample will receive a unique alphanumeric code (sample I.D. number) for tracking. This code will be standard for all samples and contain information as to the station, sample interval number, and sequential monitoring event number. Samples will be kept properly chilled and transferred to the analytical laboratory within holding times to achieve the highest quality data possible. To ensure proper tracking and handling of the samples, documentation will accompany the samples from the initial pickup to the final extractions and analysis. This documentation will be in the form of Chain of Custody Forms (Appendix C). These forms, or equivalent, will be used to track and handle samples. All samples collected will be labeled with the following information:

3.2 Chain of Custody Procedures

Samples will be considered 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 can not be reached without breaking the seal. A COC record (Appendix C) and field logs (Appendix B) are the principal documents used to track samples and to document possession. COC procedures will be used for all samples throughout the collection, transport, and analytical process.

COC procedures will be initiated during sample collection. A COC record will accompany each sample or group of samples. Each person who has custody of the samples will sign the form and ensure that samples are not 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 and received by the analytical laboratory.
- Shipping company and waybill information (if used).
- Constituents to be tested, preservatives, and temperature requirements.

Completed COC forms will be placed in a waterproof envelope and kept with the samples. Once delivered to the analytical laboratory, the COC form will be signed by the sample recipient. The condition of the samples (*i.e.*, confirming all samples are accounted for and properly labeled, the temperature of the samples, and integrity of the sample bottles) will be noted and recorded by the receiver. COC records will be included in the final analytical reports prepared by the laboratories and are considered an integral part of the analytical report.

4.0 DATA ANALYSIS AND REPORTING

All field and laboratory data collected will be subjected to quality assurance/quality control (QA/QC) protocols to assure the data's accuracy and validity. Once the data have been verified, wet and dry weather bacterial concentrations will be compared to the appropriate WQO (Table 5) to determine the extent to which the objective for each indicator bacteria is being maintained at SISP.

Table 5. Water Quality Objectives for Indicator Bacteria

	30-Day Limit[1]	Single Sample Limit
Total Coliform	1,000 MPN[2]/ 100 mL	1,000 MPN/ 100 mL if Fecal > 10% of Total, or 10,000 MPN/100 mL[3]
Fecal Coliform	200 MPN/ 100 mL	400 MPN/ 100 mL
Enterococcus	35 MPN/ 100 mL	104 MPN/ 100 mL

1 = 30 day limit is based on the geometric mean of at least five weekly samples
2 = MPN is Most Probable Number
3 = Total coliform single sample limit of 10,000 MPN decreases to 1,000 when the fecal coliform value is greater than 10% of total coliform value

The results will be summarized based on dry and wet weather exceedance frequencies and presented to the RWQCB for review. A summary report will be submitted to the RWQCB every two years, in accordance with the Compliance Schedule in the TMDL Implementation Plan (RWQCB, 2008), as a periodic demonstration that wasteload allocations and WQOs are being met at SISP.

5.0 HEALTH AND SAFETY

Wet weather sampling events can pose some potentially dangerous situations that field personnel need to be aware of and take precautions against. A health and safety tailgate meeting is required prior to any on-site activity. During this meeting, site-specific hazards should be taken into account, discussed, and addressed appropriately. There are various health and safety issues of particular interest to this sampling location.

5.1.1 Inclement Weather

Extremes of heat, cold, and humidity as well as rain, snow, and ice can adversely affect monitoring instrumentation response and reliability, respiratory protection performance, and chemical protective clothing materials. Rain and wet weather conditions also 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,

increasing potential for driving accidents, and may limit the effectiveness of certain direct-reading instruments (*e.g.*, photoionization detectors (PIDs)).

Winter storms will bring in colder than normal temperatures to the area. Field crews will be working long hours in wet and cold conditions. Field personnel should wear extra layers of clothing under rain gear since to prepare for a variety of temperature changes.

5.1.2 Traffic Hazards and Traffic Control

There is potential for field crews to be driving in the rain and/or at night, so extra precaution should be taken while driving. 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 in storm water monitoring. Traffic presents hazards in the following two ways: 1) when field personnel are close to roadways, the potential exists to be hit by oncoming traffic and 2) driving to, from, and on the site poses a potential accident hazard.

There is a public parking lot at the SISP site and direct access to the site. Whenever possible, field personnel should park close to the site, in well-lit a designated parking space. Field personnel should abide by the following guidelines while working in traffic:

- Traffic awareness of other drivers and pedestrians.
- Turn on the vehicle's flashing yellow warning light and hazard lights.
- Put out safety cones to mark off the work area, and wear a reflective safety vest.
- Avoid steep slopes and stream banks.
- Always use a flashlight in the dark.
- Always wear bright rain gear during storms to be more visible.

5.1.3 Fatigue

Field staff may work long hours during the course of the monitoring event. If field personnel are too tired to safely continue working, a replacement will be provided.

These are just some basic, common hazards encountered during storm water sampling and are not intended to be a complete list for any and all sites or conditions. A complete Health and Safety Plan may need to be developed specifically for this project and will be reviewed and implemented by all field staff prior to project implementation.

6.0 REFERENCES

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SWRCB, 2004. State of California State Water Resources Control Board, Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. September 2004.

SWRCB. 2010. State of California State Water Resources Control Board. Water Quality Control Plan, Ocean Waters of California (California Ocean Plan). Effective March 10, 2010.

Appendix A

Analytical Laboratory's Quality Assurance Program Manual

Appendix B

Field Log

Appendix C

Chain-of-Custody Form

Appendix F

San Diego Debris Special Study Work Plan

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San Diego Bay Debris Special Study
Work Plan

Prepared by:
San Diego Bay Debris Study Workgroup

Prepared for:
Surface Water Ambient Monitoring Program of the State Water Resources Control Board
and
Southern California Bight 2013 Regional Marine Monitoring Survey
Bight ’13 Debris Planning Committee

October 2014

SWAMP
Surface Water Ambient Monitoring Program

Unified Port of San Diego

SAN DIEGO COASTKEEPER

Ocean Discovery Institute
Young Lives Transformed Through Science

Sea Grant California

Water Boards

CITY OF CHULA VISTA

IMPERIAL BEACH
classic southern california

THE CITY OF SAN DIEGO • STATE OF CALIFORNIA
SEMPER VIGILANS

NAVFAC
Naval Facilities Engineering Command

SURFRIDER FOUNDATION
SAN DIEGO COUNTY CHAPTER

SCCWRP
Established 1969

WILDCOAST
COSTASALVAJE

SAN DIEGO PORT TENANTS ASSOCIATION

amec

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ACRONYMS AND ABBREVIATIONS

AMRI	Algalita Marine Research Institute
Bay Debris Study	San Diego Bay Debris Study
Bight Program	Southern California Bight Regional Monitoring Program
C-CAP	Coastal Change Analysis Program
CEDEN	California Environmental Data Exchange Network
CIA	Bight Contaminant Impacts Assessment Group
cm	centimeter
COC	Chain of Custody
GPS	Global Positioning System
m	meter
mm	millimeter
MS4	Municipal Separate Storm Sewer System
NAVFAC	United States Naval Facilities Engineering Command
NHD Plus	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
RHMP	Regional Harbor Monitoring Program
RTA	rapid trash assessment
RWQCB	Regional Water Quality Control Boards
SCCWRP	Southern California Coastal Water Research Project
SDTP	Standard Data Transfer Protocol
SMC	Stormwater Monitoring Coalition
SOP	Standard Operating Procedure
SWAMP	Surface Water Ambient Monitoring Program
SWHB	San Diego Bay Shallow Water Habitat Bioaccumulation Study
QA/QC	Quality Assurance/Quality Control

1.0 INTRODUCTION

1.1 San Diego Bay Debris Special Study

In Southern California, and particularly the San Diego County coastline, the coastal wetlands and bays are an important intermediary waterbody between the upland watersheds and the downstream marine environment. As a primary linkage between rivers and the marine environment, coastal embayments may be a key sink of land-based debris and the types of land-based debris that are the most influential on conditions in the bay and eventually the marine environment are not well understood. Because of the extended residence time and exposure to the environment, coastal wetlands and bays can have the potential to increase the retention of debris and facilitate the breakdown of materials into smaller and potentially more detrimental pieces of plastic that can have diverse impacts on wildlife including bird and fish communities (Andrady, 2011). At the focus of this study, San Diego Bay, shown in Figure 1-1, is a large coastal embayment that rests between the upland watersheds in the greater San Diego area and the coastal waters off of southern California.

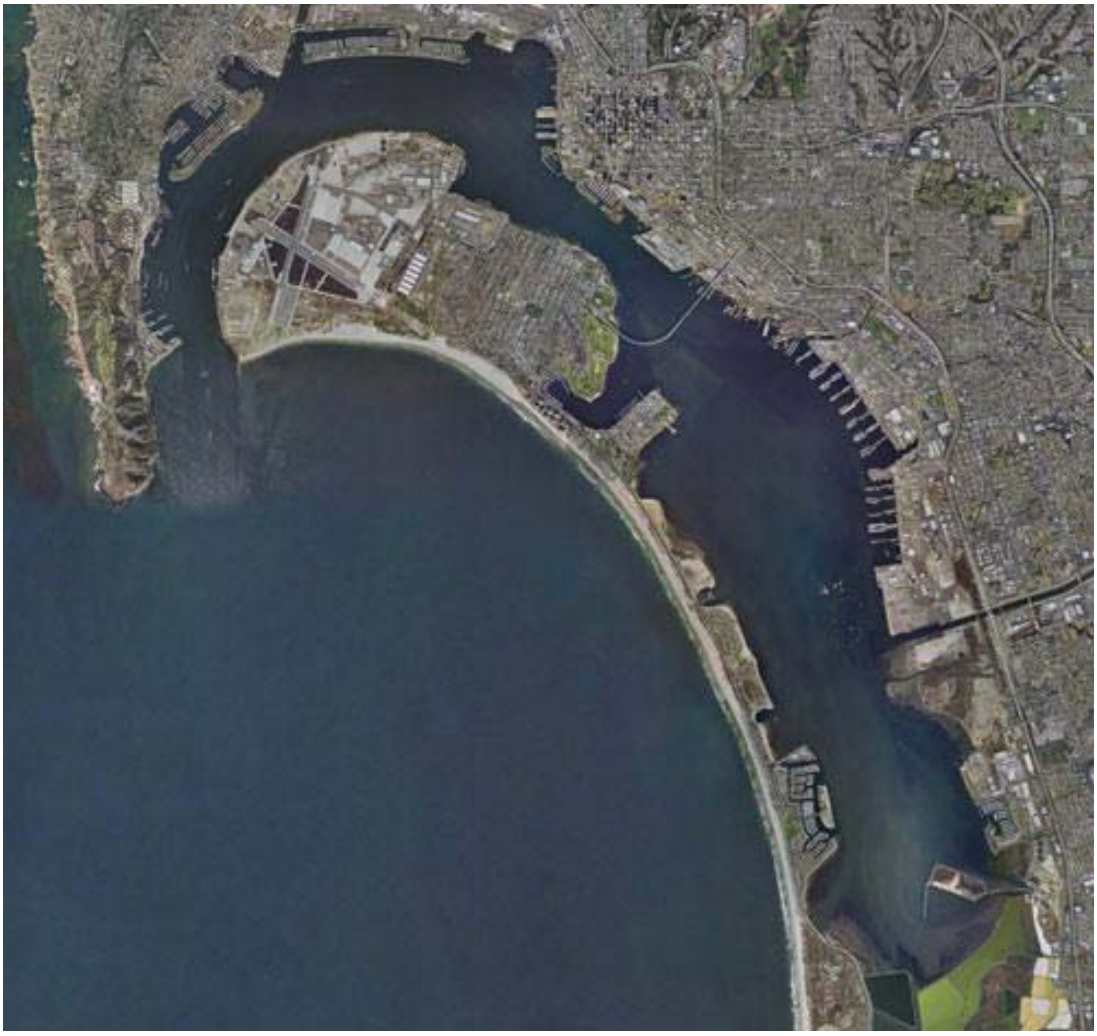

Figure 1-1. San Diego Bay

To better understand the distribution of debris amongst various bay habitats, the San Diego Bay Debris Study (Bay Debris Study) is being developed as a special study to understand the types and quantities of debris in a coastal embayment. Because plastics generally represent the largest proportion of land-based debris, the Bay Debris Study focuses only on plastic based items. The terms debris, plastic debris, and plastics may be used interchangeably in this Work Plan and intended to be synonymous to the Bay Debris Study's focus on plastics.

1.2 Geographic Setting

The San Diego Bay Watershed, shown in Figure 1-2, encompasses a 415 square mile area that extends more than 50 miles to the east - all the way to the Laguna Mountains. The watershed land area lies north of the border with Mexico and south of Mission Bay just to the north of San Diego Bay. The watershed is comprised of three smaller watersheds: Pueblo San Diego, Sweetwater, and Otay. The major water courses feeding San Diego Bay include the Sweetwater River, Otay River, Chollas Creek, Paleta Creek, Paradise Creek, and Switzer Creek.

The San Diego Bay watershed transects all or portions of seven cities including San Diego, National City, Chula Vista, Imperial Beach, Coronado, Lemon Grove, and La Mesa along with unincorporated areas of the County of San Diego, the San Diego County Regional Airport Authority, and the Port of San Diego. Nearly half of the population of San Diego County lives and works in the San Diego Bay Watershed. Most of these people live and work in close proximity to San Diego Bay itself.

San Diego Bay, which is 12 miles (19 km) long and 1 to 3 miles (1.6 to 4.8 km) wide, is the third largest of three large, protected natural bays on California's entire 840 miles (1,350 km) long coastline after San Francisco Bay and Humboldt Bay.

San Diego Bay hosts a wide range of uses including a commercial shipping port, naval base docks and shipyards, a large number of marinas for privately held boats, and numerous docks for the sport and commercial fishing fleets. The southern area of San Diego Bay is held in reserve for the San Diego Bay National Wildlife Refuge and the South Bay Naval Biological Study area. Portions of the south bay are also home to an active salt work.

The bay itself consists of a variety of different ecological habitat types including mudflats, salt marshes, sandy beaches, salt flats, freshwater and river mouth habitats, and open water areas. Portions of the bay are also protected by a series of man-made protective barriers built out of large granitic type of rocks, commonly referred to as rip-rap.

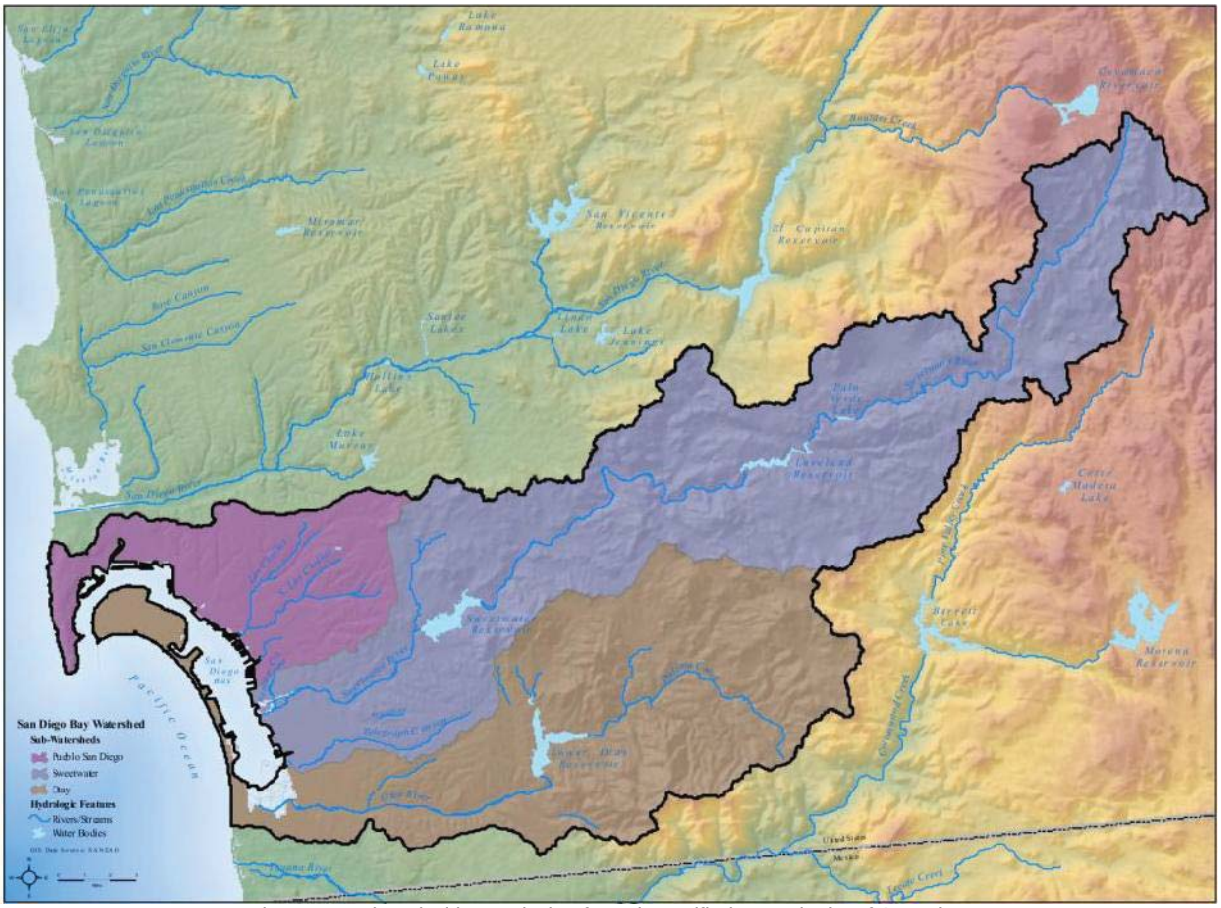

Figure reproduced with permission from the Unified Port District of San Diego.

