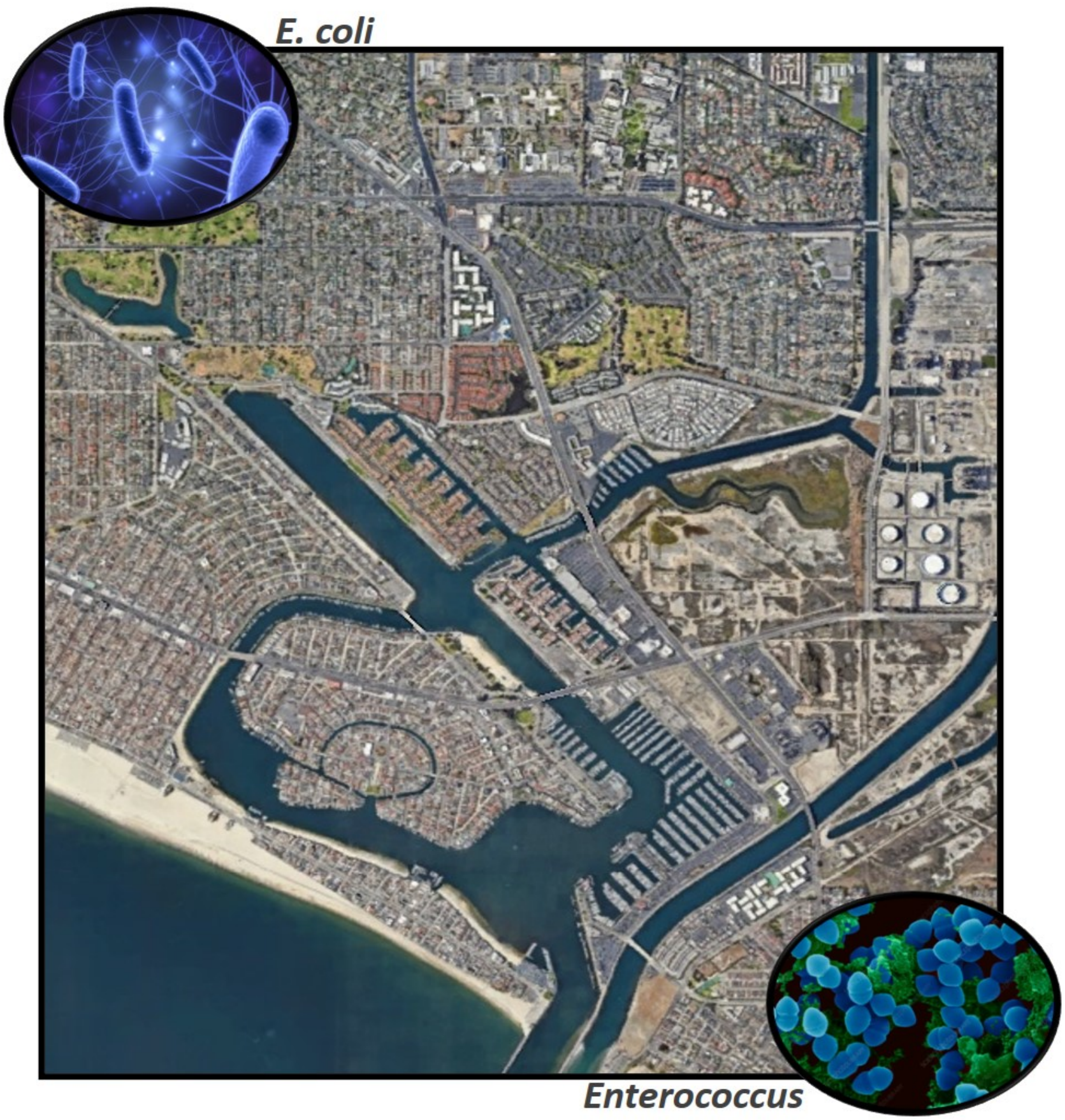
Total Maximum Daily Load for Indicator Bacteria in Los Cerritos Channel and Estuary, Alamitos Bay, and Colorado Lagoon



December, 2021
California Regional Water Quality Control Board, Los Angeles Region
320 W. 4th Street, Suite 200
Los Angeles, CA 90013

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICIES

1. INTRODUCTION

This Staff Report presents the required elements of the Total Maximum Daily Load (TMDL) to address the bacteria water quality impairments in Los Cerritos Channel and Estuary, Alamitos Bay, and Colorado Lagoon, and provides the supporting technical analysis used in the development of the TMDL by the California Regional Water Quality Control Board, Los Angeles Region (Los Angeles Water Board). The goal of this TMDL is to restore water quality in these water bodies in alignment with the goal of the federal Clean Water Act (CWA) and the statutory mission of the Los Angeles Water Board. To achieve this goal, the TMDL identifies and sets forth measures needed to remedy impairment of water quality due to elevated indicator bacteria densities in Los Cerritos Channel and Estuary, Alamitos Bay and Colorado Lagoon.

Los Cerritos Channel was included on the 1996, 1998, 2002, 2006, 2008, 2010, 2012, 2014/2016, and 2018 CWA section 303(d) lists of impaired waterbodies for high coliform count or indicator bacteria. Alamitos Bay and Colorado Lagoon were included on the 2006, 2010, 2014/2016, and 2018 CWA section 303(d) lists of impaired water bodies for indicator bacteria. The Los Cerritos Channel Estuary is not on the 303(d) list for indicator bacteria; however, recent data described in this staff report show that it is impaired by *Enterococcus*. In addition, the Los Cerritos Estuary is located upstream of Alamitos Bay and may contribute to the impairments in Alamitos Bay. Therefore, the Los Cerritos Channel Estuary is addressed in this TMDL.

The CWA requires TMDLs to be developed to restore impaired waterbodies to their full beneficial uses. Total coliform, fecal coliform, *Escherichia coli* (*E. coli*), and *Enterococcus* are fecal indicator bacteria (FIB) widely used to assess the microbiological condition of water. Although FIB do not directly cause illness, they are associated with fecal contamination and the possible presence of waterborne pathogens, which can cause illness.

1.1. REGULATORY BACKGROUND

The State of California’s principal water quality control law is the Porter-Cologne Water Quality Act (Porter Cologne) (Wat. Code div. 7), which is implemented in the Los Angeles Region through the Water Quality Control Plan - Los Angeles Region (Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties, hereinafter Basin Plan) along with statewide water quality control plans and policies. The Basin Plan sets water quality standards for the Los Angeles Region, which include designated beneficial uses of surface and ground water, numeric and narrative water quality objectives necessary to support beneficial uses, as well as the state’s antidegradation policy. The Basin Plan also includes implementation programs to protect all waters in the Los Angeles Region and the beneficial uses of those waters.

Section 303(d)(1) of the CWA requires each state to identify the waters within its boundaries that do not meet water quality standards. The resulting list is referred to as the 303(d) list. The CWA also requires states to establish a priority ranking for waters on the 303(d) list and to develop and implement TMDLs for these impaired waters. The Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) list (Listing Policy) was adopted by the State Water Resources Control Board (State Water Board) in 2004 and amended in 2015 (State Water Quality Control Board, 2015). The Listing Policy describes the process by which the State Water Board and regional water boards will comply with the listing requirements of section 303(d) of the CWA. The Listing Policy establishes a standardized approach for developing California's section 303(d) list and includes data requirements such as spatial and temporal independence.

A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards and allocates the pollutant loadings to point and nonpoint sources. The elements of a TMDL are described in 40 Code of Federal Regulations (C.F.R.) sections 130.2 and 130.7 and section 303(d) of the CWA, and in the United States Environmental Protection Agency (U.S. EPA) guidance (U.S. EPA, 1991). The Regional Water Board is also required to develop a TMDL taking into account seasonal variations and including a margin of safety to address uncertainty in the analysis (40 C.F.R. §130.7(c)(1)). A TMDL is the sum of the individual waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint sources and a margin of safety (MOS) such that the capacity of the waterbody to assimilate pollutant loads (the loading capacity) is not exceeded (U.S. EPA, 1991). Finally, TMDLs must be included in the State's water quality management plan or referenced as part of the water quality management plan if contained in separate documents (40 C.F.R. §130.6(c)(1)).

The U.S. EPA has oversight authority for the 303(d) list and is required to review and either approve or disapprove the state's 303(d) list and each TMDL developed by the state. If the state fails to develop a TMDL in a timely manner or if the U.S. EPA disapproves a TMDL submitted by a state, U.S. EPA is required to establish a TMDL for that waterbody (40 C.F.R. §130.7(d)(2)).

Chapter 3 of the Basin Plan contains bacteria water quality objectives (WQOs) to protect beneficial uses for primary contact recreation including both Water Contact Recreation (REC-1) and Non-contact Water Recreation (REC-2).

In 2001, the Los Angeles Water Board updated the bacteria WQOs for waters designated as REC-1 to be consistent with U.S. EPA's recommended criteria (published in "Ambient Water Quality Criteria for Bacteria – 1986") and the California Code of Regulations, title 17, section 7958 "Bacteriological Standards," which implements Assembly Bill No. 411 (Statutes of 1997) (Los Angeles Water Board Resolution No. R01-018, hereinafter 2001 Bacteria Objectives). The 2001 Bacteria Objectives include both single sample maximum and geometric mean objectives. The updated bacteria objectives were subsequently approved by the State Water Board on July 18, 2002 (State Water Board Resolution No. 2002-0142), the Office of Administrative Law (OAL) on September 19, 2002 (OAL File No. 02-0807-01 S), and the U.S. EPA on September 25, 2002.

Prior TMDLs based on the 2001 Bacteria Objectives used an approach developed by the Los Angeles Water Board (Resolution No. 2002-022) called the reference system/antidegradation approach to establish pollutant allocations for municipal stormwater and nonpoint source discharges. With this approach, the TMDLs established an allowable frequency of exceedances of the single sample maximum objectives, established an allowable number of exceedance days of the single sample maximum objectives, and required attainment of the geometric mean objectives at all times. The number of allowable exceedance days was based on two criteria: (1) bacteriological water quality at any site was required to be at least as good as a designated reference site, and (2) no degradation of existing bacteriological water quality was allowed, if historical water quality at a particular site was better than the designated reference site.

In 2010, the Los Angeles Water Board updated the bacteria objectives for freshwaters designated as REC-1 to remove redundancy and maintain consistency with U.S. EPA's recommendation that *E. coli* replace fecal coliform as an indicator of the presence of pathogens in fresh waters. The Los Angeles Water Board adopted the revised objectives on July 8, 2010 by Resolution No. R10-005, the State Water Board approved the revised objectives on July 19, 2011 by Resolution No. 2011-0031, and OAL (File No. 2011-0923-01 S) approved them on November 1, 2011. The revised objectives became final after U.S. EPA approval on December 5, 2011. The update of the bacteria objectives removed the fecal coliform objectives, using *E. coli* objectives as the sole objectives for freshwaters designated with the REC-1 beneficial use.

All of the bacteria TMDLs developed and adopted by the Los Angeles Water Board to date have used the 2001 and/or 2010 Bacteria Objectives including the Santa Monica Bay Bacteria TMDL (in effect in 2003), Marina del Rey Bacteria TMDL (2004), Los Angeles Harbor Main Channel and Inner Cabrillo Beach Bacteria TMDL (2005), Malibu Creek Bacteria TMDL (2006), Ballona Creek Bacteria TMDL (2008), Harbor Beaches of Ventura County (Hobie and Kiddie Beaches) Bacteria TMDL (2008), Santa Clara River Bacteria TMDL (2012), Los Angeles River Bacteria TMDL (2012), and San Gabriel River Bacteria TMDL (2016). Several of these TMDLs have also been reconsidered and modified by the Los Angeles Water Board in order to adjust technical matters.

In 2012, U.S. EPA established new recreational water quality criteria recommendations based on updated national epidemiological studies and a broader definition of illness designed to protect the public from exposure to harmful levels of pathogens while participating in water-contact recreational activities. The U.S. EPA 2012 "Recreational Water Quality Criteria" is intended as guidance to states and tribes in developing criteria to protect swimmers from exposure to water that contains organisms indicating the presence of fecal contamination and includes beach action values that can be used by local health officials, regional water boards, and authorized tribes as a tool for beach management actions in freshwaters, estuarine waters, and ocean waters. The 2012 Recreational Criteria recommend the use of either *Enterococcus* or *E. coli* as indicators of fecal or pathogen contamination in fresh waters and recommends the use of only *Enterococcus* as an indicator in marine waters. The recommended criteria are comprised of a magnitude, duration and frequency of excursion for both the geometric mean and a statistical threshold value (STV). Additionally, the criteria included two estimated illness rates (36 illnesses per 1,000 recreators or 32 illnesses per 1,000 recreators), stating that either rate is protective of the REC-1 beneficial use.

On August 7, 2018, the State Water Board adopted new statewide bacteria WQOs and implementation options to protect recreational users from the effects of pathogens in California water bodies (State Water Board Resolution No. 2018-0038). This Resolution adopted bacteria provisions and a water quality variance policy in two places: (1) Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries of California—Bacteria Provisions and a Water Quality Standards Variance Policy (Part 3 of the ISWEBE) and (2) the Amendment of the Water Quality Control Plan for Ocean Waters of California - Bacteria Provisions and a Water Quality Standards Variance Policy (Ocean Plan Amendment). Part 3 of the ISWEBE and the Ocean Plan Amendment are collectively referred to as the Statewide Bacteria Provisions. The primary goal of the Statewide Bacteria Provisions is to protect REC-1 waters through the establishment of statewide numeric WQOs for bacteria based on the U.S. EPA 2012 Recreational Criteria. The Statewide Bacteria Provisions do not contain a specific program of implementation to achieve the bacteria WQOs because TMDLs for bacteria have been established for many waterbodies throughout the state prior to the effective date of the Bacteria Provisions. The Office of Administrative Law and U.S. EPA approved the Statewide Bacteria Provisions on February 4, 2019 and March 22, 2019, respectively. The Statewide Bacteria Provisions became effective on March 22, 2019.

On February 13, 2020, the Los Angeles Water Board adopted Resolution R20-001, amending Chapter 3 of the Basin Plan to align with the WQOs contained in the State Water Board’s Bacteria Provisions. The amendment incorporated the revised bacteria objectives for water contact recreation and removed the existing 2001 and 2010 Bacteria Objectives that are no longer applicable as a result of the statewide provisions. The Los Angeles Water Board’s updated bacteria objectives were subsequently approved by the State Water Board on May 19, 2020 (State Water Board Resolution No. 2020-0017) and OAL on June 22, 2021 (OAL File No. 2021-0512-01 S).

The Los Angeles Water Board has not yet developed any bacteria TMDLs based on the Statewide Bacteria Provisions. However, bacteria TMDLs in other regions have been established based on the Statewide Bacteria Provisions, including the Russian River Watershed Bacteria TMDL (R1-2019-0038) in the North Coast Region and the Petaluma River Bacteria TMDL (R2-2019-0030) and Pillar Point Harbor and Venice Beach Bacteria TMDL (R2-2021-0002) in the San Francisco Bay Region. This Bacteria TMDL for Los Cerritos Channel and Estuary, Alamitos Bay, and Colorado Lagoon is the first TMDL in the Los Angeles Region to be developed with the Statewide Bacteria Provisions. Due to the difference in the expression of the STV objectives in the Statewide Bacteria Provisions as compared to the prior single sample maximum objectives in the 2001 and 2010 Bacteria Objectives, the reference system/antidegradation approach is not used.

1.2. ELEMENTS OF A TMDL

There are seven federally required elements of a TMDL. This Staff Report describes the analysis and findings of this TMDL for each of the required elements (Sections 2-8) in addition to sections describing costs and benefits. The required elements of a TMDL are:

1. Problem Identification (Section 2): This section reviews the bacteria data used to add the waterbody to the 303(d) list, and summarizes existing conditions using that evidence along with newly available information acquired since the inclusion of these waterbodies on the State of California's 303(d) List of Impaired Waters. This element identifies those waterbodies that fail to support the designated beneficial uses due to impacts from the subject pollutant(s); the WQOs designed to protect those beneficial uses; and, in summary, the evidence supporting the decision to list each waterbody, such as the number and severity of exceedances observed.

2. Numeric Targets (Section 3): This section describes the numeric targets for this TMDL which are based on the Statewide Bacteria Provisions WQOs and associated implementation provisions described in the Statewide Bacteria Provisions and Basin Plan.

3. Source Assessment (Section 4): This section describes bacteria contributions from point sources and nonpoint sources.

4. Linkage Analysis (Section 5): This analysis shows how the sources of pollutants discharged to the waterbody are linked to the observed conditions in the impaired waterbody. The Linkage Analysis includes a discussion of the Critical Conditions and the Margin of Safety.

5. Pollutant Allocations (Section 6): In this section, point sources are assigned waste load allocations (WLAs) and nonpoint sources are assigned load allocations (LAs). Allocations are designed such that the waterbody will not exceed numeric targets for bacteria. Allocations are based on critical conditions so that the allocated pollutant loads may be expected to not cause impairment at all times.

6. Implementation (Section 7): This section describes the programs, regulatory tools, or other mechanisms by which the WLAs and LAs are to be achieved.

7. Monitoring (Section 8): This TMDL includes a requirement for monitoring the waterbody to ensure that water quality standards are attained and describes the monitoring strategy that will be used to develop information for performance evaluation and consideration of TMDL revisions.

1.3. STAKEHOLDER OUTREACH

On December 17, 2019, Los Angeles Water Board staff held a stakeholder meeting to solicit comments on the development of (1) a TMDL for indicator bacteria in the Los Cerritos Channel and Estuary and (2) a TMDL for indicator bacteria in Alamitos Bay and Colorado Lagoon. At the time of this stakeholder meeting, staff was anticipating developing two separate sets of Staff Reports and Basin Plan Amendments. However, for efficiency, for both the Los Angeles Water Board and for stakeholders, these TMDLs are now all addressed in this Staff Report and a single recommended tentative Basin Plan Amendment. At this meeting, Los Angeles Water Board staff presented background on the TMDLs, reviewed recent data, and solicited stakeholder engagement. Nine (9) stakeholders, including a representative of U.S. EPA, a representative of Heal the Bay, representatives of the City of Long Beach and Los Angeles County, and consultants, attended the meeting.

In conjunction with the December 17, 2019 stakeholder meeting, the Los Angeles Water Board held a California Environmental Quality Act (CEQA) scoping meeting on the same day to solicit input from the interested stakeholders on the appropriateness of the scope, content and implementation options of the TMDLs. At the CEQA scoping meeting, the CEQA checklist of significant environmental issues and mitigation measures was discussed. This meeting fulfilled the requirements under CEQA (Public Res. Code, § 21083.9).

After the scoping meeting, presentation slides were sent to stakeholders upon request.

Staff reached out to marina operators within Alamitos Bay and Los Cerritos Channel Estuary. Staff spoke about the TMDL with Tom Welch, the manager of Spinnaker Bay Slip Association, Jay J. Feinberg, owner and operator of Marina Pacifica, Alyceanne Nunn, manager of one of the private marinas in what was formally known as Crissman's Marina, and Elvira Hallinan, manager of the City of Long Beach Marina Bureau. Staff also requested information about the number of slips, liveaboards, pump-out stations, and any current implementation actions that help reduce bacteria from entering the water.

Staff held a conference call with the City of Long Beach on March 26, 2020 to discuss the implementation options, compliance pathways and compliance schedule.

Pursuant to Public Resources Code sections 21080.3.1 and 21084.3(c), CEQA lead agencies are required to consult with California Native American tribes that have requested notice from such agencies of projects in the geographic areas that are traditionally and culturally affiliated with the tribes. On November 27, 2019, the Los Angeles Water Board sent formal letters to the Kizh Nation-Gabrieleño Band of Mission Indians, the San Manuel Band of Mission Indians, and the Gabrieleño /Tongva San Gabriel Band of Mission Indians, to formally notify these tribes of the TMDL, regulatory background, and project locations. On December 4, 2019, pursuant to Public Resources Code section 21080.3.1, subdivision (b), the Native

American Heritage Commission notified the Los Angeles Water Board of three other tribes that are traditionally and culturally affiliated with the geographic area of the TMDL, but have not requested notification of projects in the tribe's areas of traditional and cultural affiliation. On December 23, 2019, the Los Angeles Water Board sent formal letters to these three tribes notifying them of the TMDLs, regulatory background, and project locations.

Staff received one consultation request from Kizh Nation and subsequently held a conference call with the Kizh Nation's representatives on May 7, 2020. Staff discussed with the Kizh Nation's representatives their concerns regarding water quality in project areas where tribal people access water for ceremonial, gathering, and recreational purposes.

1.4. ENVIRONMENTAL SETTING

The Los Cerritos Channel watershed is divided into five subwatersheds: Los Cerritos Channel subwatershed, Los Cerritos Channel Estuary subwatershed, Alamitos Bay subwatershed, Colorado Lagoon subwatershed, and Los Cerritos Channel Coastal subwatershed (Figure 1). The TMDL encompasses the Los Cerritos Channel subwatershed, the Los Cerritos Channel Estuary subwatershed, the Alamitos Bay subwatershed, and the Colorado Lagoon subwatershed. For the purpose of this TMDL these four subwatersheds will be collectively referred to as the Upper Los Cerritos Channel watershed. The Los Cerritos Channel Coastal subwatershed is outside the scope of this TMDL.