Figure 1-2. San Diego Bay and the contributing watersheds

1.3 Overall Goals of the San Diego Bay Debris Study

The goal of the Bay Debris Study is to develop a baseline debris assessment of the bay habitats that includes identifying the most abundant type of plastic items, evaluating where the plastic accumulates in greatest quantities, evaluating plastic items that are preferentially transported to the bay during wet weather conditions, and whether the plastics that reach the open waters of the bay affect fish communities. The general approach adopted for the Bay Debris Study follows the question-driven approach of the San Diego Region Framework for Monitoring and Assessment (Busse and Posthumus, 2012).

This study provides one of the first opportunities to generate results that can be used for management decisions to target efforts towards controlling trash, specifically plastic based items. As one of the first comprehensive debris assessments of San Diego Bay and the contributing watershed, shown in Figure 1-2, the Bay Debris Study is intended to help managers understand the types of plastics that may be the most prevalent in the various habitats. Similarly, measuring the types of debris that are present during dry weather and preferentially transported to the bay during wet weather, or plastics found most often ingested by fish provides the opportunity to better target management decisions at the most important types of plastics.

The San Diego Bay Debris Study also provides an example of a coastal embayment debris study that might help managers to deal with debris in coastal estuaries in general.

2.0 BACKGROUND

2.1 Marine Debris

Marine debris has become one of the most recognized pollution problems in the world's oceans and watersheds today (Lippiatt et al. 2013). About 80 percent of debris found in marine environments is generated from land-based sources (Sheavly, 2010) suggesting that the reduction of watershed based debris sources is an important management action for reducing marine debris. Of the debris found in watersheds, studies generally show that about 60 percent of the debris is composed of plastic based items which are the primary and generally most abundant type of material found in marine debris (Thompson et al., 2009). Debris in the environment also represents a substantial financial burden to cities and public agencies responsible for managing debris. It is estimated that the West Coast cities of the United States spend on average $500 million per year to remove trash from streets and neighborhoods in an effort to prevent it from reaching coastal water bodies (Stickel et al., 2012). The perpetual clean up that is required to prevent debris from entering the environment and the ongoing costs to the public suggests that debris represents an environmental issue of high priority for land and public agency managers.

Debris can cause adverse impacts on aquatic and terrestrial wildlife, can affect human health and reduce the aesthetics of freshwater and coastal environments. Debris that enters the environment has the potential to become ingested by animals such as fish and birds or create entanglement problems for sea life (Boergner et al., 2010; Ryan, 1989; Azzarello et al., 1987). Persistent plastic pieces which form the predominate type of marine debris found in the ocean and type of material ingested by animals, can also function as a transport mechanism for persistent organic pollutants such as flame retardants, chlorinated organic compounds such as DDT, and chemicals created as by-products of petroleum combustion and industrial processes (Rios, 2007; Rios, 2010; Teuten et al., 2009; Engler 2012).

2.2 Bight '13 Debris Study

The Southern California Bight Regional Monitoring Program (Bight Program) is a large scale multi-stakeholder monitoring program consisting of more than 60 organizations focused on assessing emerging or priority environmental concerns across the coastal area of the Southern California Bight. The Bight Program surveys which are conducted once every five years between Point Conception and the US-Mexico Border focus on assessing issues of common concern amongst the stakeholders.

The Bight surveys provide a mechanism to develop standardized methods, quality assurance protocols, and data transfer standards agreeable to all participants. This process ensures that all data collected during the survey can be integrated and provides the foundation for enhanced coordination among southern California's monitoring programs. The surveys have also provided a forum for multi-party agreement about ways to analyze and interpret monitoring data.

A key advantage of the Bight Program is the opportunity to leverage ongoing programs and studies to expand the sampling efforts for the Bight surveys. The San Diego Bay Regional Harbor Monitoring Program (RHMP) and Shallow Water Habitat Bioaccumulation Study (SWHB) are examples of two studies focused on specific water quality issues, but through the cooperative interaction with the Bight Program, integrated a Bight survey approach into their own program and as a result have contributed information towards an understanding a debris issues in San Diego Bay.

"Core" components of Bight surveys include offshore water quality, coastal ecology, focusing on sediment quality, and shoreline microbiology. Previous Bight Program studies (1994, 1998, 2003, and 2008) have evaluated debris in the marine environment, but never highlighted marine debris a primary focus of the Bight Regional Monitoring Program. In 2013, the Bight Program started the first ever comprehensive marine debris survey. The objective for the (Bight '13) Debris Study was to characterize the extent and magnitude of debris in the Southern California Bight and its coastal watersheds. The main monitoring questions for the Bight '13 Debris Study were:

1. What are the quantities and types of debris in marine and estuarine sediments and epibenthos?
2. What is the prevalence of debris in the nearshore demersal and pelagic fish?
3. What are the quantities and types of debris in riverine channels?

The Bight '13 Debris Study focused on evaluating the types and quantities in benthic, epibenthic, and riverine habitats including an analysis of plastic ingestion in near shore demersal and pelagic fish. The coastal wetlands and bays, however, were not studied extensively for the Bight '13 debris study.

The marine environment and the coastal watersheds which were the focus of the Bight '13 debris study represents an important starting point for evaluating the linkages between watershed sources and marine debris. The bay includes several different intertidal habitats that are expected to respond to seasonal changes in debris conditions from storm event flows and these habitats represent a data gap in the Bight '13 Debris Study.

The San Diego Bay Debris Study presented in this Work Plan follows some of the approaches developed in the Bight Debris Study and expands the habitats surveyed for Bight by including a coastal embayment.

3.0 PROJECT MANAGEMENT RESPONSIBILITIES

3.1 Overview of San Diego Bay Debris Study Workgroup

The San Diego Bay Debris Study Workgroup is a multi-agency coalition of stakeholders with an interest in developing a better understanding of debris conditions in San Diego Bay. The members of the workgroup include staff from local and state government agencies, regional and joint power authorities, non-profit organizations, and the University of California. Members of the workgroup are providing support to the study through voluntary contributions of in-kind services, directed funding of various study elements, or sharing of resources from existing programs or projects of similar scope and interest.

3.2 Key Project Personnel

The Bay Debris Study workgroup consists of members from the Surface Water Ambient Monitoring Program (SWAMP) of the California State Water Resources Control Board, San Diego Region Water Quality Control Board, Unified Port District of San Diego, City of Chula Vista, City of Imperial Beach, United States Naval Facilities Engineering Command (NAVFAC), San Diego Coastkeeper, Ocean Discovery Institute, California Sea Grant, Wildcoast, Surfrider Foundation San Diego Chapter, members of the San Diego Bay Port Tenants Association, Southern California Coastal Waters Research Project, and AMEC Environment & Infrastructure.

Additional agencies are contributing to the Bay Debris Study through sharing of resources from current and ongoing projects. The City of San Diego's contribution to the Regional Harbor Monitoring Program and Shallow Water Habitat Bioaccumulation Study are providing important data to the study that will help to provide a better understanding of debris issues in San Diego Bay.

The Work Group also includes third party subject experts for reviewing project documentation, data analyses performed, and the associated reporting. The third party reviewers have key role in assessing the overall conclusions based on the data collected.

A list of the key project personnel included project titles and contributions to the Bay Debris Study are provided in Table 3-1.

Table 3-1. Key Project Personnel

Organization	Name	Bay Debris Study Title	Contribution
SWAMP	Lilian Busse	Lead Agency Program Manager	Principle-In-Charge
Port of San Diego	Philip Gibbons	Agency Project Manager	RHMP, Rip-Rap Habitat Surveys, SD Bay Port Tenants Association Liaison
RWQCB	Chad Loflen	Agency Project Manager	Water Column Trawls, SWHB Liaison
NAVFAC	Christiana Boerger	Agency Project Manager	Project Scientist, Plastic Ingestion Study
City of Chula Vista	Marisa Soriano	Agency Project Manager	Data Management, Sweetwater and Otay River Surveys
City of Imperial Beach	Wbaldo Arellano	Agency Project Manager	Otay River Surveys
SCCWRP	Shelly Moore	Agency Project Manager	Bight '13 Debris Study Lead Scientist
San Diego Coastkeeper	Travis Pritchard	Agency Project Manager	Intertidal Habitat Surveys
San Diego Coastkeeper	Kristin Kuhn	Volunteer Coordinator	Intertidal Habitat Surveys
Ocean Discovery Institute	Lindsey Goodwin	Chollas Creek Outreach Coordinator	Chollas Creek Surveys Program Coordinator
California Sea Grant	Theresa Talley	Chollas Creek Outreach Coordinator	Project Scientist, Wet Weather Tracking Study
WildCoast	John Holder	Volunteer Coordinator	Otay River Surveys
Surfrider Foundation	Haley Haggerstone	Volunteer Coordinator	Field and Lab Team Support
AMEC Environment & Infrastructure	Theodore Von Bitner	Project Manager	Project Coordination
AMEC Environment & Infrastructure	Terra Miller-Cassman	Project Support Staff	Quality Assurance Administrator
AMEC Environment & Infrastructure	Monica Netherly	Project Support Staff	Volunteer Training and Auditor
AMEC Environment & Infrastructure	Michelle Bowman	Project Support Staff	Marinas Property Owner Coordinator
NOAA, Marine Debris Program	Dr. Sherry Lippiatt	Third Party Reviewer	Technical Review
Independent Consultant	Dr. Brock Bernstein	Third Party Reviewer	Project Documentation Review

4.0 SURVEY DESIGN

4.1 Study Goal

The overall goal of this study is to characterize the extent and magnitude of debris in San Diego Bay amongst the various habitats and evaluate the potential ecological impact of plastic on fish communities in the bay. Within this study, three core questions have been developed to answer the study goals:

1) *How do the quantities and types of debris in different habitats vary during dry and wet season?*
   a) *What are the quantities and types of debris found in San Diego Bay habitats?*
   b) *What are the quantities and types of debris found in watersheds flowing to San Diego Bay?*
   c) *How do the quantities and types of trash in different San Diego Bay habitats vary by summer and winter dry season?*
   d) *What are the quantities and types of trash in San Diego Bay following the first storms of the wet weather season?*
2) *What types of riverine debris do wet weather flows transport to the bay?*[1]
3) *What species caught in the bay has ingested plastic pieces?*[1]

The first question seeks to evaluate the differences in the abundance and types of debris found in bay bottom sediments (benthic and epibenthic habitats), water column (open water habitats), estuarine (salt marsh habitats), beaches and mudflats (intertidal habitats), and upland areas (riverine habitats). The approach to answering this question leverages efforts conducted through RHMP study of benthic ecology, Bight Debris Study Riverine Habitat Surveys, and the San Diego Bay Shallow Water Habitat Bioaccumulation Study[2]. In addition to the existing collected data, additional sites in bay habitats will be surveyed in dry weather to establish a baseline comparison of the types and quantities across each of the habitat types. The habitats surveyed for the first question also include a focus on key areas expected to accumulate larger amounts of debris including the wrack line throughout the salt marsh and along the rip-rap shoreline protective barrier. A subset of the bay habitats will also be evaluated after the first major storm events of the 2014-2015 storm season in order to evaluate seasonal changes in debris types and quantities.

[1] Data needed to answer question 2and 3 will be leveraged from existing efforts to extent possible. The data that may be needed is dependent on the availability of funding or in-kind services contributed by project partners and completion of the Bay Debris Study is not contingent upon the completion of Questions 2 and 3.

[2] The RHMP and Bight '13 programs sampled for analysis of bioaccumulative compounds in sediments, invertebrates, fish, plankton, and bird eggs, which represent a primary on-going contaminant source of concern, and a wide range of trophic levels in the food chain. However, all of the sampling in San Diego Bay was focused on areas deeper than 3 meters in compliance with the Bight'13 protocols and station draw. An assessment of bioaccumulative compounds in the more heavily wildlife-utilized and productive shallow water habitats is an important recognized data gap. The initial concept for studying the trophic transfer of bioaccumulative compounds was developed for the Bight '13 program by a collaborative group comprising the City of San Diego, Port of San Diego, Southern California Coastal Water Research Project (SCCWRP), San Diego State University (SDSU), United States Fish and Wildlife (USFW), and the San Diego Regional Water Quality Control Board (SDRWQCB).

The second question focuses on evaluating the types and quantities of debris in riverine habitats that are transported to the bay during storm events. The differences or similarities in the composition of plastics in upland riverine habitats and those that occur in the bay are not fully understood. The second question focuses on better understanding which types of debris are more likely to be transported to the bay during storm events. Based on results of the riverine habitat debris surveys, a subset of the most prevalent types of plastics found will be tagged in place and tracked to the bay following a storm event by using multiple tracking methodologies. These results are intended to help better understand the types of plastics from land based sources that can be transported to the bay in comparison to the plastics that are less mobile and may be entangled on vegetation or structures in the riverine habitats.

The third question seeks to assess demersal and pelagic fish communities in the bay by quantifying the abundance and types of debris ingested. Demersal and pelagic fish collected from the RHMP and SWHB trawls and pelagic fish collected during bay trawls as part of this study will be analyzed.

4.2 Quantities and Types of Plastic Debris in San Diego Bay

4.2.1 Study Approach

To complete this baseline assessment, the Bay Debris Study has been designed with the intention of integrating existing datasets with new monitoring information from additional habitats to develop a more complete understanding of the types, quantities, and locations of debris within San Diego Bay. The data generated for the Bay Debris Study will be leveraged through coordination of ongoing projects, in-kind services, or project-directed contributions from stakeholders. In order to take full advantage of available resources, data collected for the Bight ‘13 Debris Study within San Diego Bay and its associated watersheds, including sediment, epibenthos, riverine samples, and fish gut data will be leveraged with this study dataset to the extent feasible.

This Work Plan provides details on the habitats that will be surveyed, the field and laboratory methods used to generate debris data, and the laboratory methods needed for analyzing ingested plastics in fish guts. Supporting documents to the Work Plan include field and laboratory forms, proposed sampling location lists, and Standard Operating Procedures. In addition, the detailed descriptions of the field methods, laboratory methods, and quality assurance plans that accompany the data generated for the RHMP survey of San Diego Bay (Port of San Diego, 2013) and the Bight ’13 Debris Study are available on-line at the Southern California Coastal Water Research Project (sccwrp.org) website.

4.2.2 Target Population, Sample Frame Development, and Site Selections

The target population for the Bay Debris Study includes all bay or bay-influenced habitats, including high tide zones as well as upland riverine areas. The sample frame will include three habitats studied in previous RHMP, SMC, and Bight surveys and six new habitats, for a total of nine habitats assessed during this study. Within these nine habitats, the goal is to collect a target sample size of thirty sites from each habitat in order to develop statistically based

estimates of the debris quantities. The targeted habitats for the Bay Debris Study are listed in Table 3-1.

Table 4-1. Targeted Habitats for Bay Debris Study

Category	Targeted Habitat	Data Source
Bay	Benthic	RHMP and SWHB
	Water Column	RHMP and SWHB
Structures-Facilities	Marinas	This Study
Intertidal	Mudflats	This Study
	Sandy Beaches	This Study
	Salt Marsh	This Study
	Salt Marsh, Wrackline	This Study
	Protective Barriers (Rip-Rap)	This Study
Upland	Riverine	SMC and Bight '13

This study component is being leveraged over resources in place through the RHMP 2013 survey, SMC 2013 Regional Monitoring Program, Bight '13 Debris Study, and San Diego Bay Shallow Water Habitat Study to take advantage of the target population, sample frame, and sites selected by the previous studies. Sites within habitats will be randomly selected to provide an unbiased among sampled sites and allow for inference into bay-wide conditions. For habitats not previously sampled, a systematic component will be used in the site selection to target habitats of interest following approaches adopted for the Bight Regional Monitoring Program. Briefly, a grid system will be placed over a map of the targeted habitat and a subsample of the grid will be randomly chosen from this population, and a debris survey will be conducted at the selected site within the grid cell. The grid structure allows for a systematic approach to sample targeted habitats while the random sites selection of sites within the grid ensures an unbiased estimate of ecological condition.

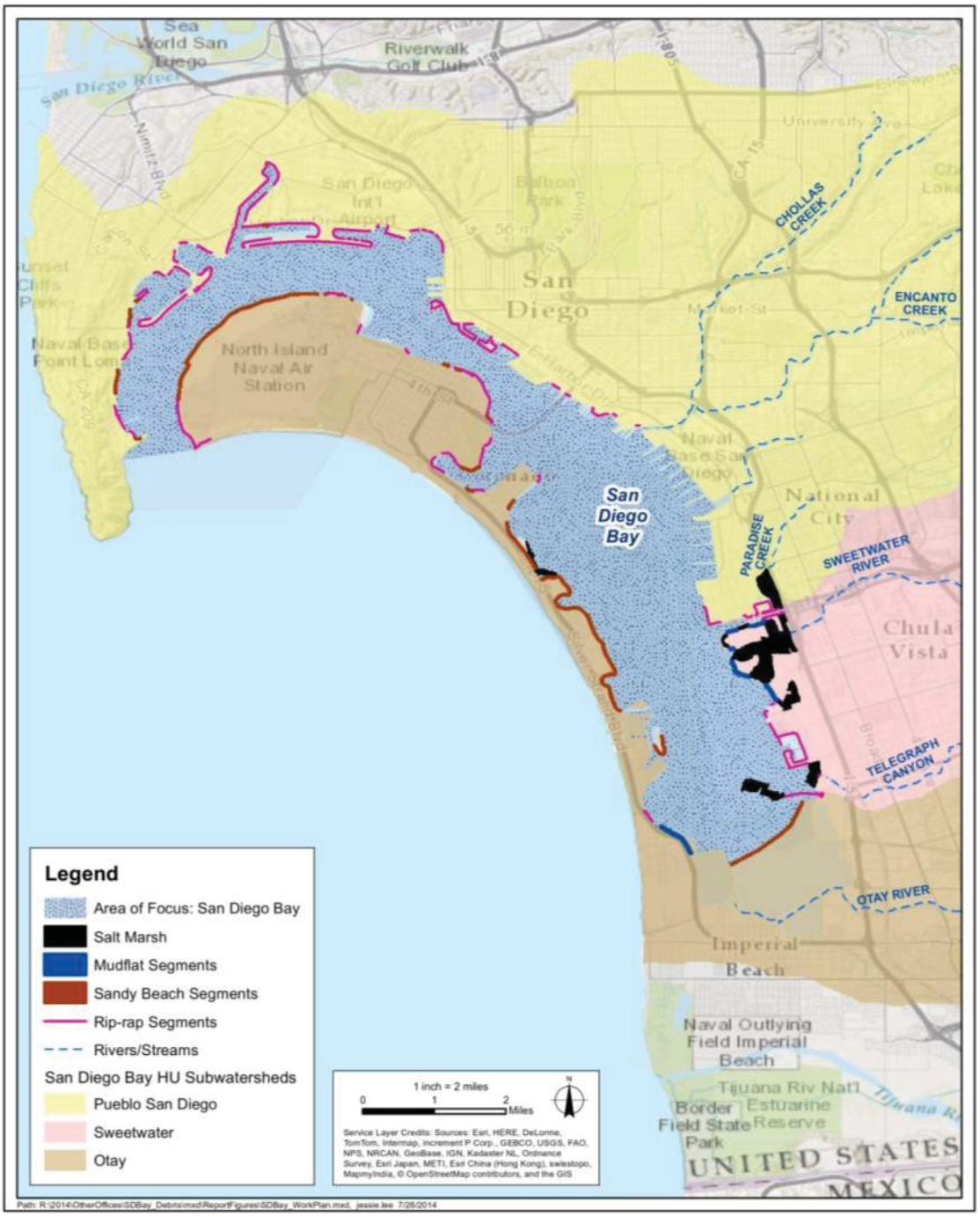

Figure 4-1. San Diego Bay Habitats for Debris Surveys

4.3 Study Schedule

The Bay Debris Study is anticipated to be a multi-year project beginning in the winter of 2014 and continuing until the spring of 2016. The timeline for completing the major elements of the study during the approximately two-year time period are shown below in Table 4-2.

Table 4-2 Bay Debris Study Proposed Schedule

Activity	Schedule	Study Element
Develop Study Design	February 2014 – June 2014	Work Plan
Prepare Work Plan and SOPs	June 2014 – August 2014	Work Plan and Data Quality Assurance
Field training and intercalibration	August 2014 – September 2014	Training and Data Quality Assurance
1st dry weather surveys, all habitats	August 2014 – October 2014	Early Season Dry Weather Condition
Wet weather tracking study	October 2014 – December 2014	Wet Weather Conditions
Post-storm trawls[1]	October 2014 – December 2014	Wet Weather Conditions
2nd dry weather trawl[2]	January 2015 – March 2015	Late Season Dry Weather Conditions
2nd dry weather surveys[2,3]	January 2015 – March 2015	Late Season Dry Weather Conditions
Marina passive samplers	September 2014 – March 2015	Early to Late Season Dry Weather Conditions
Fish gut dissections	December 2014 – May 2015	Plastic ingestion
Draft Report	December 2015	Data Analysis and Reporting
Final Report	March 2016	Reporting

Notes:
1) Post-storm surveys will be dependent on the weather and timing between early season storm events.
2) Surveys will target non-storm event dry weather conditions following an antecedent period of 14-28 days
3) Surveys will not be started until the Post-Storm Surveys are complete, does not include water column trawls.

4.4 Summary of Plastics Data from Recent Debris Surveys

The Bay Debris Study will include plastics data from surveys conducted in San Diego Bay and the contributing watershed during 2013 and 2014. The additional data is needed to develop a more complete understanding of the types and quantities of plastic throughout the bay and the information from the recent surveys helps to fill the data gaps. A summary of the monitoring programs that collected the plastics data, the habitats or studies in which the debris surveys were conducted, the plastics size ranges collected, and whether the habitats will be re-sampled for the Bay Debris Study are listed in Table 4-3.

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Table 4-3. Recent Debris Surveys for Plastics Data Included in the Bay Debris Study

Program	Monitoring Year	Habitat or Study	Debris Size(s)	Number Samples	Resample Station Location for Bay Debris Study?	Bay Debris Study Question
RHMP Benthic Ecology	2013	Benthic	Micro-, Meso-, Macro-	50	NO	1
RHMP Benthic Ecology	2013	Epibenthic	Meso-, Macro-	10	NO	1
San Diego Bay Shallow Water Habitat Bioaccumulation Study	2014	Benthic	Micro-, Meso-, Macro-	30	NO	1
San Diego Bay Shallow Water Habitat Bioaccumulation Study	2014	Epibenthic	Micro-, Meso-, Macro-	9	NO	1
Bight '13 Debris Study Riverine Habitat Surveys*	2013	Riverine	Meso-, Macro-	2	YES	1
Stormwater Monitoring Coalition (SMC) Regional Stream Trash Assessment *	2013	Riverine	Meso-, Macro-	7	YES	1
RHMP Water Column Surveys	2013	Demersal and Pelagic Fish Gut Content	Micro-	TBD	NO	3
San Diego Bay Shallow Water Habitat Bioaccumulation Study	2014	Demersal and Pelagic Fish Gut Content	Micro-	TBD	NO	3

Note: (TBD) Samples collected are currently being analyzed and the final counts of samples passing acceptability criteria have not been finalized at the time this work plan was prepared.

5.0 SAMPLING AND ANALYSIS METHODS

This section describes the field and laboratory methods associated with the data collection. The field and laboratory methodologies performed in concert with the Bight '13 Debris Study have been included in this section to provide details on the sampling and analysis approach used to collect the data that will be included in this study. Samples collected for the RHMP and San Diego Bay Shallow Water Habitat Bioaccumulation Study followed Bight '13 site selection and field methods. For additional details on the Bight '13 methods detailed information is available in the Bight '13 Field Methods Manual and Bight '13 Benthic Manual (Bight '13 Benthic Committee, 2013; Bight '13 Field Sampling & Logistics Committee, 2013).

The summary of sampling and analysis methods detailed in Section 5.0 for the habitats that will be surveyed for plastic are as follows:

5.1 Quantities and Types of Plastic Debris in the Bay Habitats
- 5.1.1 Benthic (Grabs)
- 5.1.2 Epibenthic (Trawls)
- 5.1.3 Water Column (Trawls)
- 5.1.4 Continuous Debris Collection by Trash Skimmers in Marinas

5.2 Quantities and Types of Plastic Debris in Intertidal Habitats
- 5.2.1 Mudflats, Salt Marsh (emergent vegetation), Sandy Beaches
- 5.2.2 Wrackline, Rip-Rap

5.3 Quantities and Types of Plastic Debris in Upland Habitats
- 5.3.1 Riverine

5.4 Wet Weather Debris Tracking from Riverine to Bay Habitats

5.5 Prevalence of Plastic Debris in Demersal and Pelagic Fish Gut Analysis

Sites selected for the targeted habitats in sections 5.1 to 5.3 are listed in Appendix A.

Plastic items collected for the Bay Debris Study will sorted and quantified according to size categories referenced in the NOAA Marine Debris Shoreline Survey protocols. The classification and size ranges that will be analyzed for this study are provided in Table 5-1. Section 7.0 provide details on the quality assurance and quality control procedures that will be incorporated into the data collection process for all habitats surveyed as part of the Bay Debris Study.

Table 5-1. Debris classification and size ranges to be analyzed

Category	Size (mm)
Macrodebris	> 25 cm
Mesodebris	5 mm - 25 cm
Microdebris	4.75 mm
	2.00 mm
	1.00 mm
	0.710 mm
	0.500 mm
	0.355 mm

The sampling and analysis methods described in detail in Section 5.0 are summarized in Table 5-2.

Table 5-2. Summary of sampling and analysis methods in the study habitats according to size of plastic items collected.

Habitat or Study Focus*	Method	Plastic Sizes		
Water Column	Bight '13 Trawl, Boerger 2010	Macrodebris	Mesodebris	Microdebris
Rip-Rap	NOAA Shoreline Survey	Macrodebris	Mesodebris	---
Wrackline	NOAA Shoreline Survey	Macrodebris	Mesodebris	---
Mudflat	NOAA Shoreline Survey	Macrodebris	Mesodebris	---
Salt Marsh	NOAA Shoreline Survey	Macrodebris	Mesodebris	---
Sandy Beach	NOAA Shoreline Survey	Macrodebris	Mesodebris	Microdebris
Riverine	Bight '13 Debris	Macrodebris	Mesodebris	---
Marina Skimmers	This Study	Macrodebris	Mesodebris	Microdebris
Wet Weather Tracking	This Study	Macrodebris	---	---
Fish Gut	Bight '13 Trawl, Boerger 2010	---	---	Microdebris

Note: In conjunction with the US Fish & Wildlife Service, microdebris will not be collected from the salt marsh or mudflat habitats to avoid impacts to important habitats. Similarly, collection of microdebris in these habitats requires the removal of the top 3 cm of high silt content soil and vegetation that would be prohibitive to process on a time and materials basis. Microdebris in rip-rap and riverine habitats will not be collected due to the challenges of working around large rocks and in areas of high gravel content that would be logistically infeasible to sieve.

5.1 Quantities and Types of Plastic Debris in the Bay and Marinas Habitats

Sections 4.1.1 and 4.1.2 provide details on the methods that used to previously collect debris data that will be included in this study. Sections 5.1.3 and 5.1.4 provide details on the method that will be adopted to collect new data for this study. Benthic (Grabs)

The main purpose of benthic sampling is to obtain data on the amounts and types of plastic found in the sediment. Benthic sample collections were conducted in collaboration with the RHMP 2013 survey and San Diego Bay Shallow Water Habitat Bioaccumulation Study following sample collection methods described in the Bight '13 Field Operations Manual.

Field Sampling Methods

A 0.1 m^2 modified Van Veen grab was used to collect sediment samples for physical, chemical, and infaunal analyses (Stubbs et al. 1987). The grab used for infaunal analysis was also used for macroplastic analysis. Grab acceptance criteria were the same as that for infaunal grabs, and were based on two characteristics of the sample: sample condition and depth of penetration. Sample condition was judged using criteria for surface disturbance, leakage, canting and washing (Bight '13 Field Sampling & Logistics Committee, 2013). Sediment penetration depth must have been at least 5 cm; however, penetration depths of 7-10 cm should have been obtained in silt.

Once the sample was found acceptable, any larger plastic items (or items of questionable material) found on top or within (caught in jaws or found inside the grab) the sample were retained and placed in a bag labeled with the sampling date, station and collecting agency (Bight '13 Field Sampling & Logistics Committee, 2013). The sample itself was processed in the field by washing the sediment from the grab and sending it and the wash through a 1.0-mm screen. Once the sample was washed through the screen, the material left was transferred to a labeled sample container. Samples were then returned to the lab for further analysis. Chain of Custody (COC) forms were used to track all samples from the field to the sorting lab for final debris analysis.

Laboratory Analysis Methods

Upon receiving samples at the lab, the samples was washed and transferred to a clean container. Samples were then sorted into broad debris categories for subsequent analysis. All plastic or questionable plastic items were placed in labeled vials with water, ethanol, or left dry (whatever is easiest for the sorting lab). If more than one vial was filled, then the vials were labeled as such, e.g. vial 1 of 2 or 2 of 2. All debris that has been sorted was sent to SCCWRP for delivery to Algalita Marine Research Institute (AMRI) or delivered directly to AMRI for final analysis.

The sorting labs also performed Quality Assurance/Quality Control (QA/QC) for plastic debris. Samples that underwent QA/QC were resorted and debris items that were missed from the original samples during the initial sort were placed in a vial and sent to AMRI for analysis. Error rates were computed and included in the final data analysis.

Final analysis of the debris samples included counting, typing (e.g. fragment, line, film, foam or pellet), categorizing by size (e.g. 1.00 mm - 4.99 mm, >5.00mm), volume, and if resources available, determined the polymer type using the Andrady method[3] (see Appendix D).

5.1.1 Epibenthic (Trawls)

Epibenthic or trawl marine debris sample collections were done in collaboration with the RHMP group and San Diego Bay Shallow Water Habitat Study. Sample collection methods in the field followed the Bight '13 Field Operations Manual, and sample collections occurred during the spring-summer of 2013 and 2014. The main purpose of the trawl survey was to obtain data on localized community structure of fish and invertebrate assemblages; however, the collection of these samples served a dual role in providing a more thorough characterization of the amounts and types of debris found on the bottom of the bay.

Field Sampling Methods

The field sampling methods for trawls (Appendix B) were conducted using a semi-balloon otter trawl with a 7.6-m head rope (25 ft), 8.8-m footrope (29 ft), 3.8-cm (1.5 in) body mesh, and a 1.3-cm cod-end mesh (0.5 in). Trawls were towed along isobaths at a speed-over-ground of 1.0 m/sec (or 1.5 to 2.0 knot) for 10 minutes. At the end of the prescribed trawl time, the net was retrieved and brought onboard the vessel. Any debris caught on the cable was noted, but not included in the talley. The cod-end was then opened and the catch deposited into a tub or holding tank. The criteria used to evaluate the success of any trawl included making sure that proper depth, scope, speed, and distance (or duration) were maintained, whether the net was fouled (net tangled), and whether the catch shows evidence that it was on the bottom (*e.g.*, rocks, benthic invertebrates, benthic fish). The trawl catch were sorted on deck into containers.

Trawl debris were sorted into containers for processing. Debris collected during any trawl was quantified by recording the specific types of material and their quantities on the Bight '13 Trawl Debris Form (Appendix C). This form was developed based on the same form used by the Stormwater Monitoring Coalition (SMC) for collecting debris information for land-based sources. Items within the debris categories are specific and included those commonly found by the RHMP and San Diego Bay Shallow Water Habitat 2013 trawls. Types of items within each of these categories were counted and recorded. If an item was not on the list it was placed in the appropriate "Other" category and a comment made to describe the item. In the case of items that could fit into multiple categories, the item was included in the category that the item consisted most of, and included documenting any of the other categories it would fit in the comments field. Additional descriptive information regarding the debris such as brand names was included in the comments section for that type. For debris of marine or terrestrial origin, counts of each were made; however, estimates were acceptable as well. For estimated counts a qualifier was included in the estimate box based on the following categories: L for low abundance (2-10 items); M for Moderate abundance (11-100 items); and H for High abundance (>100 items). In cases where counts were not easily made, a comment explaining the difficulty was suggested. The volume of debris items were recorded to the extent feasible but comments

[3] Application of the Andrady method on a subset of the overall samples from each habitat may be performed but is pending potential funding.

that better described the debris such as estimated size (e.g. the size of a basketball), condition (e.g. decayed kelp frond in pieces), or type/species (e.g. hard plastic, foam, wrapper, etc) are encouraged. After all of the debris has been categorized and counted, all plastic debris will be retained for further analysis. All or a piece (about the size of a quarter) of each plastic item will be placed in a gallon Ziploc bag and returned to be sent to the lab.