The Upper Los Cerritos Channel watershed is located to the west of the San Gabriel River near the border between Los Angeles County and Orange County. The cities of Bellflower, Cerritos, Downey, Lakewood, Long Beach, Paramount, and Signal Hill, and a small portion of Los Angeles County Unincorporated Area, are located within the Los Cerritos Channel watershed (Figure 2).

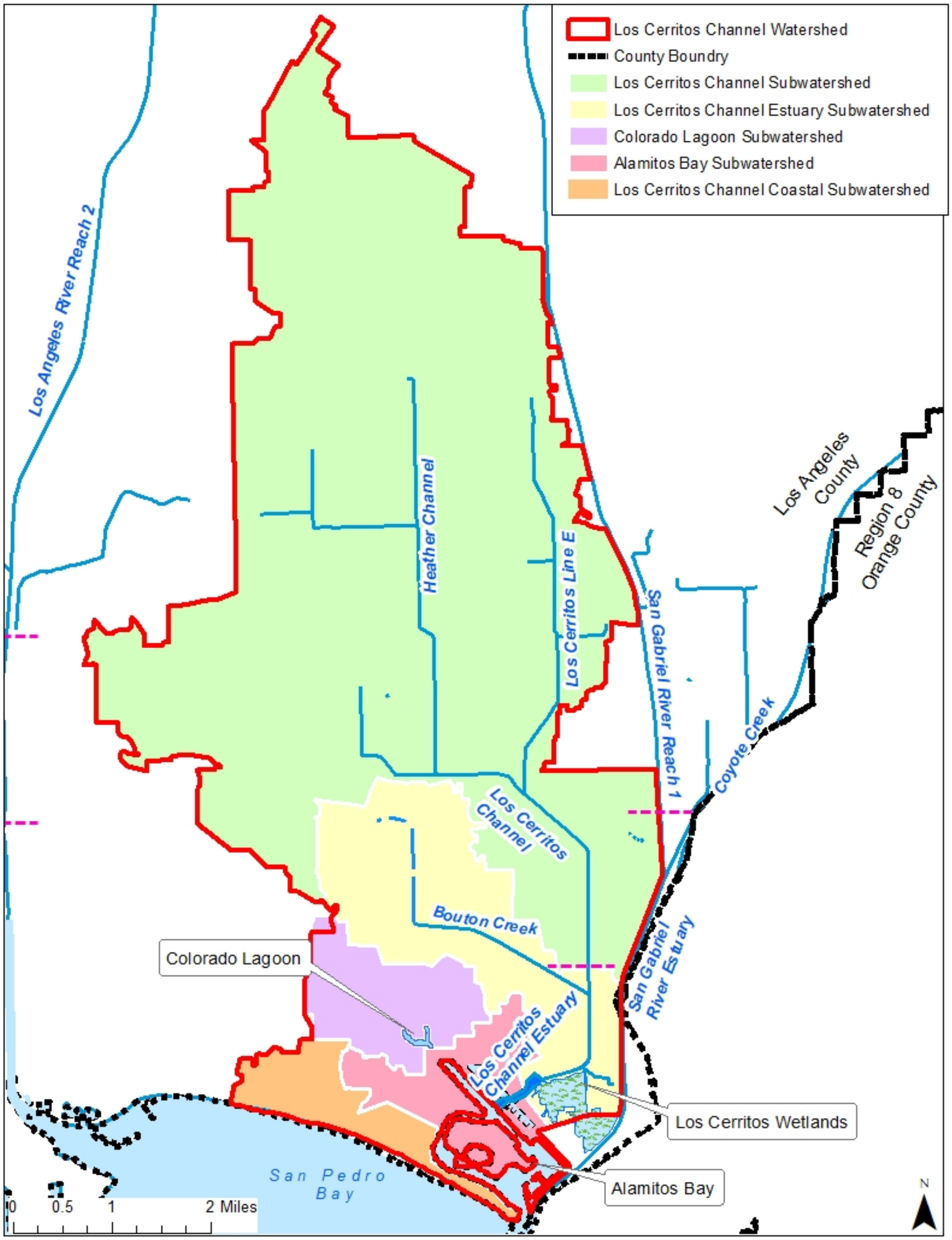


Figure 1: Los Cerritos Channel Watersheds with Subwatersheds

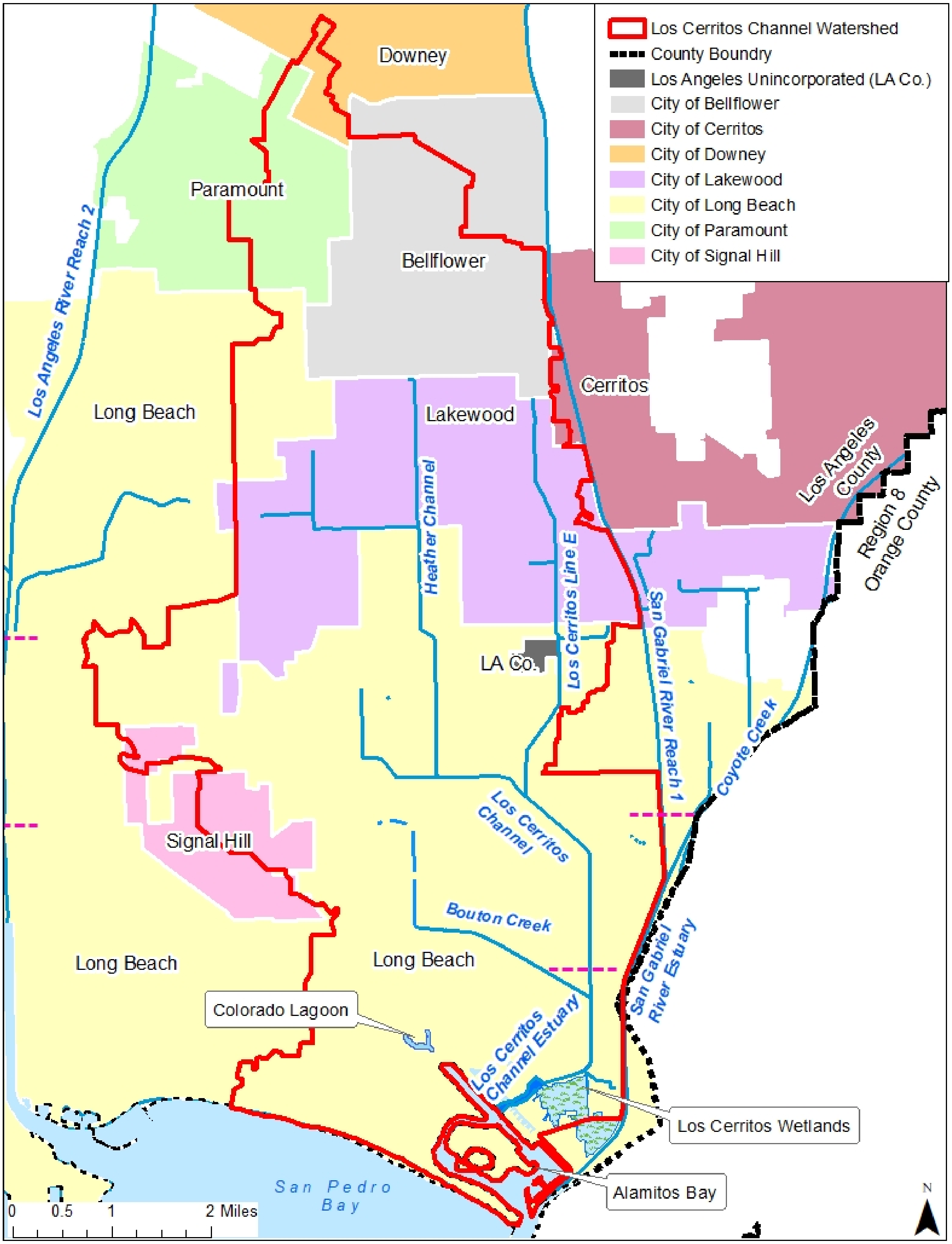


Figure 2: Jurisdictions within Los Cerritos Channel Watershed

1.4.1. LOS CERRITOS CHANNEL SUBWATERSHED AND LOS CERRTIOS CHANNEL ESTUARY SUBWATERSHED

The Los Cerritos Channel is a concrete-lined freshwater stream that is 2.1 miles in length. Los Cerritos Channel is channelized until approximately Atherton Street, where it continues for approximately 0.5 miles as a soft bottom channel to Anaheim Road. The soft bottom segment of Los Cerritos Channel is where the tidal prism[1] begins and connects to the Los Cerritos Channel Estuary at Anaheim Road. The portion of Los Cerritos Channel listed as impaired for indicator bacteria is the freshwater portion above the tidal prism. The Los Cerritos Channel above the tidal prism drains a relatively small, densely urbanized, area of approximately 17,711 acres (or 27.7 square miles). Discharges from the freshwater portion of the Los Cerritos Channel contribute the major flows to the Los Cerritos Channel Estuary.

The Los Cerritos Channel wetlands are part of the historic Los Cerritos wetlands complex which exist today in both the Cities of Long Beach and Seal Beach. The Los Cerritos Channel wetlands are within the Los Cerritos Channel Estuary subwatershed. The wetlands have a great diversity of birds despite their small size. An endangered bird species, the Belding's Savannah Sparrow, may nest there and an area adjacent to the wetlands is a historic least tern colony site. Restoration within the greater Los Cerritos wetlands complex is guided by the 2015 *Los Cerritos Wetlands Final Conceptual Restoration Plan.* In addition, the Upper Los Cerritos Wetlands Mitigation Bank has been established in these wetlands by the Los Cerritos Wetlands LLC in a 69-acre former oil production property (Los Cerritos Channel Authority, 2015).

One small marina, the Cerritos Bahia Marina (Figure 4), is located in the Estuary and is used by rowing teams and fisherman.

According to the Southern California Association of Governments (SCAG), land use types in Los Cerritos Channel are primarily Residential, Commercial & Services, Transportation, Communication & Utilities, accounting for 59%, 17% and 9% of total land use, respectively. Open Space and Recreation, and Agriculture accounted for 6% of the subwatershed. Other land uses within Los Cerritos Channel subwatershed account for 1% or less of the overall area.

Land use types in the Los Cerritos Channel Estuary subwatershed are primarily Residential, Commercial & Services, Transportation, and Communication & Utilities, accounting for 48%, 28% and 13% of total land use, respectively. Other land uses within Los Cerritos Channel Estuary subwatershed account for 4% or less of the overall area. Figure 3 shows the land use types within Los Cerritos Channel and the Los Cerritos Channel Estuary.

[1] Tidal prism is the volume of water drawn into a channel from the ocean through tides.

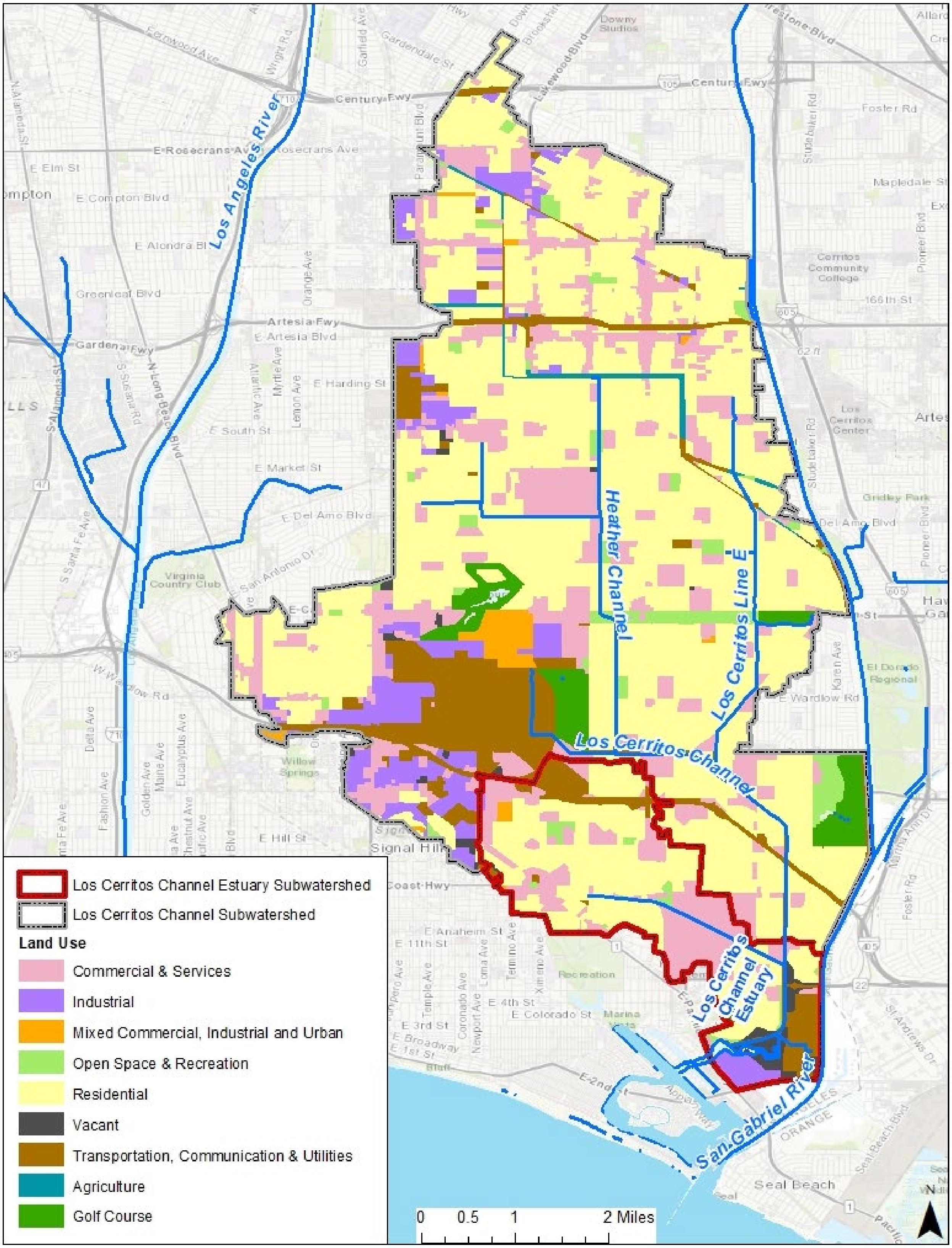


Figure 3: Land Use in Los Cerritos Channel and Los Cerritos Channel Estuary Subwatersheds

1.4.2. ALAMITOS BAY SUBWATERSHED

Alamitos Bay subwatershed is approximately 1,056-acres of land, located on the east side of San Gabriel River at the intersection of Pacific Coast Highway and Second Street, near Belmont Shore and includes Naples Island in the center of Alamitos Bay. Alamitos Bay is downstream of Colorado Lagoon and Los Cerritos Channel Estuary. Flows from Colorado Lagoon enter Alamitos Bay via California's Historical Landmark No. 1014 Long Beach Marine Stadium (California Historical Landmark, 2020). Marine Stadium is a man-made canal, created in 1932 for rowing events of the X Olympiad. Marine Stadium remains an important training and competitive center for rowers, including National and Olympic teams.

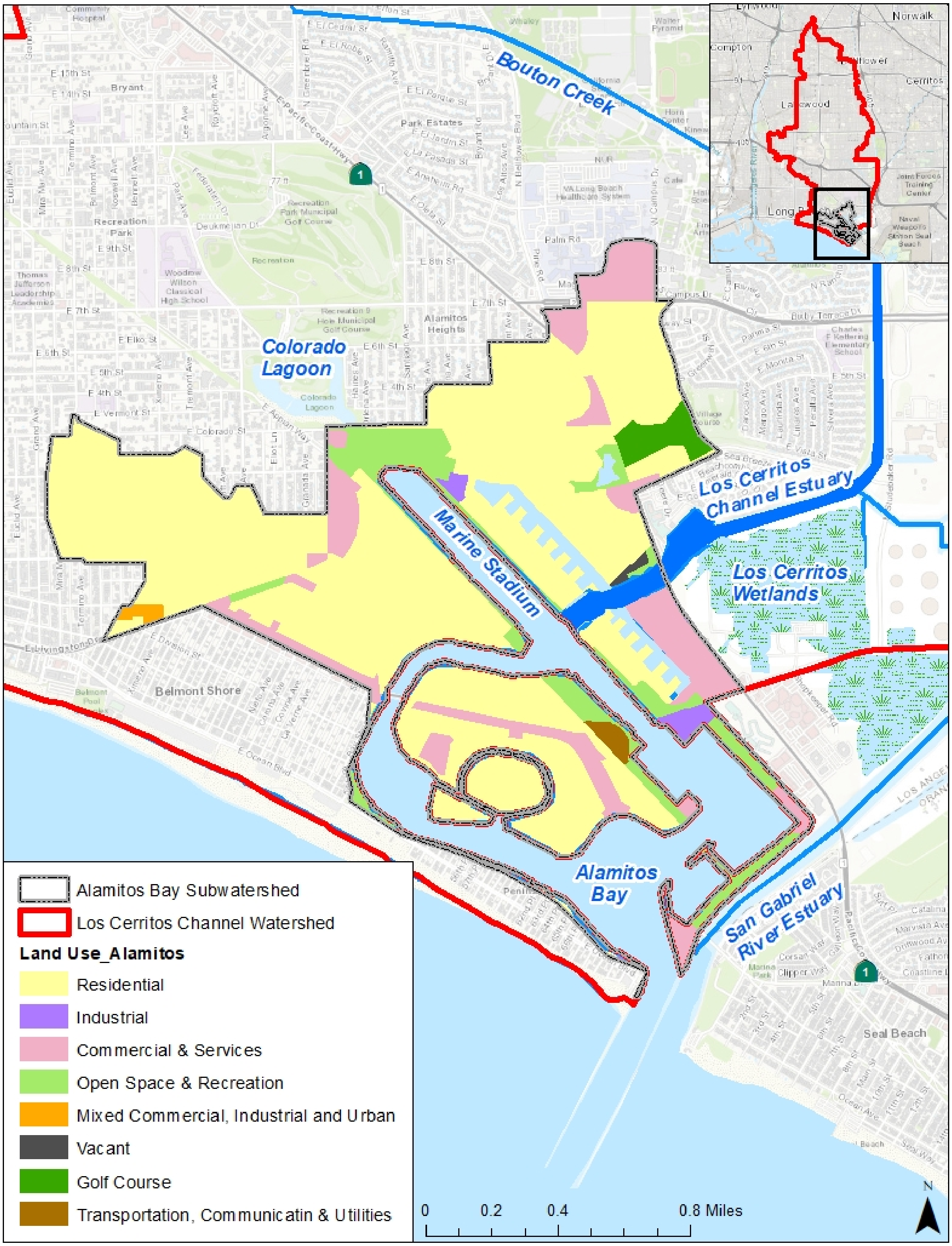
Three islands, located in the center of Alamitos Bay, make up Naples. Two of the islands are divided by the large semi-circular Rivo Alto Canal and a shorter straight Naples Canal that open to Alamitos Bay and the third island, Treasure Island. Lining the canals is an unquantified number of independent boat slips and docks fronting homes that overlook the waterways.

Recreators use the beaches that line the southern portion of Alamitos Bay, plus a sheltered bayfront beach known as Marine Park or Mother's Beach, located on the northern side of the Naples Island near the confluence with Los Cerritos Estuary.

Alamitos Bay subwatershed includes Alamitos Bay Marina, also known as Long Beach Marina, and six private marinas, including Spinnaker Bay Marina, Marina Pacifica, and four independently owned private marinas in what was formally known as Crissman's Marina. Just outside of the Alamitos Bay subwatershed, located in the Los Cerritos Estuary subwatershed, is another privately-owned marina, Cerritos Bahia Marina. Figure 4 depicts the location of all the marinas within the Los Cerritos Channel Estuary and Alamitos Bay subwatersheds.

According to SCAG, land use types in the Alamitos Bay subwatershed are primarily Residential, Commercial & Services, and Open Space & Recreation, accounting for 72%, 14% and 10% of total land use, respectively. Other land uses within the Alamitos Bay subwatershed account for 2% or less of the overall area. Figure 5 shows the land use types within the Alamitos Bay subwatershed.


Colorado Lagoon
Marine Stadium
Los Cerritos Estuary
Basin 8
Basin 6 North
Basin 6 South
Basin 4
Basin 3
Basin 2
Basin 1
Basin 7
Basin 5
Alamitos Bay
San Gabriel River Estuary
1
Cerrritos Bahia Marina
Spinnaker Bay Marina
Marina Pacifica
Alamitos Bay Marina
Independent Boat Slips
Four Individual Private Marinas
Alamitos Bay Subwatershed
N
0
0.15
0.3
0.6 Miles

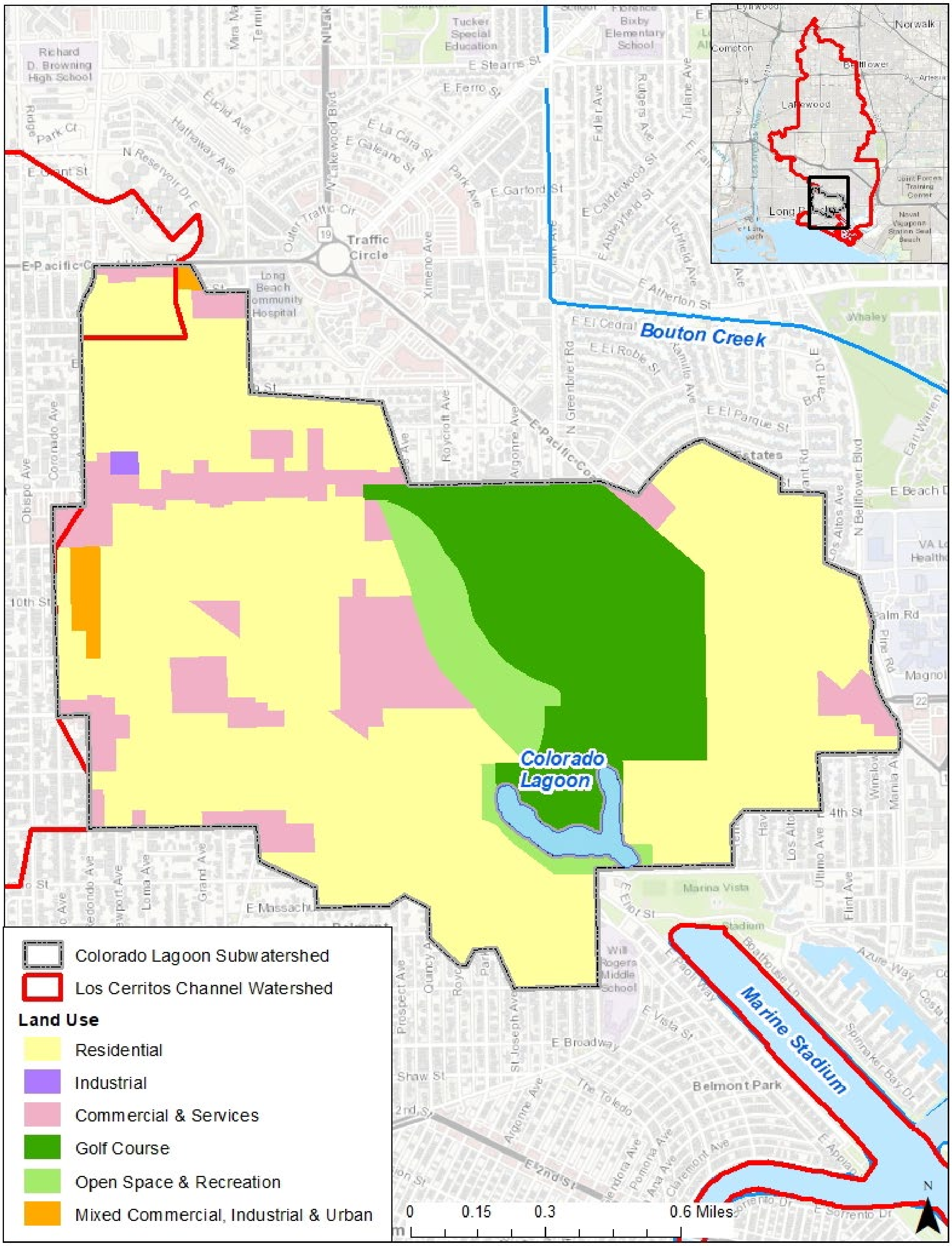

Bouton Creek
Colorado Lagoon
Los Cerritos Channel Estuary
Los Cerritos Wetlands
Marine Stadium
Alamitos Bay
San Gabriel River Estuary
Belmont Shore
Seal Beach
Alamitos Bay Subwatershed
Los Cerritos Channel Watershed
Land Use_Alamitos
Residential
Industrial
Commercial & Services
Open Space & Recreation
Mixed Commercial, Industrial and Urban
Vacant
Golf Course
Transportation, Communicatin & Utilities
0 0.2 0.4 0.8 Miles
N

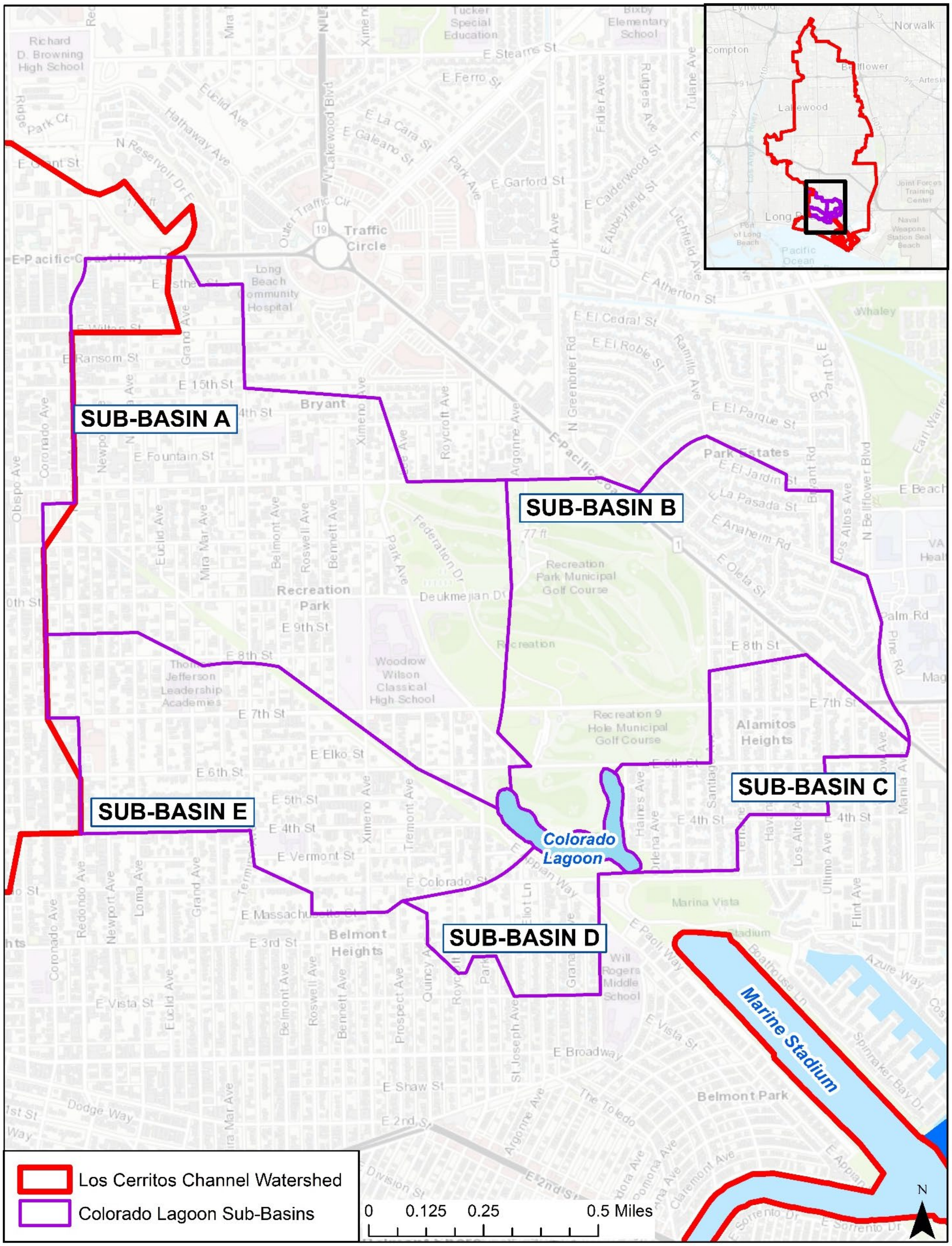
1.4.3. COLORADO LAGOON SUBWATERSHED

Colorado Lagoon is a fifteen-acre, V-shaped saltwater tidal lagoon, historically part of the greater Los Cerritos Wetlands that covered most of east Long Beach. Colorado Lagoon used to be naturally subject to tidal influence but is now hydraulically connected to Alamitos Bay's Marine Stadium via a 900-foot box culvert that runs under Marina Vista Park. It has three main functions: (1) serving as an estuarine habitat for sensitive species, (2) providing public recreational space, and (3) retaining and conveying stormwater. The lagoon is abundant in wildlife and acts as an important stop for thousands of migratory birds, including endangered species, every year. In addition, the lagoon is heavily utilized for recreational activities, including swimming, fishing, wildlife viewing, and picnicking. The lagoon is used by hundreds of visitors from communities within and surrounding the City of Long Beach.

According to SCAG, land use types in the Colorado Lagoon subwatershed are primarily Residential, Golf Courses, Commercial & Services, and Open Space & Recreation, accounting for 63%, 18%, 13%, and 5% of total land use, respectively. All other land uses within the Colorado Lagoon subwatershed account for 1% or less of the overall area. Figure 6 shows the land use types in the Colorado Lagoon subwatershed.

The Colorado Lagoon subwatershed can be separated into five sub-basins (Sub-Basin A through Sub-Basin E) that discharge stormwater and urban dry weather runoff to the Colorado Lagoon (Figure 7). Each of the sub-basins is served by a major storm sewer line and supporting laterals that collect and transport stormwater and urban dry weather runoff to the Colorado Lagoon. Surface water runoff within the watershed occurs as overland runoff into curb inlets and catch basins, and as sheet flow from nearshore areas (Los Angeles Water Board, 2009). Sub-Basin A, Sub-Basin B, and Sub-Basin C discharge to the Colorado Lagoon, while Sub-Basin D and Sub-Basin E discharge to Marine Stadium through the Termino Avenue Drain.


Colorado Lagoon
Bouton Creek
Marine Stadium
Traffic Circle
Colorado Lagoon Subwatershed
Los Cerritos Channel Watershed
Land Use
Residential
Industrial
Commercial & Services
Golf Course
Open Space & Recreation
Mixed Commercial, Industrial & Urban
0
0.15
0.3
0.6 Miles
N


SUB-BASIN A
SUB-BASIN B
SUB-BASIN C
SUB-BASIN D
SUB-BASIN E
Colorado Lagoon
Marine Stadium
Los Cerritos Channel Watershed
Colorado Lagoon Sub-Basins
0 0.125 0.25 0.5 Miles
N

1.4.4. LOS CERRITOS CHANNEL COASTAL SUBWATERSHED

The Los Cerritos Channel subwatershed drains to Long Beach City Beaches. The Long Beach City Beaches are on the 2018 CWA section 303(d) list of impaired water bodies for Indicator Bacteria. The Indicator Bacteria impairment for the Long Beach City Beaches is currently addressed by the USEPA Long Beach City Beaches and Los Angeles River Estuary TMDL for Indicator Bacteria.

2. PROBLEM IDENTIFICATION

Since the 1950s, numerous epidemiological studies have been conducted around the world to investigate the possible links between swimming in fecal-contaminated waters and health risks (Pruss, 1998; Wade, Pai, Eisenberg, & Colford Jr., 2003). Most significant associations were found for gastrointestinal illnesses. However, as shown in several large-scale epidemiological studies of recreational waters, other health outcomes such as skin rashes, respiratory ailments, and eye and ear infections are also associated with swimming in fecal-contaminated water. Many of these studies have been conducted in areas of known human sewage contamination; others have been conducted in areas where the sources of fecal contamination were unknown. A Santa Monica Bay study (Haile, et al., 1999) found swimming in urban runoff-contaminated waters resulted in an increased risk of chills, ear discharge, vomiting, coughing with phlegm and significant respiratory diseases. These studies demonstrate that there is a causal relationship between illness and recreational water quality, as measured by fecal indicator bacteria densities.

2.1. WATER QUALITY STANDARDS

Water quality standards consist of the following core elements: 1) beneficial uses; 2) narrative and/or numeric WQOs; and 3) an anti-degradation policy. The Basin Plan defines the beneficial uses and specifies the numeric and narrative WQOs for waterbodies in the Los Angeles Region. Statewide water quality control plans also specify numeric and narrative WQOs for waterbodies throughout the state, including in the Los Angeles Region. The objectives are set to be protective of the beneficial uses of each waterbody in the region and/or to protect against degradation.

2.1.1. BENEFICIAL USES

The Basin Plan designates beneficial uses for water bodies in the Los Angeles Region. These uses are recognized as existing, potential, or intermittent uses. The Basin Plan defines one existing beneficial use, two potential beneficial uses, and two intermittent beneficial uses for Los Cerritos Channel. The Basin Plan defines twelve existing beneficial uses, and no potential or intermittent beneficial uses for Los Cerritos Channel Estuary. There are eleven existing beneficial uses, and no potential or intermittent beneficial uses for Alamitos Bay. There are five existing beneficial uses, one potential beneficial use, and no intermittent beneficial uses for Colorado Lagoon. All beneficial uses must be protected. The two beneficial uses impacted by bacteria are REC-1 and REC-2.

a. Los Cerritos Channel

a.1. Existing Beneficial Use

- Wildlife Habitat (WILD): 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.

a.2. Potential Beneficial Use

- Water Contact Recreation (REC-1): 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.

- Municipal and Domestic Supply (MUN): Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

a.3. Intermittent Beneficial Use

- Non-contact Water Recreation (REC-2): 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.

- Warm Freshwater Habitat (WARM): Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

b. Los Cerritos Channel Estuary

b.1. Existing Beneficial Use

- Water Contact Recreation (REC-1)

- Non-contact Water Recreation (REC-2)

- Wildlife Habitat (WILD)

- Industrial Service Supply (IND): 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): Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

- Commercial and Sport Fishing (COMM): 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.

- Estuarine Habitat (EST): 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).

- Marine Habitat (MAR): 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).

- Rare, Threatened, or Endangered Species (RARE): 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.

- Migration of Aquatic Organisms (MIGR): Uses of water that support habitats necessary for migration, acclimatization between fresh and saltwater, or other temporary activities by aquatic organisms, such as anadromous fish.

- Spawning, Reproduction, and/or Early Development (SPWN): Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

- Shellfish Harvesting (SHELL): 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 sports purposes.

c. Alamitos Bay

c.1. Existing Beneficial Use

- Water Contact Recreation (REC-1)

- Non-contact Water Recreation (REC-2)

- Wildlife Habitat (WILD)

- Industrial Service Supply (IND)

- Navigation (NAV)

- Commercial and Sport Fishing (COMM)

- Estuarine Habitat (EST)

- Marine Habitat (MAR)

- Rare, Threatened, or Endangered Species (RARE)
- Shellfish Harvesting (SHELL)
- Wetland Habitat (WET): Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

d. Colorado Lagoon

d.1. Existing Beneficial Use

- Water Contact Recreation (REC-1)
- Non-contact Water Recreation (REC-2)
- Wildlife Habitat (WILD)
- Commercial and Sport Fishing (COMM)
- Shellfish Harvesting (SHELL)

d.2. Potential Beneficial Use

- Warm Freshwater Habitat (WARM)

2.1.2. WATER QUALITY OBJECTIVES

In 2018, the State Water Board adopted Statewide Bacteria Provisions, containing bacteria water quality objectives (WQOs) for the protection of the REC-1 beneficial use, which are based on U.S. EPA's recommended recreational water quality criteria, published in 2012. The WQOs in the Statewide Bacteria Provisions supersede numeric bacteria WQOs in Regional Water Quality Control Board Water Quality Control Plans (Basin Plans), but not narrative WQOs or numeric site-specific WQOs for protection of the REC-1 beneficial use in Basin Plans. In 2020, the Los Angeles Water Board adopted Resolution R20-001, amending the Basin Plan to align with the WQOs contained in the Statewide Bacteria Provisions.

In the Statewide Bacteria Provisions, the WQOs for fresh, estuarine, and ocean waters for the protection of the REC-1 beneficial use are based on a risk protection level of 32 illness per 1,000 recreators. The Bacteria Provisions establish *E. coli* as the sole indicator of pathogens in freshwaters (waters with the salinity equal to or less than 1 part per thousand (ppth) 95 percent or more of the time during the calendar year); *Enterococcus* as the sole indicator for saline waters (waters with the salinity greater than 1 ppth more than 5 percent of the time during the calendar year), such as coastal lagoons, enclosed bays, and estuaries; and both *Enterococcus* and fecal coliform as the indicators in ocean waters.

The WQOs in the Statewide Bacteria Provisions are specified based on magnitude, duration and frequency. The WQOs for freshwater are a six-week rolling geometric mean of *E. coli* not to exceed 100 colony forming units (cfu) per 100 milliliters (mL), calculated weekly, and an Statistical Threshold Value, known as STV, of 320 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner. For saline waters, the WQOs are a six-week rolling geometric mean of *Enterococcus* not to exceed 30 cfu/100 mL, calculated weekly, and an STV of 110 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner. Table 1 shows the REC-1 WQOs in the Bacteria Provisions. The Bacteria Provisions will result in the protection of REC-2 beneficial uses because REC-1 bacteria objectives are more stringent than REC-2 bacteria objectives.

Table 1: REC-1 Water Quality Objectives in Part 3 of the ISWEBE

Waterbody Salinity	**Bacteria Indicator**	**Geometric Mean (cfu/100 mL)**	**Statistical Threshold Value (cfu**Error! Bookmark not defined.**/100 mL)**
equal to or less than 1 ppth 95 percent or more of the time during the calendar year	*E. coli*	100	320
greater than 1 ppth more than 5 percent of the time during the calendar year	*Enterococcus*	30	110
The waterbody geometric mean shall not be greater than the applicable geometric mean magnitude in any six-week interval, calculated weekly. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.			

The Bacteria Provisions include implementation provisions that may be used, if appropriate. These include use of a reference system/antidegradation approach or natural sources exclusion approach in the context of a TMDL addressing municipal stormwater and nonpoint source discharges. The Bacteria Provisions also allow for the adoption of a high flow suspension of the water contact recreation (REC-1) beneficial use that reflects water conditions considered unsafe for the REC-1 beneficial use due to high water flow or velocity. If a high flow suspension of the REC-1 beneficial use is adopted, the bacteria water quality objectives for the REC-1 beneficial use do not apply during the period of time that the REC-1 use is suspended; however, during all other times outside of the period of the high flow suspension, the bacteria water quality objectives for the

REC-1 use apply. All other applicable public health-related beneficial uses need to be protected during the period of the high flow suspension.

A TMDL that employs any of the implementation approaches above is subject to U.S. EPA's approval authority under Clean Water Act section 303(d). Where a TMDL is paired with a Basin Plan amendment that simultaneously modifies the underlying water quality standards or implementation provisions, those modifications are subject to U.S. EPA's approval authority under Clean Water Act section 303(c).

2.1.3. ANTIDEGRADATION

Both the State of California and the federal government have established antidegradation policies for water quality. The State policy is formally referred to as the "Statement of Policy with Respect to Maintaining High Quality of Waters in California" (State Water Board Resolution No. 68-16). This policy restricts degradation of surface or ground waters and protects water bodies where existing quality is higher than is necessary for the protection of beneficial uses. The federal Antidegradation Policy (40 CFR 131.12) was developed under the CWA. This TMDL complies with federal and state antidegradation policies by ensuring the protection of beneficial uses and by setting WLAs and LAs equal to the numeric targets.

2.2. DATA REVIEW

During the 2014/2016 303(d) Water Quality Assessment for the Los Cerritos Channel, Alamitos Bay, and Colorado Lagoon, the Los Angeles Water Board evaluated total coliform, fecal coliform, and *Enterococcus* monitoring data and concluded that the Los Cerritos Channel, Alamitos Bay, and Colorado Lagoon were impaired for Indicator Bacteria. Recent water quality data sets were reviewed during the development of this TMDL and confirm the 2014/2016 303(d) listed bacteria impairments for the Los Cerritos Channel, Alamitos Bay, and Colorado Lagoon.

The sources of bacteria data for Los Cerritos Channel and Los Cerritos Channel Estuary include the City of Long Beach Stormwater Monitoring Program, the Southern California Marine Institute Volunteer Monitoring Program, and the Los Cerritos Channel Coordinated Integrated Monitoring Program (CIMP) and the City of Long Beach Integrated Monitoring Program (IMP), conducted in accordance with the 2012 Los Angeles County MS4 Permit and the 2014 Long Beach MS4 Permit. There are seven monitoring locations in the Los Cerritos Channel and Los Cerritos Channel Estuary, illustrated in Figure 8.