5.1.2 Water Column (Trawls)

Surface waters in San Diego Bay will be sampled for plastic debris sizes and sample collections will be performed using manta trawl field methods based on past southern California plastics trawls (Moore et al., 2001; Moore et al., 2002; Boerger et. al., 2010; Lattin et al., 2004), with modifications for consistency with other sampling conducted by Bight '13. Sample collection methods in the field will follow the Bight '13 Field Operations Manual to the extent feasible, and sample collections will occur from summer of 2014 through spring 2015. The main purpose of the trawl survey is to obtain data on amounts and types of debris located floating on or near the water surface in various portions off the bay. Subsequent mid-depth water column trawls may be conducted if resources are available.

The bay will be split into 4 regions (mouth, north, central, south), to account for differences in tidal flows and circulation, habitat types, watershed inputs, and vessel traffic (Largier, 1995; Largier et al., 1997; Komoroske et al., 2012), with trawls conducted at randomly selected fixed transects in each region. Trawls conducted at the mouth of the bay may also be conducted during both flood and ebb tides on the first event to evaluate the effect of tidal exchange process on debris quantities. Additionally, tide direction stratified sampling may be conducted during subsequent events if the results from the first event indicate significant differences in debris quantities as a result of tidal exchange processes. The project target is a total of 10 trawls per time period within each region and 10 trawls at the mouth of the bay over each tide condition

Trawls will occur within 3 time periods: 1) Summer Dry, 2) Winter Wet, and 3) Winter Dry. Summer Dry trawls will occur in the late summer to early fall (September-October) time period when there is limited to no rainfall and storm event flows to the bay from the adjacent watersheds will not complicate the data interpretation. Winter Wet trawls will occur during the rainy season (October – December) immediately following an early season storm event of at least 0.5 inches over a 24 hour duration, or following the first event of the rainy season depending on the storm totals. Winter Dry will occur during the late rainy season (January - March), but will follow a period of at least 14 to 28 days of preceding dry weather.

Field Sampling Methods

Trawl field methods will performed to be consistent with monitoring approaches adopted for the Bight '13 surveys to the extent feasible given that surface trawls samples were not collected during the Bight Program (Appendix B). Trawls will be conducted using an aluminum framed manta trawl with 0.335 mm net mesh and cod-end. The manta trawl net opening is 16 cm in height and 60 cm in width with a 4 meter net. Trawls will be towed along fixed bay transects at roughly 1-3 knots over a distance of 1,000 meters. A flow-meter will be attached to the manta trawl in order to calculate volumetric trawl data. At the end of the prescribed trawl time, the net

is retrieved and brought onboard the vessel. Any debris caught on the cable will be noted, but not included in the final item talley. The net is then rinsed from the outside using site water to move sample into the cod-end. Large items may be manually removed from the net when necessary. The cod-end is then opened and turned inside out and the catch deposited into a tub, holding tank, or pre-cleaned 1 liter glass jar, depending upon sample size. The criteria used to evaluate the success of any trawl includes making sure that proper depth, scope, speed, and distance (or duration) were maintained, whether the net was fouled (net tangled), and whether the catch shows evidence that the opening was fouled in any way (*e.g.*, kelp, large plastic bags, etc).

The catch will be placed directly into pre-cleaned 1 liter glass jars, if possible. If not, large trawl debris will be sorted into appropriate containers for later processing. Debris collected during any trawl should be field quantified by recording the specific types of material observed, including counts where feasible for large items, and other pertinent quantitative and qualitative information on the Trawl Debris Field Form (Appendix C). This form was developed based on the same form used by the SMC for collecting debris information for land-based sources. The major categories are consistent with Bight ’13, though some items have been removed (e.g. glass, metal), and others added to reflect a more detailed analysis of plastics in the upper water column and surface. Items within these categories are specific and include those commonly found by the Bight ’13 Trawl Group in previous surveys (Appendix C). Full plastics typing, counts, and measurements will be done in the San Diego Water Board laboratory. Samples will be placed on ice in the field and immediately frozen upon return to the San Diego Water Board laboratory.

Laboratory Analysis Methods

All samples analyzed in the lab will follow methods utilized for plastic in Southern California (Moore et al., 2001; Moore et al., 2002; Lattin et al., 2004), with minor deviations for archival purposes. Samples will be thawed and sorted by category (plastics, paper, feathers, etc.) prior to filtering and analysis. Large items will be rinsed with DI water in the lab to remove smaller debris that is adhered to the surface. A dissecting scope will then be used to remove and sort remaining debris in categories. Filtering will then be conducted for each category type using six pre-cleaned *Newark* type sieves, sized 4.75, 2.0, 1.0, 0.710, 0.500, and 0.355 mm. Debris for each category will then be counted for each size class prior to further material identification. Volume will also be measured and recorded for each size class.

Types of items within each of the size class categories will be sorted according to color (i.e. white, red, black, etc.) based on previous studies indicating a feeding preference by fish based on the color of plastic microdebris (Boerger, 2010). If an item is not on the list it will be placed in the appropriate “Other” category and a comment made to describe the item. In the case of items that could fit into multiple categories, the item will be included in the category that the item consists most of, and records will document any of the other categories it would fit in the comments field. Notes will include additional descriptive information regarding the debris such as brand names and item color(s) in the comments section for that item. In cases where counts cannot be easily made, estimates will be generated and a qualifier included in the estimate box

based on the following categories: L for low abundance (2-10 items); M for Moderate abundance (11-100 items); and H for High abundance (>100 items).

After all of the debris has been categorized and counted, all plastic debris will be retained and archived at the San Diego Water Board laboratory for future analysis. All or a piece (about the size of a quarter) of each item will be placed in archive.

5.1.3 Continuous Debris Collection by Passive Samplers

Debris movement throughout the bay is governed by tides and wind directions that vary on daily and seasonal time periods. Tracking the movement of debris in the bay on a daily basis for the Bay Debris Study would be challenging in terms of timing with tides, local wind currents, and seasonal inputs. At the same time, collecting samples of debris on a continuous basis over the study period would also be logistically challenging and resource intensive. In order to capture variations in bay debris types and quantities over the time period of this study, this survey design includes the use of passive samplers anchored in four different marinas throughout the bay. The passive samplers, commonly referred to as a trash skimmers, are situated in four locations throughout the bay and provide an opportunity to collect continuous debris data in concert with habitat survey and trawl events. The trash skimmers are situated in areas of the bay that have been previously documented to accumulate trash from tidal processes and daily surface winds (Port of San Diego, 2011).

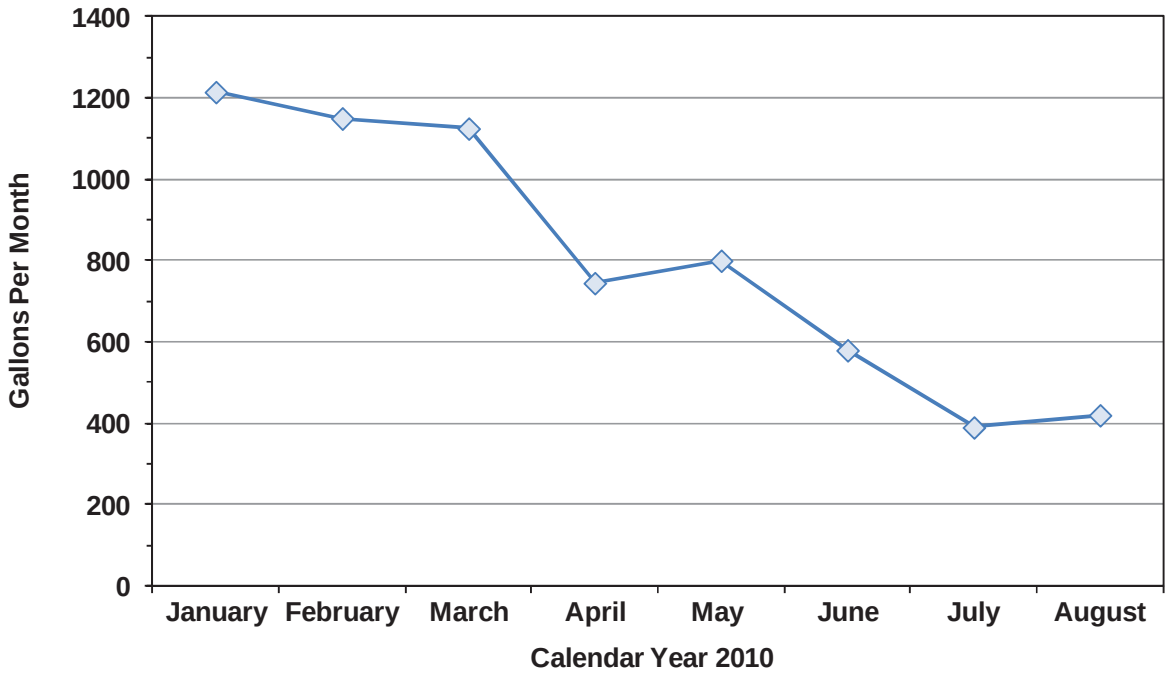
Site Selection

The marinas with trash skimmers currently are:

- Pt. Loma Marina: Owned by America's Cup Harbor located along the east end of the main dock. This skimmer location is an area of debris collection located below a high traffic area and is also routinely exposed to prevailing winds transporting debris directly into the area.
- Half Moon Marina: Owned by Humphrey's in Shelter Island located on the east end of the Shelter Island Basin. Humphrey's By the Bay concert venue overlooks the site and is a prime location for debris collection.
- Harbor Island West Marina: Located in Harbor Island located along a channel leading to a low flush area of the Harbor Island Basin. Debris must pass through this region during high tide and again as the tide retreats.
- Pier 32 Marina: Located in Chula Vista along the Sweetwater River outlet to the bay. The skimmer has been placed in a section of the marina that has been previously documented to have low tidal exchange characteristics.

The inclusion of the passive samplers for this project is based on a published report which suggested that the presence of trash skimmers in the marinas can have a notice positive impact on improving water quality through the continuous removal of large and floating debris. Plastics data collected from a trash skimmers located in Half Moon Bay Marina is shown in Figure 5-1 to

provide an example of the type of information that can be obtained using passive samplers in this study.



Note: Data reproduced with permission from the Unified Port District of San Diego.

Figure 5-1. Debris Volumes from San Diego Bay Marina Trash Skimmer Study (Port of San Diego, 2011)

Field Sampling Methods

The debris collection and quantification methods for this study will follow methods described in the marina trash skimmer study (Port of San Diego, 2011). The sample collection period will occur September 2014 to March 2015 in order to have the continuous data overlap with the dry weather event, post-storm trawl, and winter dry weather trawl events. The four marinas with trash skimmers will keep detailed logs of debris collected by the skimmer on a weekly to monthly basis. Each marina will record volumes of debris and types of debris following the item descriptions in the Intertidal and Riverine Field Forms (Appendix E and F).

Laboratory Analysis Methods

Macro and mesodebris will be sorted by type and counted. Volumes will be recorded for debris in each size class collected during each assessment. Additional information such as brand names will also be noted on data sheets if available. If available, microdebris collected from skimmers will be sieved for size classes of 4.75, 2.0, 1.0, .710, 0.500, and 0.355 mm. After further sorting the microdebris by these size classes, items will be counted to determine the abundance and the volume will be measured for each size class. Item colors will also be counted for microdebris according to the colors of ingested plastic found previously in fish gut trawl samples (Boerger et al., 2010).

5.2 Quantities and Types of Plastic Debris in Intertidal Habitats

Debris deposited in intertidal habitats accumulates from land-based and bay-based sources, and varies according to geographic location, oceanographic and meteorological conditions, and climatic changes (Lippiatt et al., 2013). The goal of this assessment is to obtain information on the types of amounts of debris which accumulate onshore on the mudflats, salt marsh, sandy beaches, rip-rap structures, and along the high tide line (wrackline) throughout the bay. Section 5.2 provides details on the methods used to collect new data that will be included in this study.

Site Selection

Intertidal assessment sites will be randomly chosen from a set of grids placed over the intertidal habitats. As a general guide for the site selection process for the mudflat, salt marsh – emergent vegetation, and sandy beaches, the following criteria suggested by the NOAA Marine Debris Monitoring Program will be used:

- Clear, direct, year-round access[4]
- At least 100 meter (m) length of shoreline
- No regular cleanup activities such as beach grooming

Survey sites within each stratum will be randomly selected to ensure that sites are selected in each stratum and that the quantities of plastic are based on unbiased estimates.

Field Sampling Methods

Debris collection methods will be adapted from the NOAA Marine Debris Monitoring methodology (Lippiatt et. al 2013; Viehman, 2011; Viehman, 2009). The NOAA shoreline technique is designed to be useable by trained community volunteer organizations while simultaneously providing data that can be used to address key management questions. Sampling efforts will focus on collecting detailed information about macrodebris (greater than 25 cm) and mesodebris (5 mm up to 25 cm) in each assessment site. Microdebris (sizes less than 5 mm) will also be collected, but on a limited extent in order to avoid impacts to sensitive estuarine habitats.

Sampling will be conducted during dry weather conditions and conducted within three hours of low tide if possible in order to take advantage of the maximum width of the shoreline section. A subset consisting of no more than 10 percent of the wrackline and rip-rap sites will re-evaluated after 30 days from the date of survey following the next spring tide event in order to assess whether debris re-accumulation occurred as a result of tidal displacement of the remaining plastic along the high tide zone.

Site specific information recorded at each assessment site includes the substrate type, tidal range, and transect width from the low tide water line to the wrackline. Photo documentation

[4] Seasonal restrictions apply from February 15 to September 15 for intertidal areas within the San Diego Bay National Wildlife Refuge. Debris surveys during the winter dry weather season will be performed in coordination with project partner from US Fish and Wildlife Service during time periods that are expected to not interfere with the nesting season for specific bird species.

will record the physical characteristics of the assessment site prior to the survey being conducted to document the aesthetic condition of the site.

5.2.1 Emergent Vegetation, Mudflat, and Sandy Beach Assessments

Transects for the intertidal assessments will be distributed between the wrackline and the low tide line or water's edge. For the purposes of this study, wrackline assessments will be conducted separately in order to obtain a more detailed assessment of the intertidal habitats as shown in Figure 5-2. Intertidal habitat surveys sites in the emergent vegetation, mudflats, and sandy beach will consist of evenly sized 150 m^2 grid cells follows method previously adopted for intertidal debris surveys (Lippiatt et. al 2013, Viehman 2009).

Note: Red dots indicate locations of GPS coordinates. Image not to scale.

Figure 5-2. Example of Survey Transects in Emergent Vegetation and Wrackline Habitats

Within each transect, surveys will be conducted over the entire transect area for macrodebris (sizes greater than 25 cm). Mesodebris (sizes from 25 cm – 5m) and microdebris (sizes less than 5 mm) will be collected using a quadrat approach (Lippiatt et. al 2013).

Quadrat locations for mesodebris in all intertidal habitats and microdebris surveys on sandy beaches will be randomly distributed over each transect following methods previously published (Moore, et. al, 2001). Quadrats will be distributed at 20 percent margins of the transect length, and alternate between left edge, middle, and right edge in order to capture the distribution of debris over the entire transect area. Within quadrats, debris will be counted and recorded within categories and then collected. Items that do not fall under a specific subcategory will be entered into the "Miscellaneous" category on the field sheets (Appendix E). Field crew will provide a written description and photo documentation of these items.

5.2.2 Wrackline and Rip-Rap Assessments

In order to capture the quantity of debris potentially associated with the wrackline or the high tide elevation in the shoreline protective rip-rap barrier as shown in Figure 4, detailed surveys will be conducted using a modified NOAA shoreline assessment approach. Detailed assessments will be conducted along a 30 m transect length of the wrackline or rip rap, running parallel to the water's edge. Transects will be 5 m wide, and will be measured from the highest edge of the wrackline or rip rap towards the water. The debris collection and quantification approach will be consistent with the intertidal habitat survey method provided in Section 5.2.1.

Note: Red dots indicate locations of GPS coordinates. This image is not to scale.

Figure 3-4. Example of Survey Transects on Intertidal Rip-Rap Habitats.