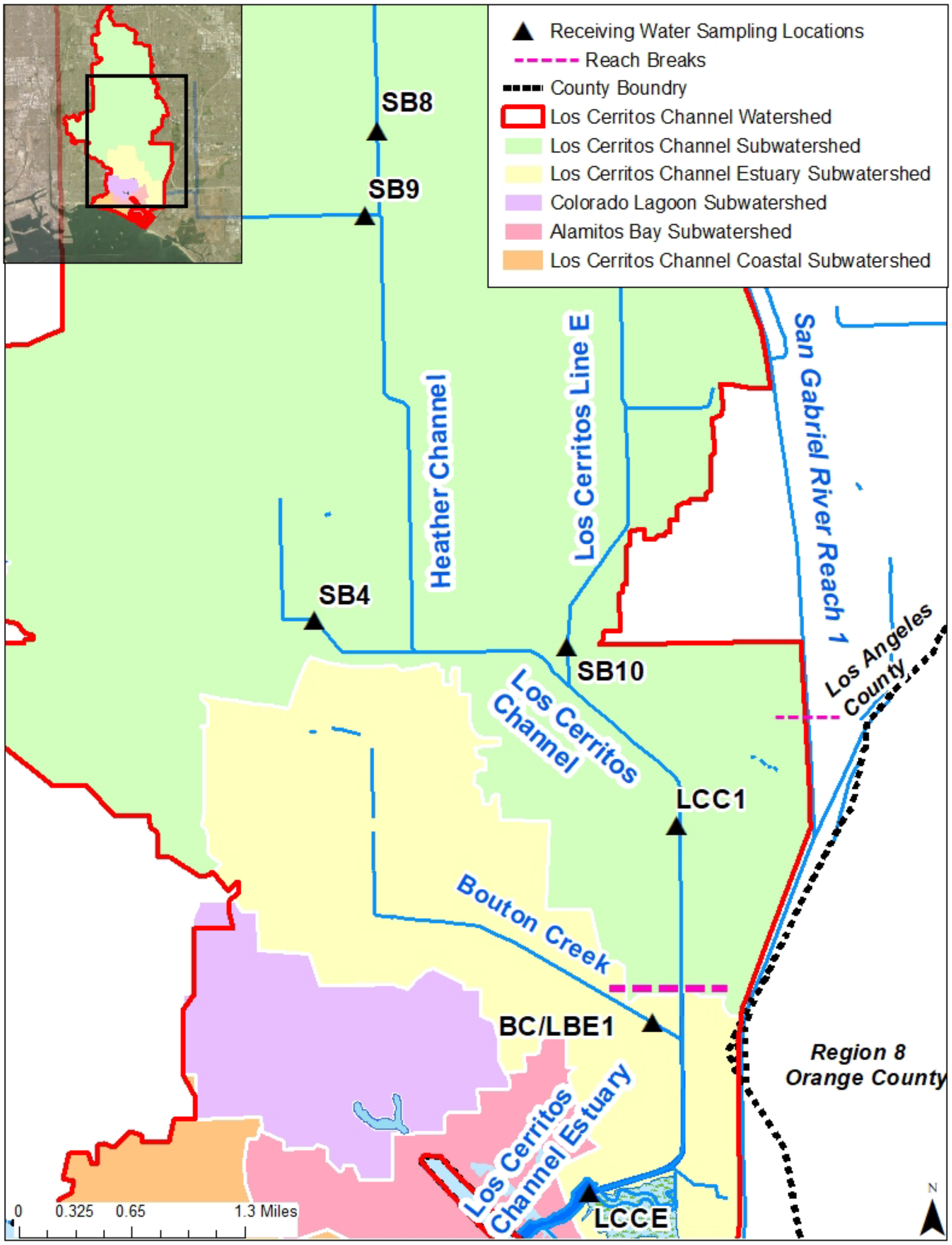


Figure 8: Sampling Locations in Los Cerritos Channel and Los Cerritos Channel Estuary

The bacteria data for Alamitos Bay and Colorado Lagoon are from the City of Long Beach Department of Health & Human Services collected as part of Assembly Bill No. 411 (Health and Safety Code § 115880) monitoring requirements. There are three receiving water sampling locations in Colorado Lagoon and seven in Alamitos Bay, illustrated in Figure 9.

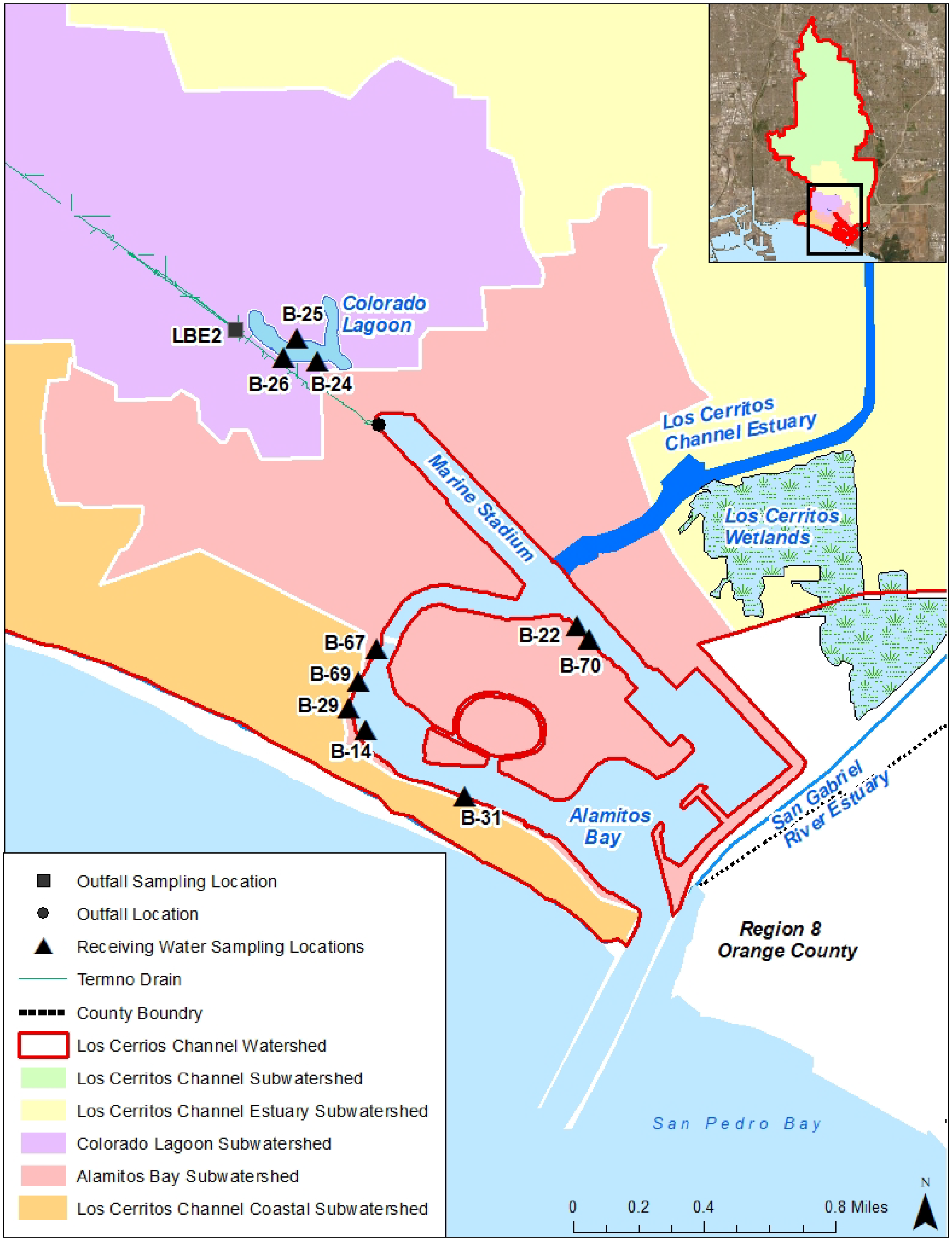


Figure 9: Sampling Locations in Alamitos Bay and Colorado Lagoon

2.2.1 LOS CERRITOS CHANNEL AND ESTUARY SUBWATERSHEDS

The City of Long Beach has historically monitored Total Coliform, Fecal Coliform, and *Enterococcus* in the Los Cerritos Channel at Stearns Street (LCC1), and in Bouton Creek (BC also known as LBE1) near its discharge into Los Cerritos Channel Estuary. Since 2016, *E. coli* has been monitored under the Los Cerritos Channel CIMP at LCC1 and the City of Long Beach IMP at LBE1.

The sampling station LCC1 is a mass emission station located at Stearns Street. The City of Long Beach has maintained this mass emission station since 2000. This site is located about 100 feet downstream of a former United States Geological Survey (USGS) gauging station and, except for a 0.5-mile stretch between Stearns Street and Atherton Street, it marks the downstream extent of freshwater within the Los Cerritos Channel. During low tides, freshwater may extend down to Anaheim Street and during high tides saline water may extend up to Stearns Street. LCC1 marks the upper extent of tidal influence for all but the most extreme high tides. Data collected from this site will be important to the evaluation of upstream influences into Los Cerritos Channel Estuary.

The sampling station LBE1 is located in Bouton Creek a short distance upstream from the point of discharge into Los Cerritos Channel, alongside of the Alamitos Maintenance Yard of the Los Angeles County Department of Public Works. Bouton Creek is an open, concrete box channel measuring 35 feet in width and 8.5 feet in depth and flows into the Los Cerritos Channel Estuary.

In addition to these two monitoring stations, LCC1 and LBE1, the Los Cerritos Channel CIMP includes monitoring at "watershed segmentation sites" upstream of LCC1: SB4, SB8, SB9, and SB10, which are intended to reflect the input from four sub-basins, covering 68% of the Los Cerritos Channel subwatershed. Due to construction occurring at the Long Beach Airport during the 2017/2018 stormwater season, the SB4 site was relocated downstream and was renamed as SB4-M (Los Cerritos Channel Watershed Management Group, 2015).

Data for LCC1 and LBE1 from the City of Long Beach Stormwater Monitoring Program span from June 2000 to April 2015. Data for LCC1, SB4, SB8, SB9, and SB10 from the Los Cerritos Channel CIMP and for LBE1 from the City of Long Beach IMP span from January 2016 to April 2019.

The sampling station LCCE is located in Los Cerritos Channel Estuary. Data for LCCE is from the Southern California Marine Institute Volunteer Monitoring Program (from November 2003 to May 2007).

A 1:1 fecal coliform to *E. coli* ratio was used to translate fecal coliform data to *E. coli* for the purpose of analysis. MPN (Most Probable Number) is used here as a unit of measure, equivalent for practical data interpretation and regulatory purposes to cfu. The term MPN also describes a laboratory method consisting of a multi-phase laboratory assay followed by a statistical estimate of the number of organisms present. For data interpretation and regulatory purposes, MPN and cfu can be considered equivalent when used as units of measurement, both referring to the estimated bacteria concentration in the sample (U.S. EPA, 2001).

To estimate exceedances of the STV and the frequency of exceedances staff followed the steps below.

STV Analysis Steps for *E. coli*:

1. Divide data into calendar months
2. Compare the sample results within each month to the STV of 320 cfu/100mL and count the number of times the sample result is above the STV
3. Calculate the monthly percent exceedance (Number of times the sample result is above the STV divided by the total number of samples)
4. If the monthly percent exceedance is above 10%, then the STV is exceeded for that month
5. Count the number of cumulative exceedances of the STV and the number of months to calculate a frequency of exceedance (number of STV exceedances/ total of months with data).

See a hypothetical example calculation in Table 2 to illustrate staff's analysis:

Table 2: STV Example Calculation: Fecal coliform samples were collected for the months of January, June, and September 2000.

Month	**Sample Result**	**No. of times above STV (320cfu/100mL)**	**Monthly Percent Exceedance**	**Exceed the STV objective >10%**	**Frequency of Exceedance of STV**
Jan	450cfu/100mL	1	100%	Yes	66%
June	180cfu/100mL	0	0%	No	
	55cfu/100mL	0			
Sept.	200cfu/100mL	0	50%	Yes	
	650cfu/100mL	1			

The monitoring data for *E. coli* and *Enterococcus* in the Los Cerritos Channel (LCC1) and for *E. coli* in its tributaries (SB4/SB4-M, SB8, SB9, and SB10) are compared to the STV objective and summarized in Table 3.

Table 3: Summary of STV Exceedances for *E. coli* and *Enterococcus* in the Los Cerritos Channel Subwatershed

Station Code	Weather Condition	Analyte Name	STV	Total Exceedances	Total Months	Frequency of Exceedances
LCC1	All	*E. coli*	320	72	83	87%
LCC1	Wet	*E. coli*	320	47	49	96%
LCC1	Dry	*E. coli*	320	25	36	69%
LCC1	All	*Enterococcus*	110	72	76	95%
LCC1	Wet	*Enterococcus*	110	44	45	98%
LCC1	Dry	*Enterococcus*	110	30	33	91%
SB4/SB4-M	Wet	*E. coli*	320	11	11	100%
SB8	Wet	*E. coli*	320	5	5	100%
SB9	Wet	*E. coli*	320	5	5	100%
SB10	Wet	*E. coli*	320	10	10	100%

Most samples exceeded the STV limits for *E. coli* or *Enterococcus*. The number of exceedances was greater than the minimum number of exceedances required for including the waterbodies on the 303(d) list of impaired waters for the impairment of indicator bacteria.

The monitoring data for *E. coli* and *Enterococcus* in the Bouton Creek (Monitoring Station: LBE1) and the Los Cerritos Channel Estuary (Monitoring Station: LCCE) are summarized in Table 4. Most of samples collected at LBE1 station exceeded the STV limits for *E. coli* and *Enterococcus*. Two out of five samples collected at LCCE station exceeded the STV limits for *E. coli* and *Enterococcus*. The Los Cerritos Channel Estuary is not on the 2018 303(d) List for indicator bacteria. However, the data indicate the Los Cerritos Channel Estuary is impaired due to elevated *Enterococcus*.

The data are further separated into wet and dry weather periods. Wet weather is defined as rainfall of 0.1 inch or more plus 3 days following the rain event. There were fewer exceedances during dry weather than during wet weather. These results also illustrate the high percentages of samples above the STV.

Table 4: Summary of STV Exceedances for *E. coli* and *Enterococcus* in the Los Cerritos Channel Estuary Subwatershed

Station Code	Weather Condition	Analyte Name	STV	Total Exceedances	Total Months	Frequency of Exceedances
BC (LBE1)	All	*E. coli*	320	63	71	89%
BC (LBE1)	Wet	*E. coli*	320	43	44	98%
BC (LBE1)	Dry	*E. coli*	320	21	29	72%
LCCE	All	*E. coli*	320	2	5	40%

Station Code	Weather Condition	Analyte Name	STV	Total Exceedances	Total Months	Frequency of Exceedances
BC (LBE1)	All	*Enterococcus*	110	62	65	95%
BC (LBE1)	Wet	*Enterococcus*	110	40	41	98%
BC (LBE1)	Dry	*Enterococcus*	110	24	26	92%
LCCE	All	*Enterococcus*	110	2	5	40%

The data show that Los Cerritos Channel and Estuary are impaired by indicator bacteria. In addition, Los Cerritos Channel and Estuary flow to Alamitos Bay. The exceedance frequencies of *Enterococcus* in the Los Cerritos Channel and Estuary are an indication that the Los Cerritos Channel and Estuary contribute to the bacteria impairment of Alamitos Bay.

2.2.2. ALAMITOS BAY SUBWATERSHED

Long Beach Department of Health & Human Services *Enterococcus* data was assessed for the seven sampling locations in Alamitos Bay from storm years 1999-2017. Storm year is defined as November 1-October 31. Sampling locations near Bay Shore (B-14, B-29, B-69) and sampling locations on Mother's Beach (B-22 and B-70) are less than 200 meters from each other and therefore are not considered spatially independent per the Listing Policy. In addition, sampling was discontinued at three locations (B-29, B-69, B-70) in 2009. Therefore, up until 2009, the sampling locations at Bayshore were considered as one location and the sampling locations at Mother's Beach were considered as one location, and *Enterococcus* data were averaged. Staff compared the dataset for storm years 1999-2017 to the six-week rolling geometric mean *Enterococcus* objective. Staff also conducted a seasonality assessment for this dataset to determine if exceedances occurred more frequently during summer or winter. Summer is defined as April 1-October 31, and Winter as November 1-March 31.

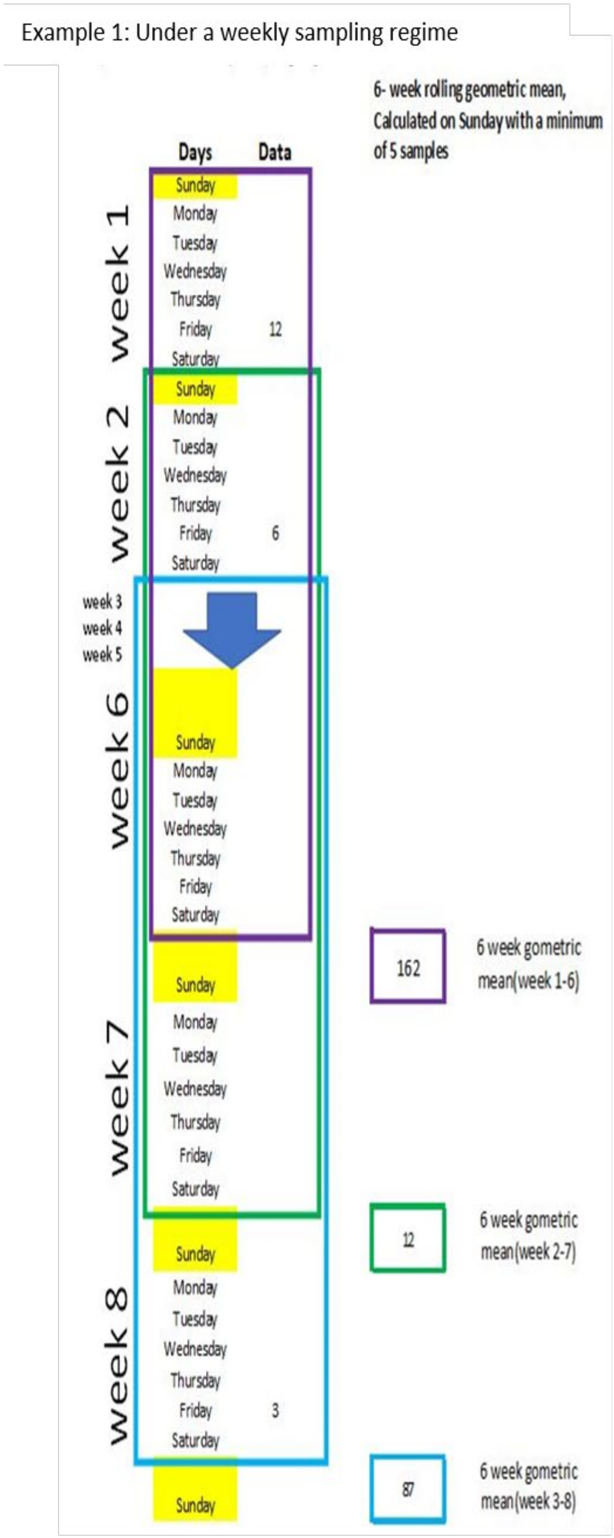
To estimate exceedances of the geometric mean and the frequency of exceedances, staff followed the steps below.

Geometric Mean Analysis Steps for *Enterococcus*:

1. Divide the data into weeks beginning on Sunday.
2. If 5 or more samples are available in a six-week period, calculate the geometric mean for the first six weeks of sample data.
3. Move forward one week, and if 5 or more samples are within the second six-week period, calculate the geometric mean. If not, do not calculate the geometric mean.

4. Continue moving forward in one-week intervals and calculating the geometric mean where there are 5 or more samples in a six-week interval.

5. Compare each calculated geometric mean to the geometric mean objective. If the calculated geometric mean is above the geometric mean objective than the geometric mean objective is exceeded for that six-week period.



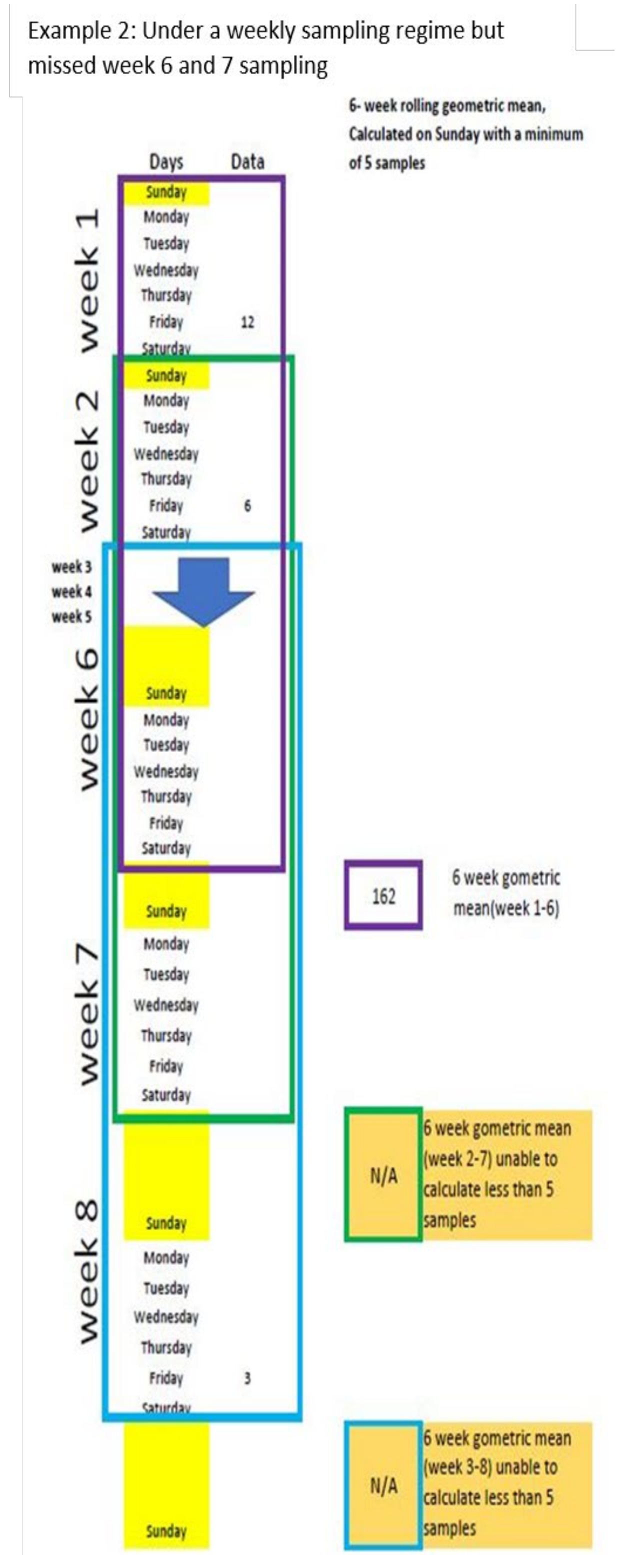


Figure 10: Examples of geometric mean calculation

See a hypothetical example calculation in Figure 10 to illustrate staff's analysis: Examples of geometric mean calculation

Analysis of the *Enterococcus* data compared to the six-week rolling geometric mean objective is presented in Table 5. The data shows that Alamitos Bay is impaired for *Enterococcus*, and exceedances occur more frequently during winter.