Laboratory Analysis Methods

Macro- and mesodebris will be sorted by type and counted. Volumes will be recorded for debris in each size class collected during each assessment. Additional information such as brand names will also be noted on data sheets if available. Microdebris collected from sandy beaches will be sieved for size classes of 4.75, 2.0, 1.0, .710, 0.500, and 0.355 mm (Appendix G). After further sorting the microdebris by these size classes, items will be counted to determine the abundance and the volume will be measured for each size class. Item colors will also be counted for each size class of items collected from sandy beaches according to the colors of ingested plastic found previously in fish gut trawl samples (Boerger et al., 2010).

5.3 Quantities and Types of Debris in Riverine Habitats

The goal of this assessment will be to determine the quantities and types debris in the channels of upland wadeable streams in the watersheds draining to San Diego Bay. Debris deposited in

riverine habits occurs through land use-based sources, incidental or wind-blown litter from adjacent areas, and direct deposit of debris through littering and illegal dumping. Understanding the quantity and types of debris in riverine habits is a first step in making the connections between land based sources and debris that is ultimately transported to the bay. Section 5.3 provides details on the methods used to collect riverine habitat data that will be included in this study.

Site Selection

This study component follows on the Bight '13 Debris Riverine Habitat Study adopted from the SMC Regional Watershed Monitoring Program, and as such the target population, sample frame, and site selection has been pre-determined by that workgroup. The target population for the SMC surveys is perennial, wadeable, and Strahler second order or higher classification streams across the Southern California watersheds. The sample frame will include the major strata used in previous SMC surveys, which are as follows:

1. Strahler Order
2. Land Use
    a. Urban
    b. Agriculture
    c. Open
3. Watershed Jurisdiction (Hydrologic Unit Boundaries)
4. County Jurisdictional Boundaries
5. Regional Water Quality Control Board Jurisdiction Boundaries

Briefly, SMC sample sites were selected using a probabilistic approach weighting by watershed, land use, and stream order. The sampling frame includes watershed units located from Ventura to San Diego and east to San Bernardino and Riverside Counties. These watersheds equate to combinations of management units utilized by the Regional Water Quality Control Boards (RWQCB) or SMC member agencies. Altogether, these 15 watershed units are comprised of roughly 28,051 km^2. The streamlines used to define the sampling frame were derived from the National Hydrography Dataset. Altogether, there are 9,492 stream miles of Strahler order 2 and greater in the sampling frame. Land use was defined as either urban, agriculture, or open based on the Coastal Change Analysis Program (C-CAP) remote imaging algorithms (National Oceanic and Atmospheric Administration 1995). C-CAP defines 35 different land use classes that have been aggregated into the three categories for this study (i.e., open, agriculture, urban, and water). The dominant land use within a 500-m buffer was assigned to each stream reach.

The Bay Debris Study will focus on the urban stratum riverine sites in the Chollas Creek, Sweetwater River, and Otay River watersheds. The riverine habitat portion of the Bay Debris Study focusing on revisiting sites surveyed during prior regional monitoring programs. Sites sampled for the SMC Regional Monitoring Program and the Bight '13 Debris Study Riverine Assessment will be selected as the first set of potential sites, up to a maximum of 30 sites over the three watersheds. In the event an insufficient number of sites cannot be developed from the existing pool of previously visited sites, additional new sites will be selected.

Field Sampling Methods

The Bight ’13 riverine assessment protocol will serve as the survey approach for the riverine habitats in the Bay Debris Study. The riverine habitat survey approach is based on combination of field methods incorporating a multimetric rapid trash assessment index and an associated item tally. Sites are numerically evaluated using a modified version of the Surface Water Ambient Monitoring Program Rapid Trash Assessment approach developed by the Bight ’13 Debris Study planning committee. In addition to the RTA score, individual debris items will be recorded according to specific item categories on the Stream Trash Item Tally Sheet.

Debris collected during any survey should be record the quantity of plastic material in specific categories on the Riverine Habitat Debris Assessment Tally Worksheet (Appendix F). Types of items within each of these categories will counted and recorded during field surveys. Field information collected during site assessments will include a description of site characteristics that will further aid in the data analysis. The additional site characterization data will include an evaluation of storm drain inputs, presence of homeless encampments, adjacent land features, and summaries of the stream geomorphologies.

Laboratory Analysis Methods

A subset of the macro and mesodebris collected will be re-counted for quality assurance purposes by size and type of item. Volumes will be recorded for each plastic debris category and size class. Additional information such as brand names will also be noted on data sheets if available.

5.4 Wet Weather Debris Tracking from Riverine to Bay Habitats

The goal of this component of the Bay Debris Study is to evaluate pathways and distances traveled of common debris (trash) items during storm events. Much of Southern California’s watersheds are composed of networks of canyons that reticulate most urban neighborhoods and act as downhill pathways to the coast. Many of the higher elevation, lower order creeks are seasonal, where debris accumulates throughout the dry season and washes downstream to the coast during the wet season. Tracking common debris items can reveal the patterns and potential influences on accumulations and flows of these items as they move throughout the watershed. Understanding the patterns and influences on pathways of debris throughout coastal waterways can strength our understanding of how land based debris enters coastal oceans and bays. Section 5.4 provides details on the methods used to track riverine habitat plastic debris that will be included in this study.

Site Selection

Four canyons within the Chollas Creek subwatershed in the City Heights neighborhood of San Diego have been chosen for these tracking studies: Manzanita, Swan, Juniper and Chollas Canyons. The canyons in the Chollas Creek watershed are representative of urban seasonal waterways with surrounding areas being densely populated and heavily urbanized, with land uses including industrial, residential, commercial, and open space. Study sites will be distributed across each of these four canyons to capture a representative assessment of the

landscape features (e.g., surrounding land use, vegetation cover and type) present in urban seasonal waterways.

Field Sampling Methods

Assessments will be conducted with the help volunteers from the Ocean Discovery Institute. Before the start of the rainy season in October, at least five sampling locations will be established in each canyon- two each on the right and left sides and one at the canyon head. Based on the availability of volunteers, the number of sites may be increased to as many as 13 sites per canyon if adequate staffing is available (6 sites on each side, one at head). Three (3) types of common, single-use plastic debris items (shopping bags, plastic bottles, Styrofoam or waxed fast food containers) will be labeled for tracking at each site. In order to avoid adding debris back into the environment, plastic items will be collected from the canyon and labeled for tracking purposes. Labels will contain sample information (site, date, item number) and study information (contact, brief explanation of project so item isn't removed). Labeling approaches planned include but may not be limited to painting items with brightly colored paint, wildlife radio frequency identification tags, and electronic trackers (e.g., radio or satellite based systems) to be able to track items placed along the subwatershed (upstream mid reach, near mouth) and to minimize loss in determining distances traveled. At each of the sites five individual items of each type of debris (e.g., 5 bags, 5 bottles, and 5 containers) will be staged for tracking. GPS locations of release sites will be recorded. Cover of land features in the immediate surrounding area will be assessed using a 10 x 10 m quadrat. Within each quadrat, cover of each feature will be assessed using the point intercept method where presence of a feature is recorded at every intersection along a grid containing $1m^2$ cells. Bags will be located and mapped every 2 weeks or immediately following a rain event. Land feature quadrats will be taken around each item (where the item is centered in the quadrat) if the items are 10 m or more apart, or taken around the center item in a cluster if items are less than 10m apart. Surveys will be conducted throughout the rainy season (through March) during post-storm event conditions and, if items are still trackable, throughout the dry season on a monthly basis. If degradation or loss of items occurs, a new item will be placed in the last known location and noted.

If funds and volunteer help are available, debris tracking releases can be conducted farther downstream in the intertidal portion of Chollas Creek. In this area of the riverine habitat tracking methods can be evaluated using the painted and labeled items as described above and using adhesive radio tags placed on items as well as receivers placed along the stream to track unidirectional locations (flow downstream).

5.5 Prevalence of Plastic Debris in Demersal and Pelagic Fish

The goal of this part of the Bay Debris Study is to determine the quantities and types debris ingested by pelagic and demersal fish. As noted previously, accumulation of plastics in the gut can have two potential harmful effects on fish communities. Plastic items can provide a false sensation of feeding satiation leading to starvation. Plastics in the marine environment can also act as an intermediary for transmitting persistent organic pollutants that can bioaccumulate in the fish tissue (Rochman, 2013). Section 5.5 provides details on the methods used to previously collect debris data that will be included in this study.

The approach for this component of the Bay Debris Study is to leverage samples collected from RHMP 2013, San Diego Bay Shallow Water Habitat Bioaccumulation 2014 Study, and fish captured during the water column trawls in this study (see Section 5.1) in order to acquire specimens of fish. Fish gut contents will be processed to quantify the size, shape, color and abundance of debris ingested by fish. Comparisons between the types and amounts of different types of plastic among pelagic and demersal fish can provide useful information for determining the extent of area effected as well as suggests pathways for ingestion of debris to determine where and what types of debris to focus on for management actions.

Site Selection

As with the RHMP and SWHB study components, the sample frame and site selection were pre-determined (see Section 5.1).

Field Sampling Methods

Fish species collected during the previous trawls will serve as the initial list of targeted species for the Bay Debris Study. The four categories of fish consisting of species from the Pelagobenthivore Guild, Benthivore Guild, which were previously found to have consumed plastics and Pelagic Species, will represent the initial targeted fish species for this study. Although some species may not be found in San Diego Bay, the initial targeted list of fish species is not intended to be exclusive of other fish potentially collected during trawls of the bay. The species identity of non-target list fish caught during trawls will be recorded and those samples will be included into the overall sample set to be analyzed for ingestion of plastic debris. The final species list of fish that will be analyzed will take into consideration additional factors including number of fish caught, size and effort needed to extract ingested plastic, and feasibility of plastic being ingested based on existing precedence from previous studies. Any fish caught but not analyzed will be determined by consensus of the technical workgroup.

Table 4-3. Targeted fish species to determine ingestion of plastic

Pelagobenthivore Guild:	Benthivores Guild:	Fish previously found with ingested plastic:	Pelagic species:
Pacific sanddab	English sole	white croaker	Deepbody Anchovy
longfin sanddab	blackbelly eelpout	queenfish	Northern Anchovy
Longspine combfish	hornyhead turbot	shiner perch	Sardine
speckled sanddab	curlfin sole	spotted cusk eel	Herring
Bay goby	bearded eelpout	lizardfish	Jack Mackerel
			Pacific Mackerel
			Smelt

Trawls were performed using Bight '13 standardized procedures as found in the Bight '13 Field Methods Manual. Fish collected, counted, and weighed as part of the RHMP and SWHB species of interest will be analyzed. Fish previously caught were frozen and transferred under COC documentation in order to retain location and specie identity information.

Laboratory Analysis Methods

In the laboratory, each fish will be measured for length, weighed, and sexed. The gut (stomach and intestinal tract) will be removed and washed into a 1 mm sieve. The contents in the sieve will be examined under a 10X magnifying lens or dissecting scope for ingested plastic. Each plastic item will be removed, sized, sorted by shape, color, type (fragment, pellet, line, film, and foam), and archived.

6.0 DATA ANALYSIS

Analysis of the overall plastic debris quantities are an important component for establishing a benchmark of the most abundant type of plastic and being able to measure changes in the plastics quantities over time. The plastics data that will be collected for the Bay Debris Study includes a substantially expanded list of items beyond the data collected during previous SMC and Bight regional monitoring programs to capture a greater level of detail about the most prevalent types of plastic items. The plastics data that will be collected for the Bay Debris Study were categorized according to major plastics categories and examples of items within each category are as follows:

- Bags and Packaging Materials
  - Single use bags, food wrapper, Styrofoam pellets, etc.
- Food Service
  - Sport drink bottles, Styrofoam cups, bottle caps, etc.
- Household
  - Sports balls, synthetic fabric clothing, CDs/DVDs, etc.
- Toxics
  - Lighters, cigarette butts, pens or markers, etc.
- Miscellaneous
  - Balloons, foam balls, PVC pipe, etc.

Additional details on the specific plastic item descriptions and size categories are provided in Appendices C, E, F, and G. The primary data analyses that will be performed to answer the study questions include the following:

Data Analyses for Study Question 1.

1. What are the abundance and volume of plastics by category, item description, and size categories for each habitat type?
2. Are the average and total abundance and volume of plastics different in each habitat between survey events?
3. How do the abundance, category, item description, and volume of plastics in trash skimmers change over the study period?

Data Analyses for Study Question 2.

1. What percent of labeled plastic items were found following a storm event?
2. How does the percent of items found vary between types of plastic items?

3. What is the average distances traveled by a plastic item following storm events?

Data Analyses for Study Question 3.

1. What proportion of fish caught have debris ingested using a presence/absence approach?
2. What is the average number of plastic pieces ingested within fish according to species and body size?
3. What are the total numbers of plastic pieces ingested according to color?

Proposed statistical methodologies include cumulative distribution frequency curves, comparison of averages including rank-sum and analysis of variance, linear and logistical regression, and correlative analyses including Spearman-Rank or Kendall Tau. All data collected will be summarized in tables included as an appendix to the study report.

7.0 DATA QUALITY ASSURANCE AND QUALITY CONTROL

Data quality assurance and quality control guidelines have been developed for the Bay Debris Study to ensure that data generated is representative and reliable for supporting management decisions. The QA/QC guidelines for debris monitoring include:

- **Development of standard operating procedures (SOPs)**: The QA/QC procedures for all habitat data collection and laboratory analyses will include the use of Standard Operating Procedures to establish consistent guidance for all the project partners that perform data collection activities. The SOP prepared for this study provides detailed step-by-step instructions for field data collection, laboratory analyses and performance audits. SOPs will provide a reference for field personnel during field activities, and should be reviewed prior to field events in order to maintain consistent methodology.

Table 7-1. Summary of standard operating procedures for data collection activities.

Habitat or Study Focus	Data Collection Method	SOP Guidance Document
Water Column	Bight '13 Trawl, Boerger 2010	Bight '13 CIA Field Operations Manual
Rip-Rap	NOAA Shoreline Survey	Intertidal Habitat Rip Rap Survey SOP, August 2014
Mudflat	NOAA Shoreline Survey	Intertidal Habitat Rip Rap Survey SOP, August 2014
Salt Marsh	NOAA Shoreline Survey	Intertidal Habitat Rip Rap Survey SOP, August 2014
Sandy Beach	NOAA Shoreline Survey	Intertidal Habitat Sandy Beach Survey SOP, August 2014
Riverine	Bight '13 Debris	Riverine Habitat Survey SOP, August 2014
Marina Skimmers	This Study	Port of San Diego Marina Trash Skimmer Study
Wet Weather Tracking	This Study	Talley 2014
Fish Gut	Bight '13 Trawl,Boerger 2010	Boerger 2010
Quality Assurance	This Study	Performance Evaluation Guidance for Data Collection Activities

- **Completion of pre-project field based training events**: Training will focus on establishing consistency in data collection activities among all field personnel. Training will include instruction in proper field sampling methods, item identification, sampling and preservation procedures, and health and safety precautions. Field teams will perform intercalibration exercises prior to collecting samples to evaluate whether the requirements outlined in the field SOPs are understood by all field personnel.

  Site captains will be appointed for each field team performing intertidal and riverine habitat assessments. These site captains will go through in depth training of all field

assessment requirements, item identification, data quality requirements, and site orientation. Field teams will be equipped with field notebooks and supplies, and site captains are required to prepare these items before each field event. Field equipment will be checked for proper performance prior to use.

- **Vessel positioning field forms.** Trawl sample tracks will be performed as to pass within approximately 10 m of the intended target collection location using a digital GPS unit with sites coordinates pre-programmed. The boat captain or field team leader on the boat will be responsible for accurate occupation of the sampling sites and will maintain a record of all station occupation and sampling event data. The data required to be recorded for every trawl is described in Appendix A. The Water Column Habitat Trawl project leader will submit station occupation and sampling event data in electronic format to the Quality Assurance Administrator.
- **Distribution of data collection guides and site maps for field teams**: A field guide will be distributed to all field teams which includes a cross reference chart with photos to identify debris. Volunteers will study this chart so that all debris items are identified consistently during field assessments. It will also be available for volunteers to crosscheck items for which they might be uncertain about the correct category.
- **Field team performance audits**: Routine QC checks of the field team data collection methodology and performance will be conducted using a tiered approach. The performance audit process consists of an initial evaluation by the designated regional team leader when field teams begin the data collection activities followed by periodic audits conducted by the site captains. The goal of the performance audits is to identify potential problems at the onset of data collection activities and maintain a consistent level of oversight during the sampling period as data sets are generated. Following the pre-season training event, the regional team leader conducts a performance audit of the field teams during the first day of data collection activities. Thereafter, the responsibility of maintaining data quality is managed by the site captains who's goal is to completed an auditor of field crews for at least 1 site per sample batch or 10 percent of the field team's sites, whichever is more, to note and provide instruction on areas of inconsistency with SOP methods.
- **Site verification requirements (site and survey area accuracy)**: Field teams will be given GPS coordinates for each site prior to field events. In order to maintain accuracy in site identification, field teams are required to record GPS coordinates for each site on the field sheet. This will be cross checked against the original GPS coordinates in order to verify that the correct site was assessed. To ensure accuracy in the transect area, field teams are also required to measure the length and width of each transect and include this information on the field sheets.
- **Site audits to evaluate data collection thoroughness (data accuracy)**: A minimum of 10 percent of sites will be randomly selected for a site audit. Team leaders will return to the site to verify that all debris items have been collected and the GPS location for the site is accurate.