Table 5: Summary of Geometric Mean Exceedances for *Enterococcus* in Alamitos Bay

***Enterococcus* Geometric Mean (30cfu/100 mL)**	**Number of Geometric Means**	**Number of Geometric Mean Exceedances**	**Frequency of Exceedances**
Storm Year 1999-2017	3717	1016	27%
Summer	2260	347	15%
Winter	1432	669	47%

Flushing, or water circulation, improves water quality in enclosed bays, reduces or eliminates water stagnation, and helps maintain biological productivity. Alamitos Bay is isolated from direct open coast circulation, and flushing is dependent on tidal flow through the harbor entrance. The San Gabriel River discharges into the eastern side of San Pedro Bay, near the entrance of Alamitos Bay. However, the Alamitos Bay entrance has two jetties, approximately 800 feet long, which separate the Alamitos Bay entrance and San Gabriel River outlet. In addition, the net direction of the flow at the mouth of San Gabriel River is down coast, away from Alamitos Bay. Therefore, San Gabriel River flows have limited mixing within Alamitos Bay (Los Angeles Department of Water and Power and AES Alamitos LLC, 2010).

Circulation within Alamitos Bay is due to tidal flows and the removal of water by two power generating stations for use as cooling water. Water is pumped from Alamitos Bay to the San Gabriel River by the Applied Energy Services (AES) Alamitos Generating Station and the Haynes Generating Station (HGS). Both generating stations pump water from Alamitos Bay to condense steam into water during the electricity-generating process, known as Once Through Cooling (OTC). Water for cooling the HGS is drawn from Basin 2 of the Long Beach Marina in Alamitos Bay through seven closed conduits under the San Gabriel River. Water for cooling the AES Alamitos Generating Station is drawn from two man-made canals connected to the Los Cerritos Estuary. The pumping activities create currents by pulling ocean water into the Bay and mixing ocean and bay water, which improves circulation and water quality.

On May 4, 2010, the State Water Resources Control Board adopted a Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling (OTC Policy). This policy became effective on October 1, 2010 and establishes technology-based standards to implement federal Clean Water Act Section 316(b) and reduce the harmful effects associated with cooling water intake structures for power generating facilities on marine and estuarine life.

The OTC Policy set the compliance deadline for the AES Alamitos Generating Station to be December 31, 2020 (State Water Board, 2010), for the HGS Units 5 & 6 to be December 31, 2013, and for the HGS Units 1, 2 and 8 to be December 31, 2029 (State Water Board, June 18, 2013). On September 1, 2020, the State Water Board adopted Resolution No. 2020-0029, amending the compliance schedule for the AES Alamitos Generating Station, which extended the compliance date for AES Alamitos Generating Station Units 3, 4, and 5 for three years until December 31, 2023. The impact of the cessation of pumping by the two generating stations on circulation and water quality in Alamitos Bay is discussed in Section 5, Linkage Analysis, and Appendix A.

2.2.3. COLORADO LAGOON SUBWATERSED

Colorado Lagoon has been undergoing restoration since 2008. Many of the restoration phases have already been completed, including dredging and removal of contaminated sediment, rerouting storm drains, installation of trash capture devices, and construction of low flow diversion systems and four bioswales. A remaining project (Phase 2A), the construction of an open, earthen hydraulic water channel to reconnect the Lagoon to Marine Stadium, is currently in the engineering design phase, and construction is expected to be completed in 2021 (Long Beach Nearshore Watershed Management Program, 2016; Friends of Colorado Lagoon, 2019).

Enterococcus data were assessed between phases of the restoration: from April 1999-December 2011, September 2012-October 2016, and May 2017-December 2018. Samples were collected from three locations: B-24, B-25, and B-26 (Figure 9). However, because the sampling locations are less than 200 meters apart, according to Section 6.1.5.2 of the Listing Policy, the sampling locations are not considered spatially independent, and therefore *Enterococcus* data were averaged among the sampling locations. Staff compared the datasets to the six-week rolling geometric mean objective for *Enterococcus* and also conducted a seasonality assessment for these datasets to determine if exceedances occurred more frequently during summer or winter. Summer is defined as April 1- October 31, and Winter as November 1-March 31.

The data are summarized in terms of percent exceedance of the six-week rolling geometric mean, calculated as the number of geometric mean exceedances divided by the number of geometric means, as shown in Table 6 through Table 8.

Table 6: Geometric Mean Exceedances for *Enterococcus* in Colorado Lagoon

Period	Num. of Geometric Mean Exceedances	Num. of Geometric Means Calculated	Frequency of Exceedances
April 1999-December 2011	234	627	37.32%
September 2012-October 2016	12	158	7.59%
May 2017-December 2020	36	179	20.11%

Table 7: Geometric Mean Exceedances for *Enterococcus* in Colorado Lagoon in Winter

Winter (November 1-March 31)	**Num. of Geometric Mean Exceedances**	**Num. of Geometric Means Calculated**	**Frequency of Exceedances**
April 1999-December 2011	159	241	65.98%
September 2012-October 2016	11	66	16.67%
May 2017-December 2020	31	67	46.27%

Table 8: Geometric Mean Exceedances for *Enterococcus* in Colorado Lagoon in Summer

Summer (April 1-October 31)	**Num. of Geometric Mean Exceedances**	**Num. of Geometric Means Calculated**	**Frequency of Exceedances**
April 1999-December 2011	75	386	19.43%
September 2012-October 2016	1	92	1.08%
May 2017-December 2020	5	112	4.46%

Enterococcus exceeded the objective more often in the April 1999-December 2011 and May 2017-December 2020 time periods than in the September 2012-October 2016 time period. In addition, exceedances were more frequent during the winter season.

3. NUMERIC TARGETS

The Bacteria TMDL has a multi-part numeric target based on the geometric mean and STV objectives to protect the REC-1 beneficial use; the numeric targets for each waterbody are equivalent to the corresponding objectives for freshwater, saline water, or marine water as described below.

Los Cerritos Channel is a freshwater stream until Atherton Street. The Los Cerritos Channel from Atherton Street to Anaheim Street, the Los Cerritos Channel Estuary, Alamitos Bay (an enclosed bay), and Colorado Lagoon (a coastal lagoon) have saline water. Freshwater is defined as waters with salinity equal to or less than 1 ppth 95 percent or more of the time during the calendar year. Saline water is defined as waters with salinity greater than 1 ppth more than 5 percent of the time during the calendar year. Since *E. coli* is the indicator bacteria of fecal or pathogen contamination for freshwater, and *Enterococcus* is the indicator bacteria of fecal or pathogen contamination for saline water, *E. coli* numeric targets are used for Los Cerritos Channel (above Atherton Street) and its tributaries, and *Enterococcus* numeric targets are used for Los Cerritos Channel (Atherton Street to Anaheim Street), Los Cerritos Channel Estuary, Alamitos Bay and Colorado Lagoon.

The numeric targets are based on the Bacteria Provisions' WQOs to protect REC-1 beneficial uses. The Numeric Targets are comprised of three elements: magnitude, duration, and frequency. All applicable numeric targets are shown in Table 9.

Table 9: Numeric Targets for Los Cerritos Channel and Tributaries, Los Cerritos Channel Estuary, Alamitos Bay, and Colorado Lagoon

Water Type	Waterbody	Bacteria Indicator	Geometric Mean (cfu/100 mL)	Statistical Threshold Value (cfu/100 mL)
Freshwater	Los Cerritos Channel (above Atherton Street) & its tributaries	*E. coli*	100	320
Saline water	Los Cerritos Channel (Atherton Street to Anaheim Street), Los Cerritos Channel Estuary, Alamitos Bay, & Colorado Lagoon	*Enterococcus*	30	110
Duration and Frequency: The waterbody's calculated geometric mean shall not be greater than the applicable geometric mean magnitude in any six-week interval, calculated weekly. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.				

To determine attainment of numeric targets, the rolling six-week geometric mean shall be applied based on a statistically sufficient number of samples, generally not less than five samples spaced over a six-week time period starting all calculations on Sunday. However, if it is not possible to calculate a geometric mean due to lack of sufficient data, then attainment of the numeric targets shall be determined based on the STV.

Both freshwater and saline water numeric targets apply during summer and winter and in both dry and wet weather since there is water contact recreation throughout the calendar year, including during wet weather. Wet weather is defined as rainfall of 0.1 inch or more plus the 3 days following the rain event. Geometric means are assessed over a 6-week period which may contain both dry- and wet-weather days.

3.1 CONSIDERATION OF HIGH FLOW SUSPENSION

A High Flow Suspension (HFS) is the suspension of indicator bacteria REC-1 objectives during certain flow conditions that physically prevent the use of a waterbody for recreation. In 2003, the Los Angeles Water Board adopted an HFS for certain waterbodies in the region. The HFS was based on a categorical Use Attainability Analysis (UAA) for all engineered flood control channels with restricted or prohibited access during storm events corresponding to physically unsafe conditions (Los Angeles Water Board, 2003a). Specifically, waterbodies subject to the HFS meet all of the following criteria.

a) inland water bodies

b) flowing water bodies

c) engineered channels

d) water bodies where access can be restricted or prohibited (through fencing/signs)

Engineered channels are defined as inland, flowing surface water bodies with a box, V-shaped or trapezoidal configuration that have been lined on the sides and/or, in some cases, bottom with concrete. Engineered channels are constructed to reduce the incidence of flooding in urbanized areas by conveying stormwater runoff to the ocean or other discharge point as efficiently as possible. These modifications create life-threatening "swift water" conditions during and immediately following significant storm events.

The HFS is included in Chapter 2 of the Basin Plan by suspending the recreational beneficial uses in engineered channels during days with rainfall greater than or equal to 0.5 inches and the 24 hours following the end of the 0.5-inch or greater rain event, as measured at the nearest local rain gauge, using local Doppler radar, or using widely accepted rainfall estimation methods (Los Angeles Water Board, 2003b).

Los Cerritos Channel is not currently included as a waterbody subject to the HFS in Chapter 2 of the Basin Plan. However, Los Cerritos Channel (above Atherton Street) is an engineered channel that meets the criteria for suspension of the REC use(s). As a result, the REC-1 and REC-2 uses are not fully attainable during and immediately following high-flow storm events in Los Cerritos Channel (above Atherton St.). Therefore, in addition to amending the Basin Plan to establish a bacteria TMDL for Los Cerritos Channel, Chapter 2 of the Basin Plan is being amended to revise Table 2-1a to include Los Cerritos Channel (above Atherton St.) based on the criteria of the UAA adopted in 2003.

However, the EFDC model (Appendix A) demonstrates that the downstream waters of Alamitos Bay, where a high flow suspension does not apply, will not meet numeric targets unless the wet-weather bacteria loading from Los Cerritos Channel is reduced by 85%. Per the model, all exceedances of the Geometric Mean and STV numeric targets at the Alamitos Bay monitoring sites occurred during a rainfall event of greater than or equal to 0.5 inches or during the following 24-hour period, for the 2010 modeled year. The model results indicate that bacteria concentrations in Alamitos Bay cannot meet the numeric targets during storm events greater than 0.5 inches unless there is an 85% reduction in bacteria loading from Los Cerritos Channel.

Based on the model findings, while an HFS is appropriate for the freshwater portion of Los Cerritos Channel, such that discharges to the Channel and the Channel itself will not be required to meet the numeric targets during high flow, the reductions in loadings from the Channel must still occur in order for the downstream waterbodies to meet numeric targets. Therefore, the TMDL contains requirements to ensure that sufficient reductions in bacteria loading from Los Cerritos Channel will occur in order to attain numeric targets downstream in Los Cerritos Channel (below Atherton Street), in Los Cerritos Channel Estuary, and in Alamitos Bay.

4. SOURCE ASSESSMENT

The TMDL requires an assessment of bacteria contributions from point sources and nonpoint sources. This section identifies the potential point sources and nonpoint sources of bacteria in the Upper Los Cerritos Channel watershed.

A point source is defined in section 502(14) of the CWA and 40 CFR section 122.2 as any discernible, confined and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. These types of discharges are regulated through a National Pollutant Discharge Elimination System (NPDES) permit, typically in the form of State waste discharge requirements (WDRs) issued by the Los Angeles Water Board. Discharges of stormwater and non-stormwater through Municipal Separate Storm Sewer Systems (MS4s) are point sources according to the CWA.

A nonpoint source is defined as any source of water pollution that does not meet the legal definition of point source in section 502(14) of the CWA and 40 CFR section 122.2. Nonpoint sources can originate from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification

4.1. POINT SOURCES

The NPDES permits within the Upper Los Cerritos Channel watershed include the Regional MS4 Permit, the California Department of Transportation (Caltrans) Municipal Stormwater Permit, the Industrial Stormwater General Permit, the Construction Stormwater General Permit, the Phase II Small MS4 General Permit, Major Individual NPDES permits, Minor Individual NPDES permits and General NPDES permits.

4.1.1. MS4 PERMITS

An MS4 is a conveyance or system of conveyances that is: (1) owned by a state, city, town, village, or other public entity that discharges to waters of the United States; (2) designed or used to collect or convey stormwater (including storm drains, pipes, ditches, etc.); (3) not a combined sewer; and (4) not part of a Publicly Owned Treatment Works. During rain events, stormwater runoff is directed to waterbodies through the MS4. Stormwater is generated from rain or snow melt that runs off surfaces, such as rooftops, paved streets, highways, or parking lots and can carry pollutants, such as sediment, trash, and bacteria. Non-stormwater discharges, such as excess landscape irrigation, sidewalk wash water, etc., from urban activities can also be conveyed by MS4s to waterbodies. Discharges of stormwater and non-stormwater runoff from MS4s are regulated under NPDES MS4 permits.

In 1990, U.S. EPA developed rules establishing Phase 1 of the NPDES stormwater program, designed to prevent pollutants from being carried by stormwater runoff into the MS4 (or from being directly discharged into the MS4) and then discharged into local waterbodies. Phase 1 of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement a stormwater management program as a means to control polluted discharges. Until recently, MS4 discharges were regulated under the County of Los Angeles MS4 Permit (Order No. R4-2012-0175), and the City of Long Beach MS4 Permit (Order No. R4-2014-0024). On July 23, 2021, the Los Angeles Water Board adopted the Regional Phase I MS4 NPDES Permit for the Los Angeles Region (Regional MS4 Permit) (Order No. 2021-0105, NPDES No. CAS004004) to regulate all Phase I MS4 dischargers in the Los Angeles Region except Caltrans.

While no watershed-specific study has been conducted for the Upper Los Cerritos Channel watershed, storm drains have been found to be the major source of pollutants, including bacteria, in the neighboring San Gabriel and Los Angeles River watersheds (Ackerman et al., 2003; Ackerman et al., 2005; Griffith et al., 2014). The results from these neighboring watersheds are applicable to the Upper Los Cerritos Watershed as well, which has similar hydrology and land use types as the lower portions of the Los Angeles and San Gabriel River watersheds (Los Angeles Water Board, 2015; Los Angeles Water Board, 2010). In addition, data collected from the Long Beach mass emission station (LCC1), which was specifically cited to characterize stormwater discharges, show that the *E. coli* WQO is exceeded in 69% of dry weather samples and 87% of wet-weather samples (Table 3). Finally, data from individual storm drain outfalls in the Upper Los Cerritos Watershed, as discussed below, confirm that dry- and wet-weather runoff from MS4 outfalls are a significant source of bacteria.

a. Los Cerritos Channel and Los Cerritos Channel Estuary subwatersheds

There are 49 MS4 outfalls located in the Los Cerritos Channel subwatershed and seven MS4 outfalls in the Los Cerritos Channel Estuary subwatershed. The flow direction within the subwatersheds is southeasterly. Figure 11 depicts the locations of the stormwater drains and the MS4 outfalls. While these 49 outfalls and seven outfalls have not been monitored for bacteria, Bouton Creek is an open channel that discharges to the Los Cerritos Estuary through the BI0009 Los Cerritos 1 Line F outfall and data from this site can be considered as outfall monitoring data. The stormwater monitoring data from Bouton Creek shown in Table 4 demonstrate that *E. coli* and *Enterococcus* levels frequently exceed the STV numeric target during wet-weather and dry-weather monitoring events. In addition, the “watershed segmentation monitoring sites” included in the Los Cerritos Channel CIMP are described by the CIMP as addressing the outfall monitoring required by the 2012 Los Angeles County MS4 Permit (Los Cerritos Channel Watershed Management Group, 2015). Thus, the data from these watershed segmentation monitoring sites (SB4/SB4-M, SB8, SB9, and SB10) can be considered representative of MS4 discharge quality. Samples from these sites exceed the STV for *E. coli* in 100% of wet weather samples.

According to the LCC Watershed Annual Report 2019-2020, “*E. coli* is ubiquitous in both urban and rural environments. Improper handling or disposal of feces from both domestic animals as well as waste products from feral animals are likely to provide the most significant contributions.”

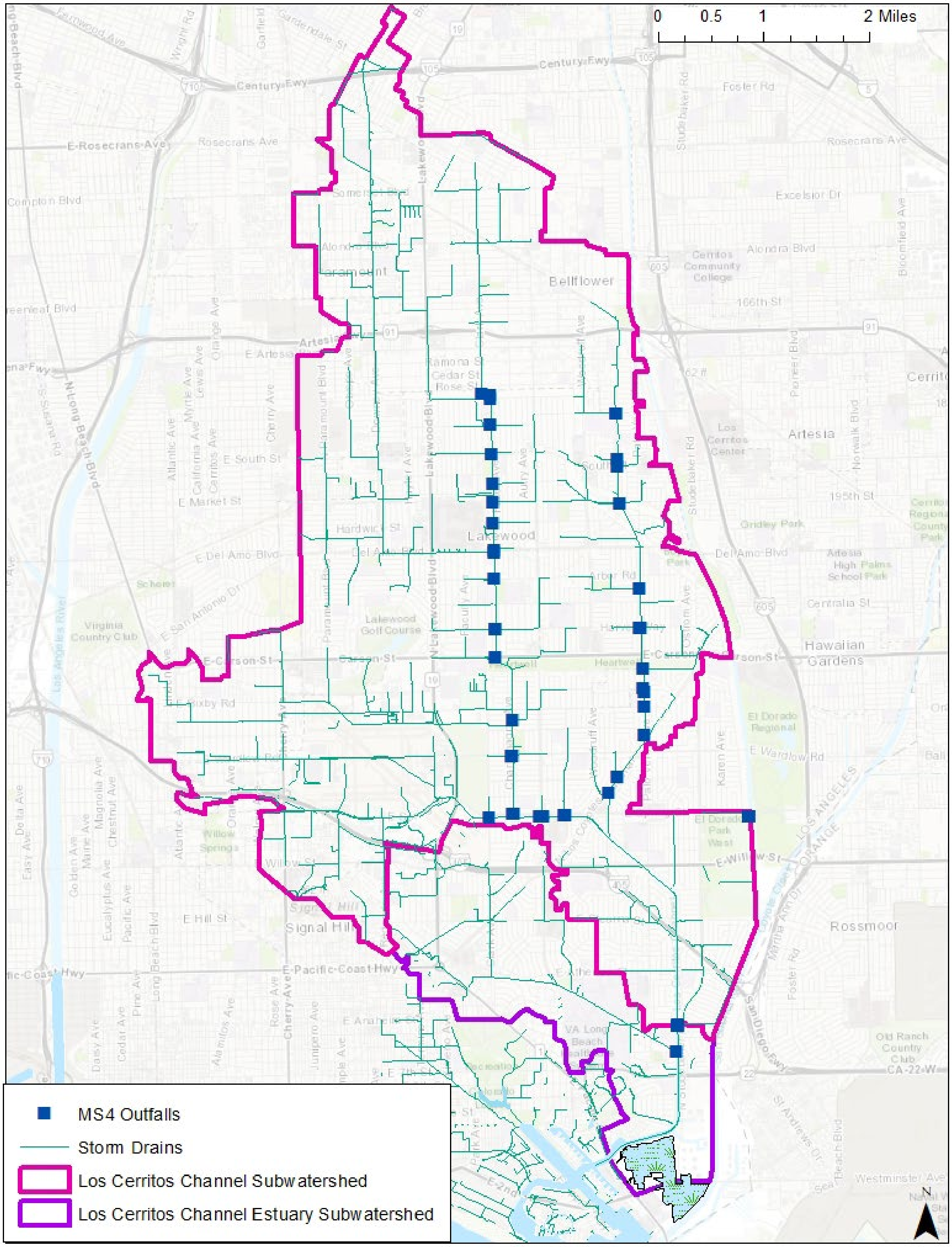


Figure 11: Storm Drains and MS4 Outfalls in the Los Cerritos Channel and Los Cerritos Channel Estuary Subwatersheds

b. Alamitos Bay Subwatershed

There are 85 MS4 outfalls located within the Alamitos Bay subwatershed. Only one outfall in the subwatershed (LBE2) is currently monitored for bacteria. The outfall discharges into Marine Stadium from Termino Drain. Due to the exact outfall location being tidally influenced and mostly underwater, sampling occurs at a manhole near Colorado Lagoon and is entirely reflective of stormwater discharges. MS4 bacteria monitoring at LBE2 started in 2016 at a frequency of 3 wet-weather events and 2 dry-weather events. To verify samples are representative of MS4 discharges, conductivity is measured to determine the presence of saltwater. Dry-weather sampling may not occur when saltwater is detected. Eight *Enterococcus* samples were evaluated at LBE2 during wet weather and all eight samples exceeded the STV objective. The data from this outfall demonstrate that the MS4 is a source of bacteria to Marine Stadium. Figure 12 depicts the locations of the stormwater drains and the MS4 outfalls.

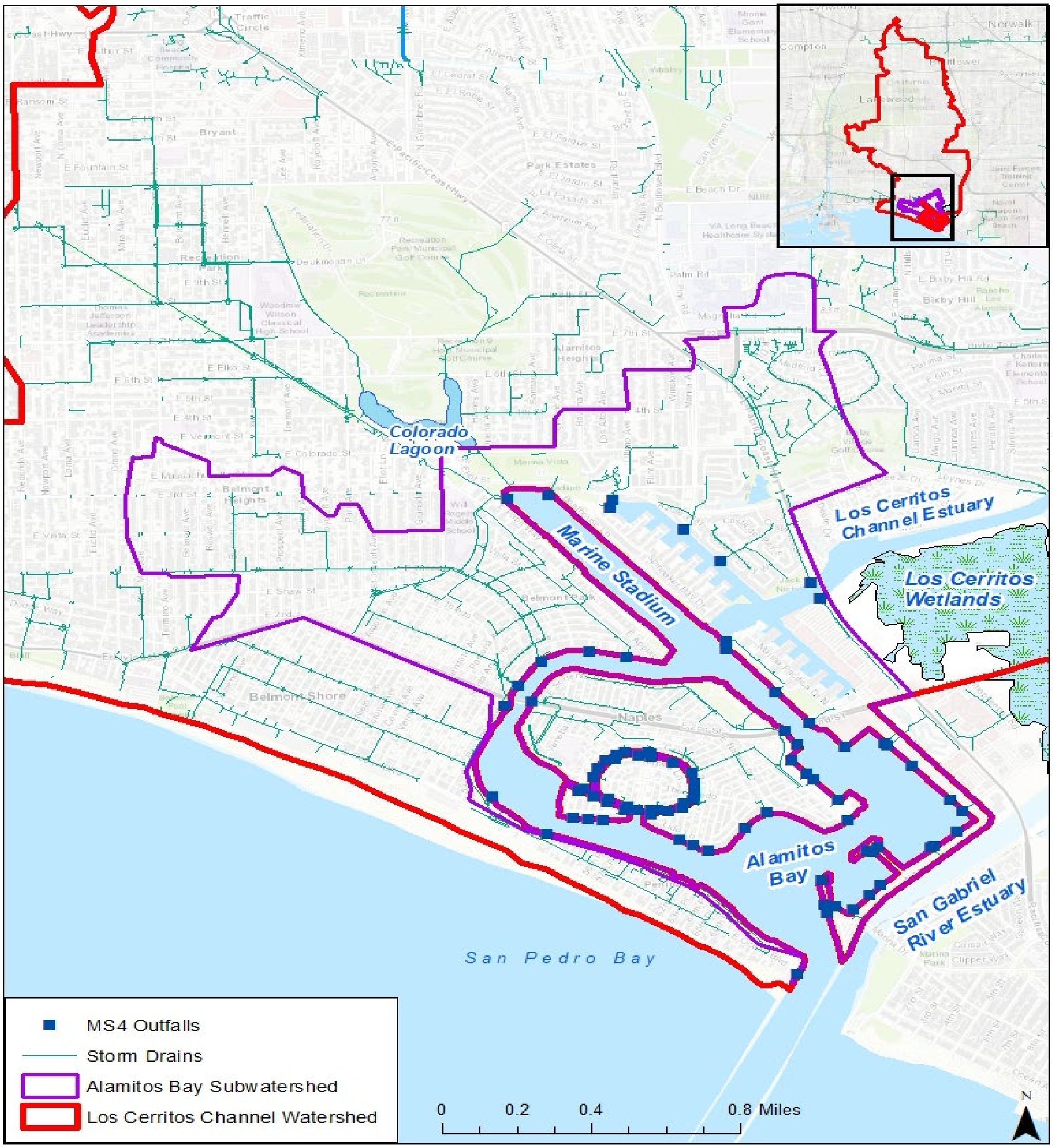


Figure 12: Storm Drains and MS4 Outfalls in Alamitos Bay Subwatershed

c. Colorado Lagoon Subwatershed

There are seven storm drains that currently discharge to Colorado Lagoon, consisting of three major storm drain outfalls and four local drain outfalls. No outfall locations are currently monitored for bacteria. Figure 13 depicts the storm drain network and outfalls discharging to Colorado Lagoon. The Colorado lagoon subwatershed is divided into five sub-basins. Sub-Basin A, Sub-Basin B, and Sub-Basin C discharge to Colorado Lagoon. Sub-Basin D and Sub-Basin E drain to Marine Stadium. A description of the flow within each sub-basin is as follows:

Sub-Basin A

Sub-Basin A drains to Colorado Lagoon's west arm via a 63-inch reinforced concrete pipe (Project 452 Drain) or discharges to Termino Drain located in Sub-Basin E. The storm drains are owned and operated by the Los Angeles County Flood Control District. The drainage pattern is generally to the south and east. Sub-Basin A contains the most commercial activities mainly along Anaheim Street and the northern part of Redondo Avenue.

Sub-Basin B

Sub-Basin B drains to Colorado Lagoon via a 54-inch reinforced concrete pipe (Line I Storm Drain) discharging into the north part of the north arm. The storm drains are owned and operated by the City of Long Beach. The drainage pattern is generally to the south and west. Sub-Basin B is predominately park/golf course open space with some residential areas on the north east corner.

Sub-Basin C

Sub-Basin C drains to Colorado Lagoon via a 48-inch reinforced concrete pipe (Line K Storm Drain) discharging into the mid-point of the north arm. The storm drains are owned and operated by the City of Long Beach. The drainage pattern is generally to the south and west. Sub-Basin C is almost entirely residential with a few commercial activities at the eastern boundary.

Sub-Basin D and Sub-Basin E

Sub-Basin D and Sub-Basin E drain to Marine Stadium via the Termino Avenue Drain. Termino Avenue Drain is owned and operated by the City of Long Beach.

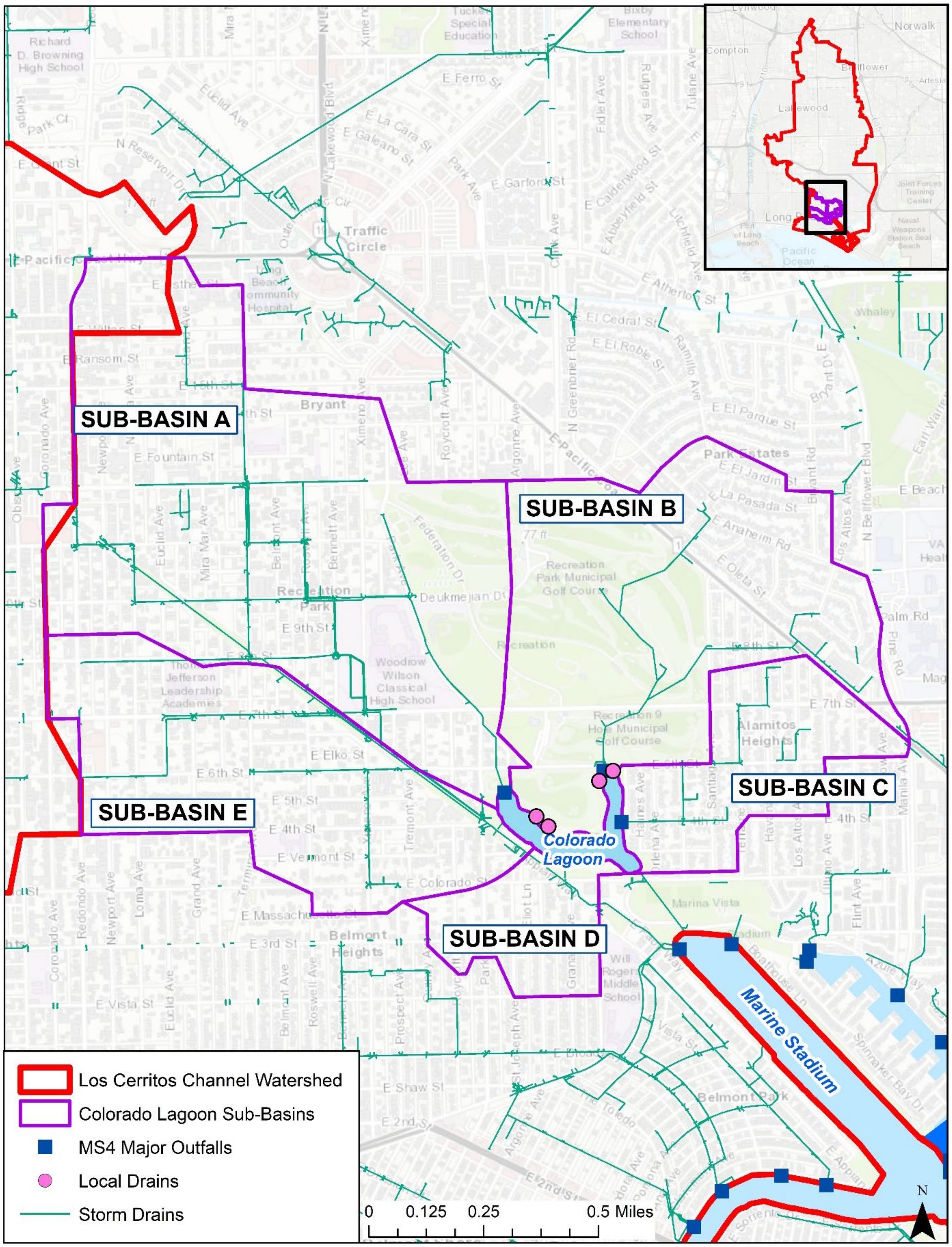


Figure 13: Storm Drains and MS4 Outfalls in Colorado Lagoon Subwatershed

4.1.2. CALTRANS STORMWATER PERMIT

Discharges from roadways and facilities under the jurisdiction of Caltrans are regulated by a statewide stormwater discharge permit that covers all municipal stormwater activities and construction activities. On September 19, 2012, the State Water Resources Control Board (State Water Board) issued a statewide general stormwater NPDES permit for Caltrans (State Water Board Order No. 2012-0011-DWQ). The Caltrans stormwater permit authorizes stormwater discharges from Caltrans properties, such as the state highway system, park and ride facilities, and maintenance yards. The stormwater discharges from most of these Caltrans properties and facilities eventually end up in a municipality owned, county owned, or flood control district owned MS4, which then discharges to Upper Los Cerritos Channel watershed.

4.1.3. GENERAL STORMWATER PERMIT

a. Industrial Activities

In 1990, U.S. EPA issued regulations for controlling pollutants in stormwater discharges from industrial sites (40 CFR Parts 122, 123, and 124) equal to or greater than five acres. The regulations require discharges of stormwater associated with industrial activity to obtain an NPDES permit and to meet all applicable provisions of Clean Water Act sections 402 and 301. On April 17, 1997, the State Water Board issued a statewide general NPDES permit for discharges of stormwater associated with Industrial Activities Excluding Construction Activities Permit (Order No. 97-03-DWQ, NPDES Permit No. CAS000001). Order No. 97-03-DWQ expired on June 30, 2015 and was superseded by Order No. 2014-0057-DWQ, which was adopted on April 1, 2014 and became effective on July 1, 2015. State Water Board Order 2014-0057-DWQ was subsequently amended in 2015 and 2018 (State Water Board Order 2015-0122-DWQ and Order XXXX-XXXX-DWQ). As of the writing of the TMDL, there are approximately 60 dischargers enrolled under the general industrial stormwater permit in the Los Cerritos Channel subwatershed, three dischargers in the Los Cerritos Channel Estuary subwatershed, three dischargers in the Alamitos Bay subwatershed, and one discharger in the Colorado Lagoon subwatershed.

b. Construction Activities

The State Water Board first issued a statewide general NPDES permit for Discharges of Stormwater Runoff Associated with Construction Activities on August 19, 1999. The Construction General Permit requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP shall lists Best Management Practices (BMPs) the discharger uses to protect stormwater runoff and the placement of those BMPs. The permit was reissued on September 2, 2009 (State Water Board Order 2009-0009-DWQ, NPDES Permit No. CAS000002) and amended on July 17, 2012 (State Water Board Order 2012-0006-DWQ). As of the writing of this TMDL, there are zero dischargers enrolled under the general construction stormwater permit in the Los Cerritos Channel subwatershed, three dischargers in the Los Cerritos Channel Estuary subwatershed, no dischargers in the Alamitos Bay subwatershed, and one discharger in the Colorado Lagoon subwatershed.

c. Phase II Small MS4 General Permit

On December 8, 1999, U.S. EPA promulgated regulations, known as Phase II stormwater regulations under authority of the CWA section 402(p)(6), which require NPDES permit coverage for stormwater discharges from small municipalities. The term, Small MS4s, includes systems, such as military bases, large hospital or prison complexes, and highways and other thoroughfares, also referred to as Non-traditional Small MS4s. There is currently one statewide Phase II Small MS4 General Permit (State Water Board Order 2013-0001-DWQ) adopted by the State Water Board on February 5, 2013. The permit identifies one permittee, California State University Long Beach, located in the Los Cerritos Channel Estuary subwatershed, and one permittee, Long Beach VA Medical Center, located on the border of the Los Cerritos Channel Estuary subwatershed and the Alamitos Bay subwatershed. The Long Beach VA Medical Center submitted a waiver request and is currently waived from permit requirements. No facilities located within the Los Cerritos Channel subwatershed and the Colorado Lagoon subwatershed are identified under the Phase II MS4 permit. The Los Angeles Water Board may designate additional Phase II MS4 permittees in the future.

4.1.4. NPDES PERMITS

a. Major Individual NPDES Permits

There is one major discharge in the Los Cerritos Channel Estuary subwatershed, the AES Alamitos Generating Station (Order R4-2015-0173). The AES Alamitos Generating Station is located in Long Beach between the Los Cerritos Channel Estuary and the San Gabriel River Estuary. The OTC water at this facility is drawn from the Los Cerritos Channel Estuary through two intake channels using circulating water pumps. After using the water to cool the generating units, the facility discharges the water to the San Gabriel River Estuary through two outfalls. The discharge permit for the San Gabriel River Estuary OTC outfalls also regulates stormwater runoff that is discharged to the Los Cerritos Channel Estuary. There are no major individual NPDES permits within Los Cerritos Channel, Alamitos Bay and Colorado Lagoon subwatersheds.

b. Minor Individual NPDES Permits

Minor discharges are all other NPDES discharges that are not categorized as a Major. Many of these permits are for episodic discharges rather than continuous flows. Minor permits cover miscellaneous wastes such as treated stormwater runoff and treated groundwater. There are two minor NPDES permits associated with treated stormwater runoff in the Los Cerritos Channel subwatershed. These permits contain receiving water limitations for bacteria. There are no minor individual NPDES permits within Los Cerritos Channel Estuary, Alamitos Bay and Colorado Lagoon subwatersheds.

c. General NPDES Permits

Pursuant to 40 CFR parts 122 and 123, the State Water Board and the Regional Water Boards have the authority to issue general NPDES permits to regulate a category of point sources if the sources: involve the same or substantially similar types of operations; discharge the same type of waste; require the same type of effluent limitations; and require similar monitoring. The Los Angeles Water Board has issued multiple general NPDES permits for non-process wastewater (NPDES No. CAG994003), construction and project dewatering (NPDES No. CAG994004), hydrostatic test water (NPDES No. CAG674001), petroleum-fuel contaminated sites (NPDES No. CAG834001), and volatile organic compounds-contaminated sites (NPDES No. CAG914001). The State Water Board has issued a statewide general permit for drinking water system discharges (Order WQ 2014-0194-DWQ). Discharges associated with non-process wastewater, petroleum fuel cleanup sites, volatile organic compounds cleanup sites, and hydrostatic test water do not typically require monitoring for bacteria and are not considered significant sources of bacteria to the watershed. Construction and project dewatering, and potable water are typically required to monitor for bacteria under their permits.

Currently, there are four enrollees in general NPDES permits in the Los Cerritos Channel subwatershed, two in the Los Cerritos Channel Estuary subwatershed, one in the Alamitos Bay subwatershed, and none in the Colorado Lagoon subwatershed.

4.2. NONPOINT SOURCES

Nonpoint sources in the Upper Los Cerritos Channel watershed include onsite wastewater treatment systems, sanitary sewer overflows, irrigated agriculture lands, golf courses, wildlife, and marina activities.

4.2.1. ONSITE WASTEWATER TREATMENT SYSTEMS

The majority of sanitary sewer discharges in the watershed are to sanitary sewer collection systems and to a Water Reclamation Plant; however onsite wastewater treatment systems (OWTS), also known as septic systems, are also still in use. They are typically designed to treat small quantities of sewage waste usually from a single or small multifamily residence or small business. Many of the OWTS installed today are for parcels where sewer services are not readily available. Correctly sited, operated, and maintained OWTS are highly effective at removing bacteria. Failures have been attributed to improper siting, design, and maintenance. Therefore, OWTS can be significant sources of bacteria when the systems provide inadequate treatment and discharge directly to groundwater in close proximity to surface waters or discharge directly to surface water via overland flow.

The State Water Board adopted the Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems (OWTS Policy) on June 19, 2012 under Resolution No. 2012-0032. The OWTS Policy was approved by the Office of Administrative Law on November 13, 2012; and consistent with OWTS Policy section 13.0, became effective six months later on May 13, 2013. The OWTS Policy authorizes subsurface disposal of domestic strength, and in limited instances high strength, wastewater and establishes minimum requirements for the permitting, monitoring, and operation of OWTS for protecting beneficial uses of waters of the state and preventing or correcting conditions of pollution and nuisance. The Policy also conditionally waives the requirement for owners of OWTS to apply for and obtain waste discharge requirements (WDRs) in order to operate their systems if they meet the conditions set forth in the Policy. The Policy applies to OWTS on federal, state, and tribal lands to the extent authorized by law or agreement.

Staff obtained inventories of onsite wastewater treatment systems that were permitted by Los Angeles County and identified the onsite wastewater treatment systems within the

Upper Los Cerritos Channel watershed. There are twelve OWTS within the Los Cerritos Channel subwatershed and no permitted OWTS found within the Los Cerritos Channel Estuary, the Alamitos Bay, and the Colorado Lagoon subwatersheds. OWTS are considered potential sources and are assigned LAs.

4.2.2. SANITARY SEWER OVERFLOWS

Sanitary sewer overflows (SSO) are Any overflow, spill, release, discharge or diversion of untreated or partially treated wastewater from a sanitary sewer system (State Water Board, 2020)... A Category 1 overflow is defined as “Discharges of untreated or partially treated wastewater of any volume resulting from an enrollee’s sanitary sewer system failure or flow condition that: Reach surface water and/or reach a drainage channel tributary to a surface water; or Reach a municipal separate storm sewer system and are not fully captured and returned to the sanitary sewer system or not otherwise captured and disposed of properly. Any volume of wastewater not recovered from the municipal separate storm sewer system is considered to have reached surface water unless the storm drain system discharges to a dedicated stormwater or ground water infiltration basin (State Water Board, 2020b).”

Publicly-owned sanitary sewer systems greater than one mile in length are regulated under General Waste Discharge Requirements (WDRs) for Sanitary Sewer Systems, State Water Board Order 2006-0003-DWQ (Statewide Sanitary Sewer Systems General Order) and Monitoring and Reporting Program WQ 2013-0058-EXEC. The Sanitary Sewer Systems General Order prohibits the discharge of untreated or partially-treated wastewater from sanitary sewer systems to waters of the United States (State Water Resources Control Board, 2006; State Water Resources Control Board, 2013). The WDRs prohibit any SSO that results in a discharge of untreated or partially treated wastewater that creates a nuisance as defined in California Water Code section 13050, subdivision (m).

Sanitary sewer overflow data from the California Integrated Water Quality System, entered by owners/operators of sanitary sewer systems (State Water Board, 2020a) from 2007 to January 21, 2020 show 52 sanitary sewer overflows in the Los Cerritos Channel subwatershed (10 Category 1), 15 sanitary sewer overflows in the Los Cerritos Channel Estuary subwatershed (5 Category 1), 17 sanitary sewer overflows in the Alamitos Bay subwatershed (2 Category 1), and 18 sanitary sewer overflows in the Colorado Lagoon subwatershed (6 Category 1).