- **Duplicate counts of collected items (data precision)**: Macrodebris and mesodebris collected during intertidal field assessments and trawl water column assessments will be reanalyzed at the lab. Debris will be sorted by type and recounted for each size category. The results should be compared to the field data sheets for each site for quality assurance purposes, however, it is recognized that quantities could be skewed by the breakup of debris during the transportation process.

  In light of the fact that data quality objectives have not been developed for debris surveys, variations of more than 30 percent in any portion of the QA/QC analyses would be sufficient to flag that portion of the data. If flagged data is identified during QA/QC reviews, data quality issues will be discussed and agreed upon by the workgroup, and based on the severity of the QA/QC issues may include re-collecting data.

- **Data analysis and reporting**: Following initial field data collection, a QA/QC review of all raw data and field sheets will be conducted by the project partners. Data collected during field surveys and laboratory analyses will be reviewed by the site captains and regional team leaders. Field forms will be reviewed by the site captains following each site survey and regional team leaders will perform random checks of the field forms for completeness. Once field forms have been reviewed and the information is considered complete, the raw data will be entered into a computer database for further review and data validation, preferably in the SWAMP database if appropriate fields for data exist. A 100 percent check of this data against the field sheets will be performed preceding any data analysis. Any data analyses and associated conclusions included in a final report will also go through a 100 percent QA check.

8.0 INFORMATION MANAGEMENT PLAN

The San Diego Bay Debris Study is funded, in part, by SWAMP and is a collaboration between many different stakeholders of San Diego Bay watershed in coordination with the Bight ’13 debris regional monitoring program. The study provides a unique challenge for collecting and organizing the data among the different stakeholders in a comparable way; therefore a data/information management plan is crucial for this study. The San Diego Bay Debris Study will follow the information management plan for Bight ’13 (Bight ’13 Information Management Committee) and the SWAMP database management plan (SWAMP data management plan).

The Bight ’13 Information Management Technical Committee is responsible for creating Standardized Data Transfer Protocols (SDTPs) to ensure data comparability and ease of data analyses for the Bight program. The Bight ’13 information management plan includes SDTPs for the Bight ‘13 Debris Study but does not fully address the information management needs for the San Diego Bay Debris Study.

According to the information management plan for Bight ’13, the information management needs to occur on several levels: (1) a process must be developed to ensure the quality, compatibility, and timeliness of the data each organization collects, (2) the data must be readily available for review, analysis, and interpretation, and (3) the data must be made available to other interested organizations and the general public. The following major functions are described in the Information Management Plan (Bight ’13 Information Management Committee) which will be followed by the San Diego Bay Debris Study:

1. The Standardized Data Transfer Protocols each participating agency will use to transfer data from their internal Information Management System to the Bight’13 Information Management System.
2. The data submission process for submitting data to the Bight’13 Information Management Officer.
3. The technical guidelines of how the data will be organized in the centralized Bight’13 database.
4. The milestones and mechanisms by which the data will be made accessible to project participants, other organizations, and the general public.

Because the San Diego Debris Study is supported by SWAMP funds awarded to the San Diego Water Board, data management also has to follow SWAMP’s data management requirements. Data generated from this study will be stored in the SWAMP database. Field crews will be responsible for entering all field generated data into the database. In cases where laboratory results will be created, results from the laboratory analyses will be uploaded into the SWAMP database by the lab analysts with the help of the SWAMP database management team. It is expected that the data will also be uploaded to the California Environmental Data Exchange Network (CEDEN). The SWAMP Database Manager and support staff will follow their SOPs for data management, including record keeping and tracking, document control, and data handling. They will perform all QA/QC on data before entering into the SWAMP Permanent database.

Standard Data Transfer Protocols (SDTPs):

Field sampling data sheets will be prepared for debris assessments for the riverine habitats, the water columns habitats, and the intertidal habitats. The SWAMP database management team will build the SDTPs for the San Diego Bay Debris Study based on the field sampling data sheets. The SDTPs will be compatible with the Bight ’13 information management plan. Meta data, field data, and lab data (when available) will be stored in the SWAMP database which is organized through a relational structure.

Submission Process

Field crew leaders and lab crew leaders are responsible for compiling the data into the STDP tables. They are also responsible for the QA/QC checks on the data prior to its submission to the SWAMP database.

Database

The data from the San Diego Bay Debris Study will be stored in the SWAMP database. These data will then be uploaded into CEDEN and will not be stored in the Bight ’13 centralized database. However, the program managers for the San Diego Bay Debris Study will coordinate with the Information Management Officer for Bight ’13.

Accessibility to Data

The data from the San Diego Bay Debris Study will be submitted to CEDEN by the SWAMP data management team and will be available on the CEDEN website to the public.

The program managers for the San Diego Bay Debris Study will oversee the implementation of the information/data management plan.

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APPENDIX A

Proposed Locations for San Diego Bay Debris Sample Collection

Habitat	Segment ID	Latitude	Longitude	Waterbody Name	Sample Type	Sample Status
Mudflat	9	32.64759	-117.11119	San Diego Bay	NOAA Method	New Sample
Mudflat	26	32.64782	-117.11033	San Diego Bay	NOAA Method	New Sample
Mudflat	48	32.64813	-117.10922	San Diego Bay	NOAA Method	New Sample
Mudflat	66	32.64879	-117.10874	San Diego Bay	NOAA Method	New Sample
Mudflat	73	32.64908	-117.1086	San Diego Bay	NOAA Method	New Sample
Mudflat	95	32.64664	-117.11515	San Diego Bay	NOAA Method	New Sample
Mudflat	100	32.64671	-117.1149	San Diego Bay	NOAA Method	New Sample
Mudflat	115	32.64322	-117.1155	San Diego Bay	NOAA Method	New Sample
Mudflat	136	32.64042	-117.11508	San Diego Bay	NOAA Method	New Sample
Mudflat	187	32.63842	-117.11422	San Diego Bay	NOAA Method	New Sample
Mudflat	195	32.63818	-117.11399	San Diego Bay	NOAA Method	New Sample
Mudflat	207	32.63795	-117.11344	San Diego Bay	NOAA Method	New Sample
Mudflat	212	32.63783	-117.11322	San Diego Bay	NOAA Method	New Sample
Mudflat	243	32.63744	-117.11166	San Diego Bay	NOAA Method	New Sample
Mudflat	249	32.63565	-117.10816	San Diego Bay	NOAA Method	New Sample
Mudflat	266	32.63504	-117.10761	San Diego Bay	NOAA Method	New Sample
Mudflat	286	32.63426	-117.1071	San Diego Bay	NOAA Method	New Sample
Mudflat	296	32.63385	-117.10689	San Diego Bay	NOAA Method	New Sample
Mudflat	302	32.6336	-117.10676	San Diego Bay	NOAA Method	New Sample
Mudflat	327	32.60726	-117.12955	San Diego Bay	NOAA Method	New Sample
Mudflat	341	32.60689	-117.12895	San Diego Bay	NOAA Method	New Sample
Mudflat	353	32.60657	-117.12844	San Diego Bay	NOAA Method	New Sample
Mudflat	383	32.6058	-117.12713	San Diego Bay	NOAA Method	New Sample
Mudflat	393	32.60556	-117.12668	San Diego Bay	NOAA Method	New Sample
Mudflat	401	32.60538	-117.12631	San Diego Bay	NOAA Method	New Sample
Mudflat	423	32.60485	-117.12532	San Diego Bay	NOAA Method	New Sample
Mudflat	440	32.60424	-117.1248	San Diego Bay	NOAA Method	New Sample
Mudflat	468	32.60313	-117.1241	San Diego Bay	NOAA Method	New Sample
Mudflat	480	32.60264	-117.12384	San Diego Bay	NOAA Method	New Sample
Mudflat	491	32.60219	-117.12359	San Diego Bay	NOAA Method	New Sample

Habitat	Segment ID	Latitude	Longitude	Waterbody Name	Sample Type	Sample Status
Riprap	55	32.70558	-117.23657	San Diego Bay	NOAA Method	New Sample
Riprap	58	32.70636	-117.23682	San Diego Bay	NOAA Method	New Sample
Riprap	63	32.71514	-117.23323	San Diego Bay	NOAA Method	New Sample
Riprap	72	32.71474	-117.23337	San Diego Bay	NOAA Method	New Sample
Riprap	114	32.71089	-117.22943	San Diego Bay	NOAA Method	New Sample
Riprap	141	32.71606	-117.22237	San Diego Bay	NOAA Method	New Sample
Riprap	150	32.71816	-117.22036	San Diego Bay	NOAA Method	New Sample
Riprap	151	32.71842	-117.22033	San Diego Bay	NOAA Method	New Sample
Riprap	191	32.72865	-117.20668	San Diego Bay	NOAA Method	New Sample
Riprap	242	32.72468	-117.20852	San Diego Bay	NOAA Method	New Sample
Riprap	244	32.72474	-117.20789	San Diego Bay	NOAA Method	New Sample
Riprap	245	32.72477	-117.20757	San Diego Bay	NOAA Method	New Sample
Riprap	260	32.72508	-117.20278	San Diego Bay	NOAA Method	New Sample
Riprap	276	32.72505	-117.19766	San Diego Bay	NOAA Method	New Sample
Riprap	280	32.72499	-117.19638	San Diego Bay	NOAA Method	New Sample
Riprap	286	32.72485	-117.19447	San Diego Bay	NOAA Method	New Sample
Riprap	388	32.73515	-117.21118	San Diego Bay	NOAA Method	New Sample
Riprap	465	32.72525	-117.2115	San Diego Bay	NOAA Method	New Sample
Riprap	473	32.72558	-117.20897	San Diego Bay	NOAA Method	New Sample
Riprap	498	32.68519	-117.16378	San Diego Bay	NOAA Method	New Sample
Riprap	544	32.69083	-117.16439	San Diego Bay	NOAA Method	New Sample
Riprap	651	32.7031	-117.18087	San Diego Bay	NOAA Method	New Sample
Riprap	700	32.7045	-117.16617	San Diego Bay	NOAA Method	New Sample
Riprap	718	32.70423	-117.16119	San Diego Bay	NOAA Method	New Sample
Riprap	739	32.70711	-117.16857	San Diego Bay	NOAA Method	New Sample
Riprap	771	32.70662	-117.23687	San Diego Bay	NOAA Method	New Sample
Riprap	826	32.72087	-117.22708	San Diego Bay	NOAA Method	New Sample
Riprap	828	32.72111	-117.22747	San Diego Bay	NOAA Method	New Sample
Riprap	907	32.72693	-117.17567	San Diego Bay	NOAA Method	New Sample
Riprap	931	32.68047	-117.17076	San Diego Bay	NOAA Method	New Sample
Riprap	942	32.69853	-117.1682	San Diego Bay	NOAA Method	New Sample
Riprap	968	32.70326	-117.18093	San Diego Bay	NOAA Method	New Sample
Riprap	1028	32.65119	-117.12039	San Diego Bay	NOAA Method	New Sample
Riprap	1033	32.64986	-117.1201	San Diego Bay	NOAA Method	New Sample
Riprap	1042	32.64785	-117.11922	San Diego Bay	NOAA Method	New Sample
Riprap	1055	32.65005	-117.10988	San Diego Bay	NOAA Method	New Sample
Riprap	1108	32.62451	-117.10553	San Diego Bay	NOAA Method	New Sample
Riprap	1126	32.62533	-117.10177	San Diego Bay	NOAA Method	New Sample
Riprap	1131	32.62405	-117.10125	San Diego Bay	NOAA Method	New Sample
Riprap	1135	32.62302	-117.10084	San Diego Bay	NOAA Method	New Sample
Riprap	1137	32.62251	-117.10063	San Diego Bay	NOAA Method	New Sample
Riprap	1138	32.62225	-117.10053	San Diego Bay	NOAA Method	New Sample
Riprap	1185	32.61957	-117.10061	San Diego Bay	NOAA Method	New Sample
Riprap	1211	32.6137	-117.10161	San Diego Bay	NOAA Method	New Sample
Riprap	1601	32.60043	-117.11363	San Diego Bay	NOAA Method	New Sample
Riprap	1636	32.60126	-117.11205	San Diego Bay	NOAA Method	New Sample

Habitat	Segment ID	Latitude	Longitude	Waterbody Name	Sample Type	Sample Status
Salt Marsh	719	32.65728	-117.1085	San Diego Bay	NOAA Method	New Sample
Salt Marsh	893	32.65647	-117.10839	San Diego Bay	NOAA Method	New Sample
Salt Marsh	1569	32.65323	-117.10708	San Diego Bay	NOAA Method	New Sample
Salt Marsh	1902	32.60955	-117.10221	San Diego Bay	NOAA Method	New Sample
Salt Marsh	1917	32.61017	-117.1019	San Diego Bay	NOAA Method	New Sample
Salt Marsh	1939	32.61109	-117.10145	San Diego Bay	NOAA Method	New Sample
Salt Marsh	1973	32.64876	-117.10767	San Diego Bay	NOAA Method	New Sample
Salt Marsh	2677	32.64613	-117.11628	San Diego Bay	NOAA Method	New Sample
Salt Marsh	2827	32.64579	-117.10711	San Diego Bay	NOAA Method	New Sample
Salt Marsh	3146	32.64491	-117.11691	San Diego Bay	NOAA Method	New Sample
Salt Marsh	3628	32.64419	-117.10326	San Diego Bay	NOAA Method	New Sample
Salt Marsh	3703	32.64405	-117.10443	San Diego Bay	NOAA Method	New Sample
Salt Marsh	4358	32.64307	-117.10922	San Diego Bay	NOAA Method	New Sample
Salt Marsh	4618	32.64283	-117.10495	San Diego Bay	NOAA Method	New Sample
Salt Marsh	4777	32.64251	-117.1123	San Diego Bay	NOAA Method	New Sample
Salt Marsh	4951	32.64242	-117.10601	San Diego Bay	NOAA Method	New Sample
Salt Marsh	5162	32.64215	-117.10559	San Diego Bay	NOAA Method	New Sample
Salt Marsh	5218	32.64198	-117.11102	San Diego Bay	NOAA Method	New Sample
Salt Marsh	5874	32.64023	-117.10887	San Diego Bay	NOAA Method	New Sample
Salt Marsh	5932	32.63997	-117.10823	San Diego Bay	NOAA Method	New Sample
Salt Marsh	6455	32.63808	-117.10736	San Diego Bay	NOAA Method	New Sample
Salt Marsh	6579	32.63766	-117.10906	San Diego Bay	NOAA Method	New Sample
Salt Marsh	6672	32.63739	-117.10916	San Diego Bay	NOAA Method	New Sample
Salt Marsh	7413	32.63256	-117.10411	San Diego Bay	NOAA Method	New Sample
Salt Marsh	7426	32.63257	-117.10272	San Diego Bay	NOAA Method	New Sample
Salt Marsh	7481	32.63244	-117.10133	San Diego Bay	NOAA Method	New Sample
Salt Marsh	8354	32.61627	-117.11215	San Diego Bay	NOAA Method	New Sample
Salt Marsh	8489	32.61609	-117.09862	San Diego Bay	NOAA Method	New Sample
Salt Marsh	8535	32.61589	-117.10853	San Diego Bay	NOAA Method	New Sample
Salt Marsh	9094	32.61425	-117.11064	San Diego Bay	NOAA Method	New Sample