Untreated sewage from sanitary sewer system releases can contain high levels of indicator bacteria, pathogenic microorganisms and other pollutants. The reported SSO incidents demonstrate that SSOs can be a source of bacteria. Therefore, they are assigned LAs.

4.2.3. IRRIGATED AGRICULTURE LANDS

Irrigation with bacteria-polluted water, application of manure, and wild animals living on irrigated agriculture lands may contribute bacteria to waterbodies through runoff (Los Angeles Waterboard, 2010).

On November 3, 2005, the Los Angeles Water Board adopted a Conditional Waiver for Discharges from Irrigated Agriculture Lands (Order R4-2005-0080) (Conditional Waiver) with a five-year term. The Conditional Waiver was renewed on October 7, 2010 (Order R4-2010-0186). On October 8, 2015, the Conditional Waiver was extended for a six-month term (Order R4-2015-0202). On April 14, 2016, the Conditional Waiver was renewed (Order R4-2016-0143). On April 8, 2021, the Conditional Waiver was extended per Order R4-2021-0045 until April 14, 2022. The single sample WQO for *E. coli* of 235 MPN/100mL was incorporated in the Conditional Waiver as a water quality benchmark.

The dischargers enrolled in the Conditional Wavier were required by Order R4-2010-0186 to conduct a Bacteria Special Study to characterize potential discharges of bacteria from irrigated agriculture lands. On February 28, 2014, five locations were sampled for bacteria in the Los Angeles River watershed. Due to lack of qualifying storm events under drought conditions, no storm events were sampled. The Bacteria Special Study results for the Nursery Growers Association – Los Angeles Irrigated Lands Group (NGA-LAILG) representing growers in Los Angeles County indicated that at four out of five sites, the sources of *E. coli* were partially composted or un-composted horse or chicken manure either on-site (a horse ranch and a community garden) or on adjacent lands (Pacific Ridgeline Inc., 2015). Based on the Bacteria Special Study for Los Angeles River watershed, discharges from irrigated agriculture are a source of bacteria. Therefore, discharges from irrigated agriculture in the Los Cerritos Channel and Estuary subwatersheds are deemed as a source of bacteria and are assigned LAs. No irrigated agriculture lands are in the Alamitos Bay and Colorado Lagoon subwatersheds.

4.2.4. GOLF COURSES

Golf courses are near or adjacent to waterways in the Upper Los Cerritos Channel watershed. Golf courses are a potential source of bacteria since, typically, fertilization and watering rates are high. Bacteria may be transported to waterways via shallow groundwater flows, irrigation and stormwater runoff. Golf courses also attract birds, which may contribute to the bacteria loads. Although the contribution from golf courses cannot be quantified based on available data, they are deemed as potential sources of bacteria in the Santa Clara River and San Gabriel River Bacteria TMDLs adopted by the Los Angeles Water Board previously and are, therefore, assigned LAs in this TMDL.

4.2.5. WILDLIFE

Wildlife wastes from the undeveloped portions of the watershed can contribute to bacterial loads. Approximately, 6% of the Los Cerritos Channel subwatershed and 3% of the Los Cerritos Channel Estuary subwatershed are undeveloped, open space; 10% of the Alamitos Bay subwatershed and 5% of the Colorado Lagoon subwatershed are open space and recreation or vacant land use. The abundance of wildlife varies among the different habitat and vegetation types. However, there were not enough data to quantify bacteria contribution from wildlife. Therefore, no LAs are assigned to wildlife.

4.2.6. MARINA ACTIVITIES IN LOS CERITOS CHANNEL ESTUARY AND ALAMITOS BAY

Nonpoint sources from marina activity are located within Los Cerritos Channel Estuary subwatershed and Alamitos Bay subwatershed and include marina activities such as boat sanitary waste systems, pump-out stations, boat deck and slip washing, fishing waste disposal, swimmer “wash-off”, and restaurant washouts.

Boats over 20 feet long are generally equipped with a head (toilet) and a marine sanitation device. Boats with poorly maintained marine sanitation devices or open Y-valves can increase bacteria loads in waterways. To get an estimate of the quantity of boats within the Estuary and Alamitos Bay, staff contacted the marinas and requested the quantity of slips located within the marinas. Staff identified approximately 1,655 slips (8% are designated as liveaboards) within Alamitos Bay Marina; 265 slips within Cerritos Bahia Marina, 192 slips within Spinnaker Bay Marina, 178 slips within Marina Pacifica, and 55 slips in the four independently owned private marinas in what was formally known as Crissman’s Marina. Staff was unable to quantify the number of boats and or boat slips surrounding Naples island, Treasure Island, and Bay Shore Avenue. However, according to Harbors and Navigation Code Section 780, no person shall disconnect, bypass or operate a marine sanitation device so as to potentially discharge sewage into waters of the state unless expressly authorized or permitted and that no person shall occupy or operate a vessel in which a marine sanitation device is installed unless the marine sanitation device is properly secured and under Section 117515 of the California Health and Safety Code prohibits dumping of sewage into marinas and yacht harbors from any vessel tied to a dock, slip, or wharf that has toilet facilities available for persons on such vessels.

Pump- out facilities for vessel sewage holding tanks are available in 5 primary forms: fixed pump-out stations, dockside pump-outs, portable pump-outs, pump-out boats, and dump stations. Fixed pump-out stations are generally located at the end of a pier, often on a fueling pier so that fueling and pump-out operations can be combined. A boat requiring pump-out services docks at the pump-out station. A flexible hose is connected to the wastewater fitting in the hull of the boat and pumps the wastewater to an onshore holding tank, or a connection to the sewer system. Poorly maintained pump-out stations or improper connection from boat to pump-out station may contribute to bacteria loading. The City of Long Beach Marina has a total of 14 pump-out facilities spread throughout the Alamitos Bay Marina. Of these 14 pump-out facilities, three are available to visiting boats and the others are reserved for slip owners within the Alamitos Bay Marina. Marina Pacifica owns two private pump-out facilities and Spinnaker Bay owns one private pump-out facility to be used by their slip owners. Cerritos Bahia Marina offers free pump-out services for its slip owners, but it is unknown how many pump-out facilities exist. Marine sanitation devices are assigned LAs.

Fish waste on boats and docks may enter waterways and contribute to bacteria loading. In addition, birds may be attracted to boat and dock areas, thus contributing to bacteria loading. Other marina activities, such as boat deck and slip washing, swimmer “wash-off”, restaurant washouts and natural sources from birds, waterfowl and other wildlife, may also be sources of bacteria. However, there is insufficient data to quantify the bacteria loading from these nonpoint sources and no LAs are assigned.

5. LINKAGE ANALYSIS

This section describes the relationship between the sources of bacteria and bacteria impairments. This relationship can then be used to set allocations that will ensure the attainment of water quality objectives and protection of beneficial uses.

Certain concepts of the linkage analysis for this TMDL are the same as, or similar to, other bacteria TMDLs previously developed by the Los Angeles Water Board. The linkage between the numeric targets, the impairments, and the allocations is supported by the following findings:

1. In Southern California, in dry weather, non-stormwater discharges from urban areas are significant sources of bacteria that principally drive exceedances (Los Angeles Water Board, 2002b; Los Angeles Water Board, 2003c; Los Angeles Water Board, 2004).

2. In Southern California, in wet weather, stormwater runoff from watershed sources conveyed through MS4s causes bacteria exceedances (Los Angeles Water Board, 2002a; Los Angeles Water Board, 2003c; Los Angeles Water Board, 2004).

3. Studies show that bacterial degradation and dilution during transport from the watershed to the receiving water do not significantly affect bacterial indicator densities (Los Angeles Water Board, 2003c).

For this TMDL, the FIB load and waste load allocations will protect the water contact recreation beneficial use because they are based on the WQOs adopted by the State Water Board and the Los Angeles Water Board. Because numeric targets to attain the bacteria WQOs apply within the receiving water, any potential bacteria source must meet numeric targets at the point of entrance to the receiving water in order to ensure that the quality of water entering the impaired waterbody meets the numeric targets for bacteria. Therefore, the loading capacity for Los Cerritos Channel and Estuary, Alamitos Bay, and Colorado Lagoon is defined in terms of bacterial indicator densities (concentrations) and is equivalent to the numeric targets. This is consistent with the approach used in bacteria TMDLs adopted by other regional boards in California (Central Coast Water Board, 2012; San Francisco Water Board, 2020).

In addition to relying on linkage analyses for previous TMDLs, this TMDL uses the Environmental Fluid Dynamics Code (EFDC) model to simulate the transport of bacteria in the Upper Los Cerritos Channel Watershed by linking sources of bacteria from Los Cerritos Channel and Estuary and Colorado Lagoon to Alamitos Bay (Appendix A). The calibrated model was used to predict the effects of (1) the reduction of bacteria loading from Los Cerritos Channel on bacteria concentrations in Alamitos Bay, (2) the cessation of intake pumping withdrawals from Alamitos Bay by the AES Generating Station and HGS, and (3) the application of an HFS to the freshwater portion of Los Cerritos Channel.

The model simulated concentrations of bacteria in Alamitos Bay under several bacteria load reduction scenarios for Los Cerritos Channel. Results indicated that the bacteria concentrations in Alamitos Bay exceed the WQOs during storm events greater than 0.5 inch and load reductions are required. The model showed that bacteria loading to Alamitos Bay from Los Cerritos Channel and Estuary will need to be reduced by at least 85% in order to meet the WQOs in Alamitos Bay. The model showed the current assimilative capacity of the Upper Los Cerritos Channel watershed is low. Therefore, the load and waste load allocations are set equal to the numeric targets to ensure that numeric targets are attained.

In order to understand the effects of the cessation of power plant intake pumping withdrawals, the model evaluated the residence times of fecal coliform at four monitoring stations (B-22, B-67, B14, and B-31) under different cessation scenarios for AES Alamitos Generating Station and HGS. The model shows an increase in fecal coliform residence times ranging from 0.3 days to 0.8 days in wet weather and from 0.5 days to 0.6 days in dry weather when there are no power plant pumps in operation. Model results also show that the power plant pumps enhance circulation in Alamitos Bay by an average of 11% at all four locations, and a maximum of 15% at B-67 during wet weather. Model simulations were performed with intake pumping and without intake pumping under the baseline, 75% reduction scenario, and 85% reduction scenario. Results show that without power plant pumping, and with an 85% reduction in bacteria loading from Los Cerritos Channel, there would be no exceedances of the geometric mean or STV for *Enterococcus* at B-67, B-14, B-22, and B-31, there would be no exceedances of the geometric mean or STV for fecal coliform at B-67, B-14, and B-31, and there would be exceedances of the STV, but not the geometric mean, for fecal coliform at B-22. Since fecal coliform is not an applicable WQO for Alamitos Bay, the 85% Load Reduction Scenario will ensure that applicable WQOs are attained in Alamitos Bay, even after the cessation of power plant intake withdrawals.

As discussed in Section 3, Numeric targets, the EFDC model demonstrates that bacteria concentrations in Alamitos Bay will not meet numeric targets during storm events greater than 0.5 inches unless the wet-weather bacteria loading from Los Cerritos Channel is reduced by 85%. Per the model, all exceedances of the geometric mean and STV numeric targets at the Alamitos Bay monitoring sites occurred during a rainfall event of greater than or equal to 0.5 inches or during the following 24-hour period, for the 2010 modeled year. In other words, an HFS may apply to discharges ***to*** Los Cerritos Channel and to water ***within*** the Channel itself, but an HFS may not apply to discharges ***from*** Los Cerritos Channel to the Estuary and Alamitos Bay. In order to attain numeric targets in Alamitos Bay, bacteria loading from Los Cerritos Channel must be reduced by 85% of the baseline in the 2010 modeled year. In order to address uncertainty in the model assumptions, this TMDL will achieve this reduction by requiring the water discharged from Los Cerritos Channel above Atherton Street to achieve the numeric targets for the downstream Los Cerritos Channel Estuary and Alamitos Bay.

5.1. CRITICAL CONDITION

The critical condition in a TMDL defines an extreme condition for the purpose of setting allocations such that the TMDL numeric targets may be met throughout all conditions. While it is a separate element of the TMDL, it may be thought of as an additional margin of safety such that the allocations are set to meet the numeric target during an extreme (or above average) condition, such as high or low flows. For these waterbodies, the critical condition is winter when assessing data by the geometric mean standard and wet weather when assessing data by the STV standard. While FIB densities can be greater during the winter wet season due to factors such as stormwater runoff, they can be high at any time of year. Given that exceedances of the objectives are frequent during all seasons and conditions and given that recreational uses of the Los Cerritos Channel Estuary, Alamitos Bay, and Colorado Lagoon take place during all seasons and conditions, the TMDL allocations are applied equally during all time periods and conditions.

5.2. MARGIN OF SAFETY

TMDLs are required to include a margin of safety to account for uncertainty in the relationship between pollutant loads and water quality in the receiving water body. An implicit margin of safety is incorporated in the allocations under the assumption that no bacterial decay occurs in discharges from storm drains to the receiving water when determining compliance with allocations. In addition, the numeric targets and allocations in this TMDL are based on the 2012 U.S. EPA Recreational Criteria and the Statewide Bacteria Provisions. By directly applying the numeric water quality objectives as WLAs and LAs, there is little uncertainty about whether meeting the TMDL will result in meeting the water quality standards. Therefore, no additional explicit margin of safety is needed for this TMDL.

6. ALLOCATIONS

WLAs are allocations for bacteria assigned to point sources and LAs are allocations for bacteria assigned to nonpoint sources.

For many pollutants, TMDLs are expressed as a mass-based load (e.g., kilograms per year). For FIB, however, it is the number of organisms in a given volume of water (i.e., the density) that is associated with public health risk. The numeric water quality objectives are also density-based.[2] Therefore, density-based allocations equal to the water quality objectives and numeric targets are used for this TMDL. Previous bacteria TMDLs in the Los Angeles region also set density-based allocations. Density-based allocations have also been used in FIB TMDLs in the North Coast, San Francisco, and Central Coast Water Boards. (Central Coast Water Board, 2012; San Francisco Water Board, 2020; North Coast Water Quality Control Board, 2019). Unlike mass-based load allocations, the density-based load allocations do not add up to equal a total load since the densities of individual pollution sources are not additive. Each source needs to meet the density-based load allocation in order to achieve the overall load allocation set in the density-based TMDL.

The WLAs and LAs will apply throughout the year and in dry and wet weather. Allocations require assessment of data over a calendar month, and rolling 6-week periods for both WLAs and LAs. Per the bacteria objectives, a calendar month is a period of time from a day of one month to the day before the corresponding day of the next month if the

[2] The STV objective is expressed as colony-forming units (cfu)/100 mL (a density) and the geometric mean objective is a mean of cfu/100 mL. Alternatively, the objectives can be expressed as most probable number (MPN)/100 mL (a density) and a mean of MPN/100 mL.

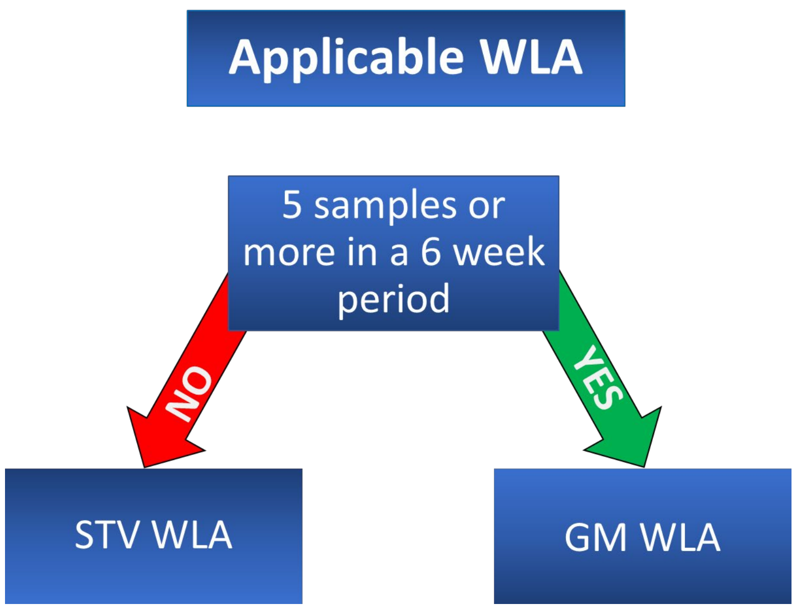
corresponding day exists, or if not, to the last day of the next month (e.g., from January 1 to January 31, from June 15 to July 14, or from January 31 to February 28).

All permittees or entities that discharge FIB or have jurisdiction over such dischargers are responsible for meeting these allocations. The attainment of these allocations will ensure protection of water quality and beneficial uses.

6.1. WASTE LOAD ALLOCATIONS

WLAs are assigned to point sources including MS4 permittees[3], individual NPDES permittees, general NPDES permittees, general industrial stormwater permittees, general construction stormwater permittees, and any other stormwater dischargers that are subject to an NPDES permit.

The applicable WLA for point sources is either a six-week rolling geometric mean or a calendar-month STV. The geometric mean WLA is applicable when a minimum of five samples or more are collected over a six-week period. The STV WLA is applicable when there are not enough samples to calculate the geometric mean, as shown in the following flow chart.



The geometric mean shall be calculated weekly, as a rolling geometric mean using five or more samples, for a six-week period, starting all calculations on Sunday.

[3] The MS4 permittees in the Los Cerritos Channel subwatershed include the permittees covered by the Regional MS4 Permit, that is, the County of Los Angeles, Los Angeles County Flood Control District, the Cities of Bellflower, Cerritos, Downey, Lakewood, Paramount, Long Beach and Signal Hill; Caltrans; and any current and future permittees enrolled under the Phase II MS4 permit.
The MS4 permittees in the Los Cerritos Channel Estuary, Alamitos Bay subwatershed and the Colorado Lagoon subwatershed include the permittees of the Regional MS4 Permit, that is, Los Angeles County Flood Control District, and the City of Long Beach; Caltrans; and any current and future permittees enrolled under the Phase II MS4 permit.

As described in Section 1.1, Regulatory Background, and Appendix A, previous bacteria TMDLs in the Los Angeles Region allowed a certain number of days of exceedance of the previous single sample maximum objective. However, this TMDL directly applies the STV of the recently adopted Statewide Bacteria Provisions. The STV shall be calculated in a static manner and shall not be exceeded by more than 10 percent of the samples collected in a calendar month.

Per the Statewide Bacteria Provisions, the objectives differ for fresh and saline waters. Los Cerritos Channel above Atherton Street is a freshwater system. Los Cerritos Channel (Atherton Street to Anaheim Street), Los Cerritos Channel Estuary, Alamitos Bay and Colorado Lagoon are saline waters.

6.1.1. LOS CERRITOS CHANNEL SUBWATERSHED

The WLAs for all point sources in the Los Cerritos Channel subwatershed (including the portion of the watershed draining to the transition between the Los Cerritos Channel and Los Cerritos Channel Estuary), are listed in Table 10.

Table 10: WLAs for the Los Cerritos Channel Subwatershed

Location	Bacteria Indicator	Geometric Mean (cfu/100 mL)	Statistical Threshold Value (cfu/100 mL)
Los Cerritos Channel (above Atherton Street)	*E. coli*	100	320
Los Cerritos Channel (Atherton Street to Anaheim Street) - the transition between the Los Cerritos Channel and Los Cerritos Channel Estuary	*Enterococcus*	30	110
Duration and Frequency: The waterbody's calculated geometric mean shall not be greater than the applicable geometric mean magnitude in any six-week interval. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a calendar month. Applicability: The WLAs for discharges to Los Cerritos Channel (above Atherton Street) may be suspended during days with rainfall greater than or equal to 0.5 inches and the following 24 hours, if it can be demonstrated that, for the same time period, discharges to Los Cerritos Channel below Atherton Street from Los Cerritos Channel above Atherton Street, attain the WLAs for Los Cerritos Channel below Atherton Street.			

6.1.2. LOS CERRITOS CHANNEL ESTUARY, ALAMITOS BAY, COLORADO LAGOON

The WLAs for all point sources in the Los Cerritos Channel Estuary, Alamitos Bay, and Colorado Lagoon subwatersheds are listed in Table 11.

Table 11: WLAs for Los Cerritos Channel Estuary, Alamitos Bay, and Colorado Lagoon Subwatersheds

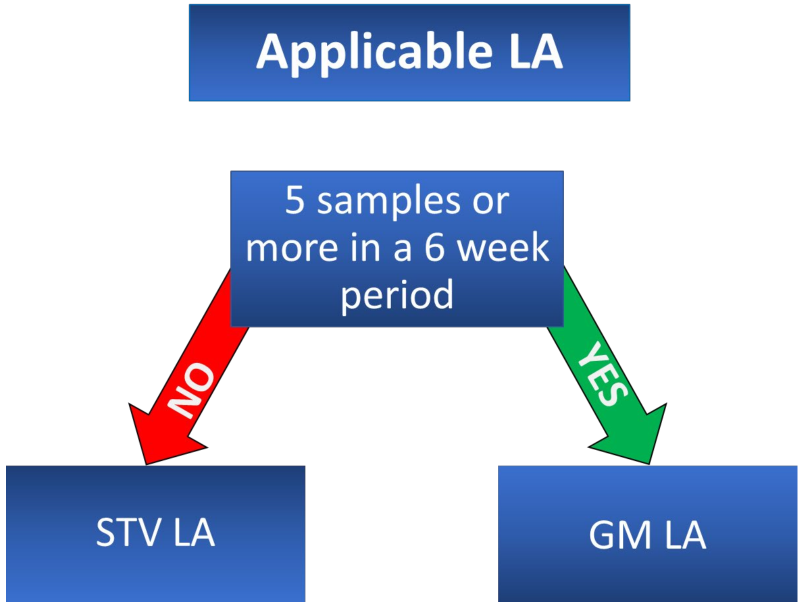
Location	Bacteria Indicator	Geometric Mean (cfu/100 mL)	Statistical Threshold Value (cfu/100 mL)
Los Cerritos Channel Estuary, Alamitos Bay, and Colorado Lagoon	*Enterococcus*	30	110
Duration and Frequency: The waterbody’s calculated geometric mean shall not be greater than the applicable geometric mean magnitude in any six-week interval. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a calendar month.			