Habitat	Segment ID	Latitude	Longitude	Waterbody Name	Sample Type	Sample Status
Sandy Beach	140	32.71026	-117.23675	San Diego Bay	NOAA Method	New Sample
Sandy Beach	165	32.70916	-117.23695	San Diego Bay	NOAA Method	New Sample
Sandy Beach	232	32.72852	-117.20904	San Diego Bay	NOAA Method	New Sample
Sandy Beach	253	32.68542	-117.23525	San Diego Bay	NOAA Method	New Sample
Sandy Beach	266	32.7005	-117.17340	San Diego Bay	NOAA Method	New Sample
Sandy Beach	318	32.69005	-117.16459	San Diego Bay	NOAA Method	New Sample
Sandy Beach	322	32.68987	-117.16453	San Diego Bay	NOAA Method	New Sample
Sandy Beach	830	32.71401	-117.20605	San Diego Bay	NOAA Method	New Sample
Sandy Beach	946	32.71468	-117.20003	San Diego Bay	NOAA Method	New Sample
Sandy Beach	959	32.71467	-117.1991	San Diego Bay	NOAA Method	New Sample
Sandy Beach	1257	32.70439	-117.22305	San Diego Bay	NOAA Method	New Sample
Sandy Beach	1330	32.7069	-117.22055	San Diego Bay	NOAA Method	New Sample
Sandy Beach	1520	32.71205	-117.21275	San Diego Bay	NOAA Method	New Sample
Sandy Beach	1538	32.7124	-117.21189	San Diego Bay	NOAA Method	New Sample
Sandy Beach	1748	32.60426	-117.10727	San Diego Bay	NOAA Method	New Sample
Sandy Beach	1793	32.60558	-117.10545	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2062	32.6235	-117.129	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2475	32.65045	-117.14499	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2491	32.64988	-117.14447	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2529	32.6483	-117.14374	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2551	32.64736	-117.14337	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2553	32.64727	-117.14334	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2606	32.64509	-117.14221	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2703	32.64119	-117.14017	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2750	32.63927	-117.13909	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2774	32.63826	-117.13865	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2795	32.63792	-117.13955	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2808	32.63779	-117.1402	San Diego Bay	NOAA Method	New Sample
Sandy Beach	2881	32.63557	-117.1403	San Diego Bay	NOAA Method	New Sample
Sandy Beach	3010	32.63052	-117.13759	San Diego Bay	NOAA Method	New Sample

Habitat	Segment ID	Latitude	Longitude	Waterbody Name	Sample Type	Sample Status
Water Column	WC1	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC2	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC3	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC4	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC5	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC6	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC7	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC8	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC9	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC10	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC11	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC12	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC13	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC14	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC15	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC16	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC17	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC18	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC19	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC20	TBD	TBD	San Diego Bay	Trawl	Resample
Water Column	WC21	TBD	TBD	San Diego Bay	Trawl	Resample

Habitat	Segment ID	Latitude	Longitude	Waterbody Name	Sample Type	Sample Status
Marinas	MTS1	32.723459	-117.224659	Pt. Loma Marina	Marina Trash Skimmers	New Sample
Marinas	MTS10	32.726707	-117.208384	Harbor Island West Marina	Marina Trash Skimmers	New Sample
Marinas	MTS18	32.715079	-117.230096	Half Moon Marina	Marina Trash Skimmers	New Sample
Marinas	MTS24	32.6505	-117.108768	Pier 32 Marina	Marina Trash Skimmers	New Sample

Habitat	Segment ID	Latitude	Longitude	Waterbody Name	Sample Type	Sample Status
Riverine	SMC01258	32.64950	-117.05887	Sweetwater River	Bight '13	Resample
Riverine	SMC17918	32.66304	-117.03173	Sweetwater River	Bight '13	Resample
Riverine	WCAP99-1014	32.83213	-116.72650	Sweetwater River	Bight '13	Resample
Riverine	SMC01962	32.66067	-117.03919	Sweetwater River	Bight '13	Resample
Riverine	SMC06458	32.66902	-117.01724	Sweetwater River	Bight '13	Resample
Riverine	SMC06714	32.67579	-117.00604	Sweetwater River	Bight '13	Resample
Riverine	SMC08426	32.65071	-117.05482	Sweetwater River	Bight '13	Resample
Riverine	SMC09162	32.84088	-116.70988	Sweetwater River	Bight '13	Resample
Riverine	SMC16266	32.81856	-116.75313	Sweetwater River	Bight '13	Resample
Riverine	SMC14218	32.82998	-116.73604	Sweetwater River	Bight '13	Resample
Riverine	SMC23495	32.83382	-116.72302	Sweetwater River	Bight '13	Resample
Riverine	SMC05146	32.84458	-116.61367	Sweetwater River	Bight '13	Resample
Riverine	CC-SD8(1)	32.70490	-117.12115	Chollas Creek	Bight '13	Resample
Riverine	CC-NF54	32.74136	-117.08349	Chollas Creek	Bight '13	Resample
Riverine	RCC3	TBD	TBD	Chollas Creek	Bight '13	Resample
Riverine	RCC4	TBD	TBD	Chollas Creek	Bight '13	Resample
Riverine	RCC5	TBD	TBD	Chollas Creek	Bight '13	Resample
Riverine	RCC6	TBD	TBD	Chollas Creek	Bight '13	Resample
Riverine	RCC7	TBD	TBD	Chollas Creek	Bight '13	Resample
Riverine	RCC8	TBD	TBD	Chollas Creek	Bight '13	Resample
Riverine	RCC9	TBD	TBD	Chollas Creek	Bight '13	Resample
Riverine	RCC10	TBD	TBD	Chollas Creek	Bight '13	Resample
Riverine	SMC04330	32.61428	-117.03332	Otay River	Bight '13	Resample
Riverine	OR-TWAS-1	32.58846	-117.07168	Otay River	Bight '13	Resample
Riverine	ROR1	32.59021	-117.09018	Otay River	Bight '13	New sample
Riverine	ROR2	32.59021	-117.08283	Otay River	Bight '13	New sample
Riverine	ROR3	32.59000	-117.08375	Otay River	Bight '13	New sample
Riverine	ROR4a	32.59072	-117.06206	Otay River	Bight '13	New sample
Riverine	ROR4b	32.59067	-117.06247	Otay River	Bight '13	New sample
Riverine	ROR7	32.59126	-117.0345	Otay River	Bight '13	New sample
Riverine	ROR10	32.59236	-117.00540	Otay River	Bight '13	New sample
Riverine	ROR11	32.59095	-117.07958	Otay River	Bight '13	New sample
Riverine	ROR13	32.59428	-117.09272	Otay River	Bight '13	New sample
Riverine	ROR14	32.59068	-117.07299	Otay River	Bight '13	New sample
Riverine	ROR15	32.59155	-117.07528	Otay River	Bight '13	New sample

APPENDIX B

Trawling Field Data Forms

STATION OCCUPATION

BIGHT'13

Agency Code

Vessel Name

Arrival Time (hh:mm)

Weather: Clear, Overcast, Partly cloudy, Drizzle, Rain, Thunderstorm, Fog

Sea State: Calm, Choppy, Rough

Nav Type: DGPS, GPS

Station ID

Date

Abandoned site? Y or N (If Y explain in comments)

Station Fail Code

Wind: Speed (kts), Direction (4)

Swell: Period (s), Height (ft), Direction (4)

Station Comments

TRAWL EVENTS

Trawl Number		Time (hh:mm)	Latitude (DD°MM.mmmm)	Longitude (DD°MM.mmmm)	Depth (m)	Wire Out	Distance to target (m)	Trawl Fail Code (3)	P/T Sensor Data (Y/N)	Community Structure (Y/N)	Tissue Chemistry (Y/N)
	Net Over										
	Start Trawl										
	End Trawl										
	Net on Deck										
	Net Over										
	Start Trawl										
	End Trawl										
	Net on Deck										
	Net Over										
	Start Trawl										
	End Trawl										
	Net on Deck										

APPENDIX C

Trawl Debris Data Forms

Water Columnn Trawl Debris Form

Agency:_____ Samplers Initials:_____ Page_____ of _____

Station:_____ Trawl #:_____ Check if trawl sample collected ☐

Date:_____ Time:_____ Check if no macrodebris or mesodebris present in sample ☐

Comments:

MACRODEBRIS WITH IDENTIFIABLE LABELS PROVIDE BRAND NAME OR MANUFACTURER

Bags and Packaging	Macrodebris Count	Mesodebris Count
Bags (single use plastic)		
Bags (takeout or other)		
Bags (large/retail)		
Food Wrapper		
Other Wrapper		
Pet Waste Bags		
Plastic straw wrapper		
Styrofoam pieces		
Styrofoam pellets		
Soft Plastic Pieces		
Hard Plastic Pieces		
Other (comment required)		

Food Service	Macrodebris Count	Mesodebris Count
Juice container		
Bottle Caps		
Milk Cartons		
Water Bottles		
Sports drink bottle		
Soda bottle		
Straws		
Lid		
Cups		
Utensils		
Styrofoam Container		
Styrofoam Cup		
6-pack rings		
Waxed Paper Cups		
Waxed Plates		
Other (comment required)		

Water Columnmn Trawl Debris Form

Agency:_____ Samplers Initials:_____ Page_____ of _____

Miscellaneous	Macrodebris Count	Mesodebris Count
Packaging Ribbon		
Polypropylene Rope		
Fishing Line/Net		
Balloons (mylar)		
Balloons (latex)		
Roping/Ties		
Bandage/Bandaid		
Cigarette Box/Wrapper		
Rubber pieces		
Foam balls		
Other (comment required)		

Household	Macrodebris Count	Mesodebris Count
Storage Containers		
Shampoo Bottles		
Toothbrushes		
CDs / DVDs		
Mechanical Pencils		
Pipe (PVC)		
Tarp		
Furniture		
Sports balls		
Tape		
Toys		
Clothing (synthetic fabric)		
Other (comment required)		

Toxic	Macrodebris Count	Mesodebris Count
Syringes or Pipettes		
Medical Devices		
Lighters		
Computers		
Keyboard		
Phones		
E-waste		
Cigarette Butts		
Chemical Containers		
Pens or Markers		
Bleach Bottles		
Cleaning Bottles		
Other (comment required)		

Water Columnmn Trawl Debris Form

STATION ID: _____ LAB TECH INITIALS: _____

DATE: _____ TIME: _____

If container used to measure not gallon please provide units. Values must be converted to Liters (L) on right

Macrodebris Category	VOLUME	UNITS	VOLUME (L)
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	
Mesodebris Category	**VOLUME**	**UNITS**	**VOLUME (L)**
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	
OVERALL VOLUME	**VOLUME**	**UNITS**	**VOLUME (L)**
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	

If container used to measure not gallon please provide units. Values must be converted to Liters (L) on right

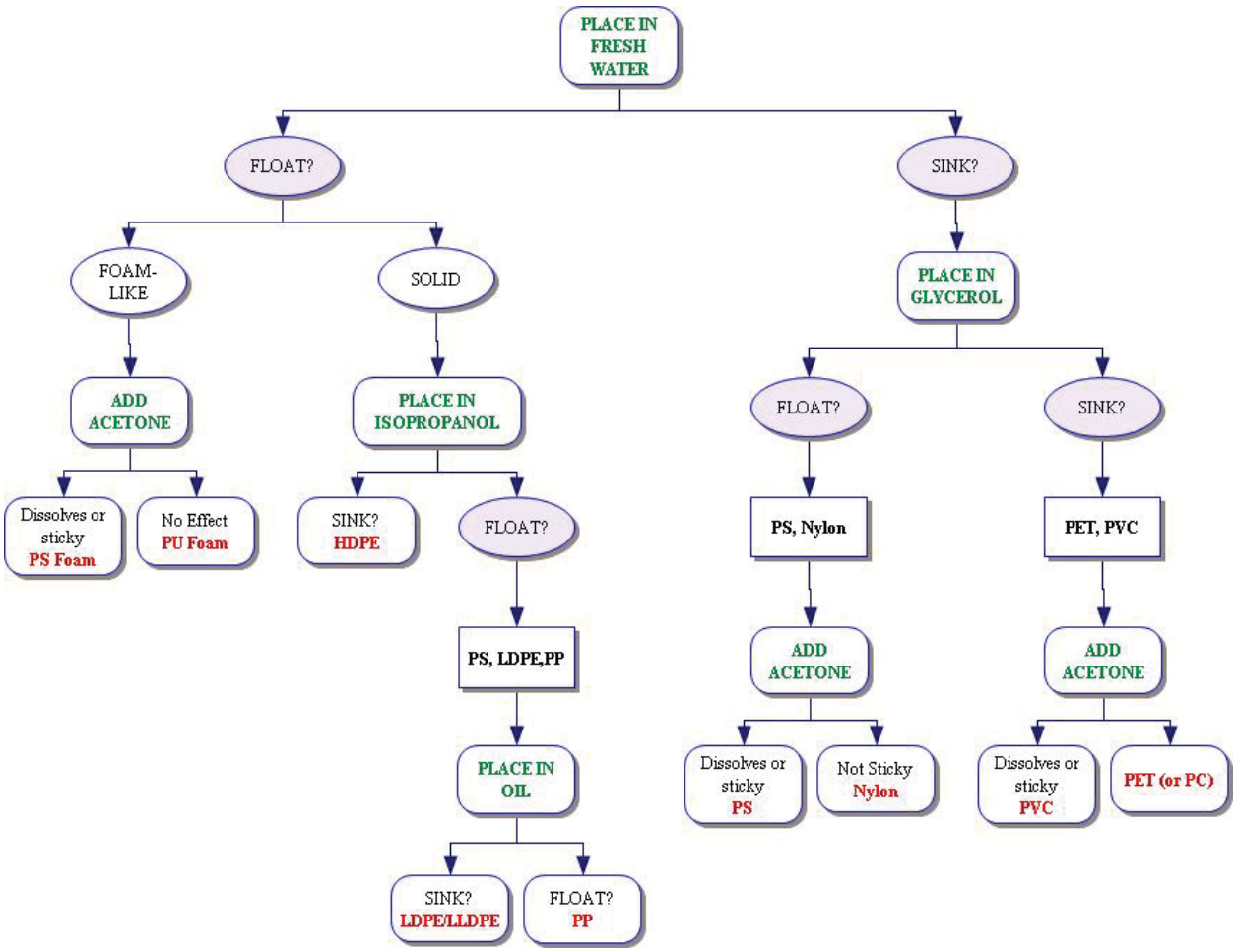
Size	VOLUME	UNITS	VOLUME (L)
>25 cm			
25 mm - 5 mm			
TOTAL VOLUME:		____	

Comments:

APPENDIX D

Andrady Method for Microdebris Plastic Type Determination

Andrady Method for Plastic Type Determination



APPENDIX E

Intertidal Habitat Debris Assessment Field Forms

Intertidal Debris Assessment Worksheet: *Trash Tally*

STATION ID: _____ **DATE**: _____

SITE CAPTAIN INITIALS: _____ **TIME**:_____

SAMPLER NAME: _____ **GPS:** Start_____

SAMPLER NAME: _____ **GPS:** End_____

SAMPLER NAME: _____

CONDITION CATEGORY

Trash Assessment Parameter	Optimal	Sub optimal	Marginal	Poor
Aesthetic Condition	No to small visual impact	Small to moderate visual impact from trash present.	Moderate to substantial impact from trash present.	Substantial to severe visual impact from trash present.
Rate impact to aestheric condition of site based on visable trash (*rate higher or lower within each category according to condition. The higher number within each category reflects decreasing aesthetic condition*)	1 _____ 2 _____ 3 _____ 4 _____ 5 _____	6 _____ 7 _____ 8 _____ 9 _____ 10 _____	11 _____ 12 _____ 13 _____ 14 _____ 15 _____	16 _____ 17 _____ 18 _____ 19 _____ 20 _____

SITE CHARACTERIZATION

Check if no data collected:	Number of photos taken:	Provide explanation for why no data collected:

Site Dimensions: **Width** _____ **(meters)** **Length**_____ **(meters)**

Habitat Type

MARSH MUDFLAT BEACH

WRACKLINE RIP-RAP

Substrate Characteristics

ROCKY	SAND	MUD	VEGETATED
(Y / N)	(Y / N)	(Y / N)	(Y / N)

Access:

Select all features located near the site

Parking Lot (Y / N)

Roadway (Y / N)

Picnic Area (Y / N)

Restricted Access Maintenance Road (Y / N)

Fence (Y / N)

Heavy or thick vegetation (Y / N)

Walkway (Y / N)

Bike Path (Y / N)

Homeless Encampment: **Within Transect (Y / N)** **Distance from Transect** _____**(Meters)**

Outfall: **Within Transect (Y / N)** **Distance from Transect** _____**(Meters)**

Physical Characteristics **Wind Direction:**_____**(degrees)** **Wind Speed:**_____**(meters per second)**

Tide Height:_____**(meters)** **Tide Direction: (flood / ebb)**

Comments:

Intertidal Debris Assessment Worksheet: *Trash Tally*

STATION ID: _____ SITE CAPTAIN INITIALS _____

DATE: _____ TIME: Start: _____

BANK: Finish: _____

	COUNTS	
Bags and Packaging	**> 25 cm**	**25 cm - 5 mm**
Bags (single use plastic)		
Bags (takeout or other)		
Bags (large/retail)		
Food Wrapper		
Other Wrapper		
Pet Waste Bags		
Plastic straw wrapper		
Styrofoam pieces		
Styrofoam pellets		
Soft Plastic Pieces		
Hard Plastic Pieces		
Other (comment required)		
Category Total		
Food Service	**> 25 cm**	**25 cm - 5 mm**
Juice container		
Bottle Caps		
Milk Cartons		
Water Bottles		
Sports drink bottle		
Soda bottle		
Straws		
Lid		
Cups		
Utensils		
Styrofoam Container		
Styrofoam Cup		
6-pack rings		
Waxed Paper Cups		
Waxed Plates		
Other (comment required)		
Category Total		

Check box if no debris present at site ☐

Comments:

Intertidal Debris Assessment Worksheet: *Trash Tally*

STATION ID: _____ SITE CAPTAIN INITIALS _____

Toxic	> 25 cm	25 cm - 5 mm
Syringes or Pipettes		
Medical Devices		
Lighters		
Computers		
Keyboard		
Phones		
E-waste		
Cigarette Butts		
Chemical Containers		
Pens or Markers		
Bleach Bottles		
Cleaning Bottles		
Other (comment required)		
Category Total		

Miscellaneous	> 25 cm	25 cm - 5 mm
Packaging Ribbon		
Polypropylene Rope		
Fishing Line/Net		
Balloons (mylar)		
Balloons (latex)		
Roping/Ties		
Bandage/Bandaid		
Cigarette Box/Wrapper		
Rubber pieces		
Foam balls		
Other (comment required)		
Category Total		

	COUNTS	
Household	> 25 cm	25 cm - 5 mm
Storage Containers		
Shampoo Bottles		
Toothbrushes		
CDs / DVDs		
Mechanical Pencils		
Pipe (PVC)		
Tarp		
Furniture		
Sports balls		
Tape		
Toys		
Clothing (synthetic fabric)		
Other (comment required)		
Category Total		
GRAND TOTAL:		

Comments:

Intertidal Debris Assessment Worksheet: *Trash Tally*

STATION ID: _____ SITE CAPTAIN INITIALS _____

DATE: _____ TIME: _____

If container used to measure not gallon please provide units. Values must be converted to Liters (L) on right

Macrodebris Category	VOLUME	UNITS	VOLUME (L)
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	

Mesodebris Category	VOLUME	UNITS	VOLUME (L)
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	

OVERALL VOLUME	VOLUME	UNITS	VOLUME (L)
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	

If container used to measure not gallon please provide units. Values must be converted to Liters (L) on right

Size	VOLUME	UNITS	VOLUME (L)
>25 cm			
25 mm - 5 mm			
TOTAL VOLUME:		____	

Comments:

APPENDIX F

Riverine Habitat Debris Assessment Field Forms

Riverine Debris Assessment Worksheet: *Riverine Characterization*

WATERSHED: _____ DATE: _____

STREAM: _____ TIME: _____

STATION ID: _____ GPS: Start _____

SITE CAPTAIN INITIALS: _____ GPS: End _____

SAMPLER INITIALS: _____

Check box if no data collected at site ☐ (Provide explanation in comments section)			Number of photos taken:	
	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
1. Aesthetic Condition	No to small visual impact	Small to moderate visual impact from trash present.	Moderate to substantial impact from trash present.	Substantial to severe visual impact from trash present.
Rate impact to aesthetic condition of site based on visable trash (*rate higher or lower within each category according to condition. The higher number within each category reflects decreasing aesthetic condition*)	1 _____ 2 _____ 3 _____ 4 _____ 5 _____	6 _____ 7 _____ 8 _____ 9 _____ 10 _____	11 _____ 12 _____ 13 _____ 14 _____ 15 _____	16 _____ 17 _____ 18 _____ 19 _____ 20 _____

Dimensions: Bank Full Width _____ (meters) Wetted Width _____ (meters) Transect Length _____ (meters)

Stream Bed Characteristics	EARTHEN / CONCRETE	EMERGENT VEGETATION	LARGE ROCKS/ COBBLE	SUBMERGED PLANTS
	(E / C)	(Y / N)	(Y / N)	(Y / N)
Stream Bank	VEGETATED / EARTHEN	RIP-RAP	CONCRETE	SLOPED/VERTICAL
	(V / E)	(Y / N)	(Y / N)	(S / V)

Homeless Encampment: Within Transect (Y / N) Distance from Transect _____(meters) (DS / US)

Public Access: **Right Bank:** ____ **Easy** ____ **Difficult** ____ **Not at All** **Comments:**_____

Left Bank: ____ **Easy** ____ **Difficult** ____ **Not at All** **Comments:**_____

Adjacent Land Features **Near Bridge (Y / N) Fence on Bridge (Y / N) Fence height overhead (estimated)** _____

Access: Select all features located near the site		**Left Bank**	**Right Bank**	
	Fence	(Y / N)	(Y / N)	
	Heavy or thick vegetation	(Y / N)	(Y / N)	
	Roadway	(Y / N)	(Y / N)	
	Walkway	(Y / N)	(Y / N)	
	Bike Path	(Y / N)	(Y / N)	
	Parking Lot	(Y / N)	(Y / N)	
	Picnic Area	(Y / N)	(Y / N)	
	Restricted Access Maintenance Road	(Y / N)	(Y / N)	
Landuse	**Residential**	(Y / N)	(Y / N)	**Comments:**
	Commercial	(Y / N)	(Y / N)	
	Industrial	(Y / N)	(Y / N)	
	Park	(Y / N)	(Y / N)	
	Open Space	(Y / N)	(Y / N)	

Riverine Debris Assessment Worksheet: *Riverine Characterization*

STATION ID:_____ SITE CAPTAIN INITIALS _____ DATE:_____

Storm Drains Within Transect Area

Storm Drain Within Transects (Y / N) Sizes Categories (12" / 18" / 24" / 30" / 36" / 48" / 60" / > 96")

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Size:_____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Storm Drains Outside of Transect Area

Storm Drain Upstream Transects (Y / N) Sizes Categories (12" / 18" / 24" / 30" / 36" / 48" / 60" / > 96")

Distance from Transect:_____ Size: _____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Distance from Transect:_____ Size: _____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Distance from Transect:_____ Size: _____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Distance from Transect:_____ Size: _____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Distance from Transect:_____ Size: _____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Distance from Transect:_____ Size: _____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Distance from Transect:_____ Size: _____ Bank: L or R Trash at Drain (None / < 10 / <50 / <100 / >100)

Comments:

Riverine Debris Assessment Worksheet: *Riverine Characterization*

STATION ID: _____ SITE CAPTAIN INITIALS _____

DATE: _____ TIME: Start: _____

BANK: Left / Right Finish: _____

	COUNTS	
Bags and Packaging	**> 25 cm**	**25 cm - 5 mm**
Bags (single use plastic)		
Bags (takeout or other)		
Bags (large/retail)		
Food Wrapper		
Other Wrapper		
Pet Waste Bags		
Plastic straw wrapper		
Styrofoam pieces		
Styrofoam pellets		
Soft Plastic Pieces		
Hard Plastic Pieces		
Other (comment required)		
Category Total		
Food Service	**> 25 cm**	**25 cm - 5 mm**
Juice container		
Bottle Caps		
Milk Cartons		
Water Bottles		
Sports drink bottle		
Soda bottle		
Straws		
Lid		
Cups		
Utensils		
Styrofoam Container		
Styrofoam Cup/pieces		
6-pack rings		
Waxed Paper Cups		
Waxed Plates		
Other (comment required)		
Category Total		

Check box if no debris present at site ☐

Comments:

Riverine Debris Assessment Worksheet: *Riverine Characterization*

STATION ID: _____ SITE CAPTAIN INITIALS _____

Toxic	> 25 cm	25 cm - 5 mm
Syringes or Pipettes		
Medical Devices		
Lighters		
Computers		
Keyboard		
Phones		
E-waste		
Cigarette Butts		
Chemical Containers		
Pens or Markers		
Bleach Bottles		
Cleaning Bottles		
Other (comment required)		
Category Total		
Miscellaneous	**> 25 cm**	**25 cm - 5 mm**
Packaging Ribbon		
Polypropylene Rope		
Fishing Line/Net		
Balloons (mylar)		
Balloons (latex)		
Roping/Ties		
Bandage/Bandaid		
Cigarette Box/Wrapper		
Rubber pieces		
Foam balls		
Other (comment required)		
Category Total		
	COUNTS	
Household	**> 25 cm**	**25 cm - 5 mm**
Storage Containers		
Shampoo Bottles		
Toothbrushes		
CDs / DVDs		
Mechanical Pencils		
Pipe (PVC)		
Tarp		
Furniture		
Sports balls		
Tape		
Toys		
Clothing (synthetic fabric)		
Other (comment required)		
Category Total		
GRAND TOTAL:		

Riverine Debris Assessment Worksheet: *Riverine Characterization*

STATION ID: _____ SITE CAPTAIN INITIALS _____

DATE: _____ TIME: Start: _____

BANK: Left / Right Finish: _____

	COUNTS	
Bags and Packaging	**> 25 cm**	**25 cm - 5 mm**
Bags (single use plastic)		
Bags (takeout or other)		
Bags (large/retail)		
Food Wrapper		
Other Wrapper		
Pet Waste Bags		
Plastic straw wrapper		
Styrofoam pieces		
Styrofoam pellets		
Soft Plastic Pieces		
Hard Plastic Pieces		
Other (comment required)		
Category Total		
Food Service	**> 25 cm**	**25 cm - 5 mm**
Juice container		
Bottle Caps		
Milk Cartons		
Water Bottles		
Sports drink bottle		
Soda bottle		
Straws		
Lid		
Cups		
Utensils		
Styrofoam Container		
Styrofoam Cup/pieces		
6-pack rings		
Waxed Paper Cups		
Waxed Plates		
Other (comment required)		
Category Total		

Check box if no debris present at site ☐

Comments:

Riverine Debris Assessment Worksheet: *Riverine Characterization*

STATION ID: _____ SITE CAPTAIN INITIALS _____

Toxic	> 25 cm	25 cm - 5 mm
Syringes or Pipettes		
Medical Devices		
Lighters		
Computers		
Keyboard		
Phones		
E-waste		
Cigarette Butts		
Chemical Containers		
Pens or Markers		
Bleach Bottles		
Cleaning Bottles		
Other (comment required)		
Category Total		
Miscellaneous	**> 25 cm**	**25 cm - 5 mm**
Packaging Ribbon		
Polypropylene Rope		
Fishing Line/Net		
Balloons (mylar)		
Balloons (latex)		
Roping/Ties		
Bandage/Bandaid		
Cigarette Box/Wrapper		
Rubber pieces		
Foam balls		
Other (comment required)		
Category Total		
	COUNTS	
Household	**> 25 cm**	**25 cm - 5 mm**
Storage Containers		
Shampoo Bottles		
Toothbrushes		
CDs / DVDs		
Mechanical Pencils		
Pipe (PVC)		
Tarp		
Furniture		
Sports balls		
Tape		
Toys		
Clothing (synthetic fabric)		
Other (comment required)		
Category Total		
GRAND TOTAL:		

Riverine Debris Assessment Worksheet: *Riverine Characterization*

STATION ID: _____ LAB TECH INITIALS: _____

DATE: _____ TIME: _____

If container used to measure not gallon please provide units. Values must be converted to Liters (L) on right

Macrodebris Category	VOLUME	UNITS	VOLUME (L)
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	
Mesodebris Category	**VOLUME**	**UNITS**	**VOLUME (L)**
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	
OVERALL VOLUME	**VOLUME**	**UNITS**	**VOLUME (L)**
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	

If container used to measure not gallon please provide units. Values must be converted to Liters (L) on right

Size	VOLUME	UNITS	VOLUME (L)
>25 cm			
25 mm - 5 mm			
TOTAL VOLUME:		____	

Comments:

Riverine Debris Assessment Worksheet: *Riverine Characterization*

STATION ID:_____ SITE CAPTAIN INITIALS _____ DATE:_____

Large or Unmoveable Items

ITEM 1	Right Bank	Left Bank	ITEM 2	Right Bank	Left Bank
Location:			Location:		
Description:			Description:		

ITEM 3	Right Bank	Left Bank	ITEM 4	Right Bank	Left Bank
Location:			Location:		
Description:			Description:		

ITEM 5	Right Bank	Left Bank	ITEM 6	Right Bank	Left Bank
Location:			Location:		
Description:			Description:		

ITEM 7	Right Bank	Left Bank	ITEM 8	Right Bank	Left Bank
Location:			Location:		
Description:			Description:		

ITEM 9	Right Bank	Left Bank	ITEM 10	Right Bank	Left Bank
Location:			Location:		
Description:			Description:		

Comments:

APPENDIX G
Laboratory Forms

Debris Assessment Laboratory Worksheets

STATION ID: _____ LAB TECH INITIALS: _____

LAB ANALYSIS DATE: _____ LAB ANALYSIS TIME: _____

	COUNT		
Bags and Packaging	**> 25 cm**	**25 cm - 5 mm**	**Labels/Brand Names:**
Bags (single use plastic)			
Bags (takeout or other)			
Bags (large/retail)			
Food Wrapper			
Other Wrapper			
Pet Waste Bags			
Plastic straw wrapper			
Styrofoam pieces			
Styrofoam pellets			
Soft Plastic Pieces			
Hard Plastic Pieces			
Other (comment required)			
Category Total			
Food Service	**> 25 cm**	**25 cm - 5 mm**	**Labels/Brand Names:**
Juice container			
Bottle Caps			
Milk Cartons			
Water Bottles			
Sports drink bottle			
Soda bottle			
Straws			
Lid			
Cups			
Utensils			
Styrofoam Container			
Styrofoam Cup/pieces			
6-pack rings			
Waxed Paper Cups			
Waxed Plates			
Other (comment required)			
Category Total			

Comments:

Debris Assessment Laboratory Worksheets

STATION ID: _____ LAB TECH INITIALS: _____

Toxic	> 25 cm	25 cm - 5 mm	Labels/Brand Names:
Syringes or Pipettes			
Medical Devices			
Lighters			
Computers			
Keyboard			
Phones			
E-waste			
Cigarette Butts			
Chemical Containers			
Pens or Markers			
Bleach Bottles			
Cleaning Bottles			
Other (comment required)			
Category Total			

Miscellaneous	> 25 cm	25 cm - 5 mm	Labels/Brand Names:
Packaging Ribbon			
Polypropylene Rope			
Fishing Line/Net			
Balloons (mylar)			
Balloons (latex)			
Roping/Ties			
Bandage/Bandaid			
Cigarette Box/Wrapper			
Rubber pieces			
Foam balls			
Other (comment required)			
Category Total			

Household	> 25 cm	25 cm - 5 mm	Labels/Brand Names:
Storage Containers			
Shampoo Bottles			
Toothbrushes			
CDs / DVDs			
Mechanical Pencils			
Pipe (PVC)			
Tarp			
Furniture			
Sports balls			
Tape			
Toys			
Clothing (synthetic fabric)			
Other (comment required)			
Category Total			
GRAND TOTAL:			

Debris Assessment Laboratory Worksheets

STATION ID:_____ LAB TECH INITIALS:_____

DATE: _____ TIME: _____

If container used to measure not gallon please provide units. Values must be converted to Liters (L) on right

Macrodebris Category	VOLUME	UNITS	VOLUME (L)
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	

Mesodebris Category	VOLUME	UNITS	VOLUME (L)
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	

OVERALL VOLUME	VOLUME	UNITS	VOLUME (L)
Bags and Packaging			
Toxic			
Miscellaneous			
Food Service			
Household			
TOTAL VOLUME:		____	

If container used to measure not gallon please provide units. Values must be converted to Liters (L) on right

Size	VOLUME	UNITS	VOLUME (L)
>25 mm			
25 mm - 5 mm			
TOTAL VOLUME:		____	

Comments:

Debris Assessment Laboratory Worksheets

STATION ID:_____ Initials:_____ Sample Date:_____ Sample Time:_____

If more than 1 sample, Sample No._____ of _____ Lab Analysis Date:_____ Lab Analysis Time:_____

Size	Count	Total Count
> 4.75 mm		
4.75 mm		
2.0 mm		
1.0 mm		
0.500 mm		
0.355 mm		
Total		

If container used to measure not liters (L) please provide units. Values must be converted to Liters (L) on right

Size	Volume	Units	Volume (L)
> 4.75 mm			
4.75 mm			
2.0 mm			
1.0 mm			
0.500 mm			
0.355 mm			
Total Volume		____	

Colors	Count	Total Count
White		
Clear		
Blue		
Green		
Black		
Yellow		
Grey		
Pink		
Red		
Orange		
Tan		
Peach		
Total		

Comments