6.2. LOAD ALLOCATIONS

LAs are assigned to nonpoint sources including OWTS, sanitary sewer overflows, marine sanitation devices, irrigated agriculture lands, and golf courses.

LAs for sanitary sewer overflows and marine sanitation devices are set to zero discharge of FIB. As discussed in Section 4.2, the Statewide Sanitary Sewer WDRs, 2006-003-DWQ prohibits any SSO that results in a discharge of untreated or partially treated wastewater that creates a nuisance. In addition, per Navigation Code section 780 and section 117515 of the California Health and Safety Code, the dumping of sewage into marinas is prohibited. Consequently, the bacteria LA for these sources is set as zero discharge of FIB.

The applicable LA for OWTS, irrigated agriculture lands, and golf courses is either a six-week rolling geometric mean or an STV. The geometric mean LA is applicable when a minimum of five samples are collected over a six-week period. The STV LA is applicable when there are not enough samples collected to calculate a geometric mean, as shown in the following flow chart.



The geometric mean shall be calculated weekly, as a rolling geometric mean using five or more samples, for a six-week period, starting all calculations on Sunday.

As described in Section 1.1, Regulatory Background, and Appendix A, previous bacteria TMDLs in the Los Angeles Region allowed a certain number of days of exceedance of the previous single sample maximum objective. However, this TMDL directly applies the STV objective of the recently adopted Statewide Bacteria Provisions. The STV shall be calculated in a static manner and shall not exceed the STV LA by more than 10 percent of the samples collected in a calendar month.

Per the Statewide Bacteria Provisions, objectives differ for fresh and saline waters. Los Cerritos Channel above Atherton Street is a freshwater system. Los Cerritos Channel Estuary, Alamitos Bay and Colorado Lagoon are saline waters.

6.2.1 LOS CERRITOS CHANNEL SUBWATERSHED

The LAs for OWTS, golf courses, and irrigated agriculture lands in the Los Cerritos Channel subwatershed are listed in Table 12.

Table 12: LAs for OWTS, golf courses, and irrigated agriculture in the Los Cerritos Channel Subwatershed

Location	Bacteria Indicator	Geometric Mean (cfu/100mL)	Statistical Threshold Value (cfu/100mL)
Los Cerritos Channel (above Atherton Street)	*E. coli*	100	320
Los Cerritos Channel (Atherton Street to Anaheim Street) - the transition between the Los Cerritos Channel	*Enterococcus*	30	110

Location	Bacteria Indicator	Geometric Mean (cfu/100mL)	Statistical Threshold Value (cfu/100mL)
and Los Cerritos Channel Estuary			
Duration and Frequency: The waterbody's calculated geometric mean shall not be greater than the applicable geometric mean magnitude in any six-week interval. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a calendar month. Applicability: The LAs for discharges to Los Cerritos Channel (above Atherton Street) may be suspended during days with rainfall greater than or equal to 0.5 inches and the following 24 hours, if it can be demonstrated that, for the same time period, discharges to Los Cerritos Channel below Atherton Street from Los Cerritos Channel above Atherton Street, attain the LAs for Los Cerritos Channel below Atherton Street.			

6.2.2 LOS CERRITOS CHANNEL ESTUARY, ALAMITOS BAY, COLORADO LAGOON

The LAs for OWTS, golf courses, and irrigated agriculture lands in the Los Cerritos Channel Estuary, Alamitos Bay and Colorado Lagoon subwatersheds are listed in Table 13.

Table 13: LAs for OWTS, golf courses, and irrigated agriculture the Los Cerritos Channel Estuary, Alamitos Bay, and Colorado Lagoon Subwatersheds

Location	Bacteria Indicator	Geometric Mean (cfu/100 mL)	Statistical Threshold Value (cfu/100 mL)
Los Cerritos Channel Estuary, Alamitos Bay, and Colorado Lagoon	*Enterococcus*	30	110
Duration and Frequency: The waterbody's calculated geometric mean shall not be greater than the applicable geometric mean magnitude in any six-week interval. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a calendar month.			

7. IMPLEMENTATION

This section describes the regulatory mechanisms that will be used to implement the TMDL, implementation measures that could be used to attain WLAs and LAs, and an implementation schedule.

7.1 REGULATORY MECHANISMS

7.1.1. MANNER OF INCORPORATION FOR MS4S

The MS4 permittees in the Upper Los Cerritos Channel watershed include: the permittees of the Regional MS4 Permit, that is, the County of Los Angeles, Los Angeles County Flood Control District, and the cities of Bellflower, Cerritos, Downey, Lakewood, Long Beach, Paramount, and Signal Hill; Caltrans; and any current and future permittees enrolled under the Phase II MS4 permit.

The WLA shall be incorporated into the applicable MS4 permit as water quality-based effluent limitations (WQBELs) at the time of permit issuance, modification, or renewal. MS4 permittees will have demonstrated compliance with the WQBELs if any of the following requirements is demonstrated:

1. There are no exceedances of the WQBELs at the Permittee's applicable MS4 outfall(s); or

2. There are no exceedances of the numeric targets, in the receiving water downstream of the Permittee's outfalls; or

3. There is no direct or indirect discharge from the Permittee's MS4 to the receiving water during the time period subject to the WQBEL.

As discussed in Section 3, Numeric Targets, and Section 5, Linkage Analysis, an HFS applies to Los Cerritos Channel above Atherton Street but not to the waterbodies below. The WLAs for discharges to Los Cerritos Channel above Atherton Street may be suspended during days with rainfall greater than or equal to 0.5 inches and the following 24 hours, if it can be demonstrated that, for the same time period, discharges to Los Cerritos Channel below Atherton Street from Los Cerritos Channel above Atherton Street, attain the WLAs for Los Cerritos Channel below Atherton Street. In other words, MS4 permittees may pursue a downstream compliance approach. This will require two points of compliance: (1) at the outfall discharging to Los Cerritos Channel above Atherton Street and (2) in Los Cerritos Channel below Atherton Street. For practical purposes, MS4 permittees may use the existing mass emission station LCC1, located at Stearns Street, about 3000 feet upstream of Atherton Street, to demonstrate compliance with WLAs in Los Cerritos Channel below Atherton Street.

MS4 Permittees shall provide an Implementation Plan to the Los Angeles Water Board outlining how each intends to individually or cooperatively achieve the WLAs. The report shall include implementation methods, an implementation schedule, milestones, and outfall and/or receiving water monitoring to determine compliance. A Watershed Management Program (WMP) developed by the responsible entities in accordance with their MS4 permit(s), which has been approved by the Los Angeles Water Board, satisfies the requirements for an Implementation Plan, where the WMP addresses the applicable waterbody-pollutant combinations of this TMDL consistent with the implementation schedule.

7.1.2. MANNER OF INCORPORATION FOR OTHER POINT SOURCES

WLAs for individual NPDES permittees, general NPDES permittees, general industrial stormwater permittees, and general construction stormwater permittees will be incorporated as WQBELs in their NPDES permits at the time of permit issuance, modification, or renewal.

7.1.3. MANNER OF INCORPORATION FOR NONPOINT SOURCES

LAs for irrigated agricultural lands will be implemented through requirements in the Conditional Waiver or other appropriate order consistent with the LAs and the State Water Board's Nonpoint Source Implementation and Enforcement Policy. The LAs for OWTS will be regulated by WDRs or waivers of WDRs consistent with the State Water Board's OWTS Policy. LAs for golf courses will be implemented through WDRs or waivers of WDRs consistent with the State Water Board's Nonpoint Source Implementation and Enforcement Policy. The Nonpoint Source Implementation and Enforcement Policy specifies that the regional water boards have the authority to regulate nonpoint source discharges through WDRs, waivers, and prohibitions.

7.2. IMPLEMENTATION MEASURES

This section includes a discussion of implementation measures currently being implemented and potential implementation measures; however, there is no requirement to follow the proposed measures as long as the allocations are met.

7.2.1. EXISTING IMPLEMENTATION MEASURES

a. Los Cerritos Channel and Estuary subwatersheds

The Los Cerritos Channel Watershed Group, including the Cities of Bellflower, Cerritos, Downey, Lakewood, Long Beach, Paramount, and Signal Hill, as well as the Los Angeles County Flood Control District and, informally, Caltrans, have WMP implementation strategies for achieving allocations assigned per other TMDLs and for achieving receiving water limitations (Los Cerritos Channel Watershed Management Group, 2017). These existing implementation strategies may also assist in reducing bacteria loads. These existing implementation strategies include source control, total suspended solids reduction, runoff reduction, stormwater capture, and low impact development (LID) and green streets (Los Cerritos Channel Watershed Management Group, 2017). These existing implementation strategies are defined and included in the permittee's stormwater plans, programs and ordinances.

At the watershed and sub-watershed scales, water capture devices are being implemented or are under planning consideration. The City of Bellflower has proposed the Caruthers Park Stormwater and Urban Runoff Capture Project. The City of Signal Hill and the City of Long Beach have nearly completed the construction of the Los Cerritos Channel Stormwater Capture Facility. The site of this facility is at the Long Beach Airport and at the Los Angeles Flood Control District's Los Cerritos Channel Line 3 Drain Right of Way. The facility is located at the bottom of the watershed intercepts channelized stormwater and removes solid waste and sediments, allowing the effluent to slowly percolate through porous gravels.

Individual permittees have taken responsibility for the implementation of the local structural and non-structural BMPs, such as street sweeping, LID and green streets, and community education.

b. Alamitos Bay subwatershed

Throughout the 8 Basins of Alamitos Bay Marina, the City of Long Beach provides three pump-out stations, accessible to visiting boats and slip owners, and 11 pump-out stations, accessible only to the slip owners of Alamitos Bay Marina. As discussed in the Source Assessment Section, there are 1,655 slips within Alamitos Bay Marina. Alamitos Bay Marina has installed in-slip pump-outs for slips designed for 35-foot or larger boats, which covers 76% of their total slips. Per conversations with the Long Beach Department of Parks, Recreation & Marine, the pump-out locations are connected directly to the sewer lines and are inspected weekly for station failures and leakage. In addition, the Alamitos Bay Marina publishes a monthly newsletter containing articles about Long Beach Environmental Policies and how to use the pump-outs and notifies subscribers about their annual Honey Pot Day. The Honey Pot Day was established in 2009 to specifically reduce the levels of bacteria in local harbors by providing free mobile pump-out service. The goals of the Honey Pot program are to educate boaters about the negative effects of raw sewage in our local waterways, inform boaters about the convenient options available to properly dispose of raw sewage, and encourage recreational boaters to properly dispose of their waste. Alamitos Bay Marina has been a part of the Clean Marine Program since 2006 and was recertified in 2018. The Clean Marine Program establishes a partnership among private marina owners, government marina operators, boatyards and yacht clubs to provide environmentally clean facilities and to protect coastal and inland waters from pollution through compliance with best management practices. The Clean Marine Program offers program manuals for best management practices, such as good boat-keeping practices, education, signs, notices, marina rules and regulations, waste receptacles, and spill prevention and rapid clean-up plans.

In August 2018, Marina Pacifica upgraded their two pump-out stations, one on slip 165 at Key 1, and one on slip 39 at Key 15. The pump-out stations were installed through the Clean Vessel Act Grant Program. In 1992, Congress passed the Clean Vessel Act to help reduce pollution from vessel sewage discharges into U.S. waters by providing funding for the construction, renovation, operation, and maintenance of pump-out and dump stations to service pleasure craft. The Grant Program requires Marina Pacifica's pump-out stations to have online monitoring for runtime/cycles, tank levels, volume calculation, power loss notification, and leakage detection. The Grant Program also requires inspections on a quarterly basis throughout the 7 years of the grant agreement to check the condition of the pump-outs, provide education and conduct dye testing (Feinberg, 2020).

Spinnaker Bay Slip Association owns and operates 192 slips within 6 basins along the south side of Spinnaker Bay. The Association has installed one private pump-out station for its residents at slip station 126.

Low flow diversions have been installed to the sanitary system at the Appian Way, located near the AB411 B-67 monitoring station, and Belmont Pump Station, located on Naples Island near Alamitos Bay Marina Basin 4. The low flow diversions operate year-round by diverting all non-stormwater flows; i.e., irrigation and other sources of urban runoff (Long Beach Nearshore Watershed Management Program, 2016). To help improve water quality in Marine Stadium, non-stormwater discharges occurring north of 7th Street from the storm drain were diverted into an existing County sanitary sewer line by installing a dry weather diversion and a diversion berm near Termino Avenue Drain (Los Angeles County Department of Public Works, 2008).

c. Colorado Lagoon subwatershed

As discussed in Section 2 (Problem Identification), Colorado Lagoon has undergone restoration since 2008, and many of the restoration efforts that are detailed in the Colorado Lagoon Restoration Master Plan have been completed. Completed restoration efforts include reconstructed of the Termino Avenue Drain to bypass Colorado Lagoon and discharge into Marine Stadium, dredging and removal of contaminated sediment, installing trash separation devices and low-flow diversions, and installing bioswales to capture surface runoff from the adjacent golf course (Friends of Colorado Lagoon, 2019). To increase circulation and reduce bacteria, the Los Angeles Water Board recommends finishing Phase 2A of Colorado Lagoon Restoration: the construction of an open, earthen hydraulic water channel to reconnect the Lagoon to Marine Stadium by the expected completion date (Long Beach Nearshore Watershed Management Program, 2016). The Nearshore Watershed Program updated WMP states that construction of the open channel (Phase 2A) is anticipated to begin in late summer or early fall of 2021 (Long Beach Nearshore Watershed Management Program, 2021).

7.2.2. POTENTIAL IMPLEMENTATION MEASURES

Per the EFDC model study in Appendix A, an 85% reduction scenario meets both the geometric mean and STV requirements. Responsible entities may choose their own analysis to demonstrate the reduction needed to meet the geometric mean and STV. Responsible entities may choose to implement a single measure or a combination of measures to meet WLAs. These measures are categorized as structural best management practices (BMPs) and non-structural BMPs.

a. Structural BMPs

MS4 Permittees may jointly or individually decide how to achieve the necessary bacteria reductions by employing one or more of the structural BMPs described below or any other viable strategy. Structural BMPs shall be chosen to target the removal of bacteria. Based on the International Stormwater 2020 BMP Database, some stormwater structural controls have been found to remove bacteria more effectively than others, such as sand filters, vegetative buffers, wetland basins, retention ponds, and retention basins (Water Research Foundation, 2020).

a.1. Sub-Regional Structural BMPs

Sub-regional structural BMPs consist of a single or a series of BMPs designed to treat flows for limited sub-regions within the watershed. Sub-regions can vary in size from small parking lots to several city blocks.

a.1.1. Local Capture Systems

Local capture systems contribute to the control of bacteria in the watershed by reducing the volume of runoff and peak flows. BMPs within this category include rain barrels, cisterns, and other containers used to hold rainwater for reuse or recharge. These systems are usually designed to capture runoff from roofs so that the water may be reused without treatment. Rain barrels typically store between 50-200 gallons and cistern containers, with greater storage capacity, may range from 200 gallons to 10,000 gallons (Bay Area Stormwater Management Agencies Association, 2012).

a.1.2. Vegetated Treatment Systems

Vegetated systems involve the use of soil and vegetation to filter and treat stormwater prior to its discharge into surface or sub-surface water. Through a combination of biofiltration, retention, infiltration, and evapotranspiration, BMPs within this category can be applied across the watershed to provide a significant contribution to bacteria control. BMPs in this category include swales, filter strips, bioretention areas, and stormwater planters (McCoy, et al., 2006). These BMPs can be installed as on-site features of developments or in street medians, parking lot islands, or curb extensions.

Biofiltration can remove particulates and the associated bacteria from stormwater runoff. Additional bioslopes, infiltration trenches, soil grading alterations, bioretention ponds, and the use of selective vegetation can further increase the efficiency of vegetative biofiltration systems. In areas where biofiltration is not practical, modification may include the design of bioslopes and infiltration trenches, which utilizes amended soil to promote subsurface flow.

Vegetated bioswales are constructed drainages used to convey stormwater runoff and generally have a trapezoidal or parabolic shape with relatively flat side slopes. Individual vegetated bioswales generally treat drainage areas five acres or less. Vegetation in bioswales allows for filtering of pollutants and infiltration of runoff into groundwater. Broad swales on flat slopes with dense vegetation are the most effective at removing pollutants and reducing runoff. Bioswales planted with native vegetation offer higher resistance to flow and provide a better environment for filtering and trapping pollutants from stormwater.

a.1.3. Local Infiltration Systems

Local infiltration systems contribute to bacteria control by reducing the potentially contaminated runoff from houses, streets, parking lots, and agriculture, and mitigating peak flows. Local infiltration systems increase on-site infiltration by including the use of alternative paving materials, retention grading and infiltration pits. The effectiveness of an infiltration system is based primarily on soil characteristics. Specific BMPs in this category include permeable paving, pervious concrete, pervious asphalt, pervious paving blocks, grass pavers, gravel pavers, pervious crushed stone, retention grading, and infiltration pits. Local infiltration systems can be effective for management of stormwater runoff from areas ranging from an individual lot to several city blocks.

a.1.4. Media Filtration

Media filtration in stormwater is primarily used to separate out fine particulates and associated pollutants but might also be used for enhanced treatment to remove bacteria. To maximize bacteria removal benefits, these devices should be strategically placed in locations with high observed or suspected bacteria loadings. During filtration process, stormwater is captured and either directed by gravity or pumped through media, such as sand, anthracite, compost, zeolite and combinations of natural and engineered substrates. These systems do not provide volume reduction benefits but may provide flow attenuation for small size storms. Media filters can be integrated directly into existing storm drain systems but are generally off-line facilities requiring a diversion structure.

a.1.5. Trash and Pet Waste Receptacles

Providing covered trash receptacles in convenient locations along the docks and at boat launch ramps may help reduce trash from entering the water and prevent birds from removing trash from uncovered or open trash receptacles. In addition, plastic bags can be provided for pet owners to collect their pet waste at specific pet walking areas.

a.1.6. Pump-Out Facilities

Marina operators can install pump-out stations at accessible locations, provide pump-out service and provide portable toilet dump stations near launch ramps and docks for smaller boats. Existing pumps can also be upgraded to online-monitoring systems, similar to the ones recently installed at Marina Pacifica, and/or bigger pumps to reduce blockage from bigger items, such as diapers.

a.1.7. Circulation Increase

Due to the future shutdown of AES and Haynes Generating Facilities once through cooling systems, circulation is expected to decrease in Alamitos Bay. However, the City of Long Beach has conducted an engineering feasibility study to evaluate the effectiveness of installing new pumps at different locations within the Bay. The City of Long Beach determined that installation of “fish-friendly” pumps at AES is a viable option for maintaining current water circulation patterns and meeting biological, environmental, and regulatory requirements. Currently, the City endeavors to formalize a partnership with AES and other stakeholders to identify and implement a preferred solution prior to the cessation of OTC operations in 2023. In addition, the City is evaluating the infrastructure needed to support installation of the new pumps. The project proposes to replace two existing vertical-axial-flow pumps at the AES Unit 6 intake well used for cooling during power generation with two new vertical-axial-flow pumps that will be used to circulate water without using it for cooling (City of Long Beach, 2020).

Circulation may also be increased by constructing a water infusion system to pump water from adjacent basins through a piping or culvert system to enhance the circulation and flushing, and to reduce water retention time.

a.2. Regional Structural BMPs

Regional structural BMPs are similar to sub-regional structural BMPs but differ in both the scope and the scale of implementation measures. Treatment areas can range from several sub-regions to the entire watershed. Regional structural BMPs retain the multiple treatment potential of sub-regional BMPs. Listed below are regional structural BMPs and a brief description of each.

a.2.1. Regional Infiltration Systems

A regional infiltration system is generally a large basin capable of detaining the entire volume of a design storm (a specific amount of rainfall over a specific duration) and infiltration volume over a specified period. Regional biofiltration systems, including sub-surface flow wetlands, promote hydrolysis, oxidation, and rhizodegradation from soil filtration through the aerobic and anaerobic zones of the soil matrix (Halverson, 2004). These systems can treat a variety of pollutants and can be utilized for flood mitigation. Water quality benefits are primarily accomplished by impounding water and allowing it to slowly percolate in surface soil and eventually to groundwater. In the event of a large storm, some flow will bypass infiltration and discharge to the receiving water untreated. However, treatment of a large percentage of flow would still be achieved. Application of a regional infiltration system depends on the suitability of soils for infiltration and the availability of sufficient open space. These systems can be applied as a stand-alone treatment feature for bacteria control on a subwatershed scale.

a.2.2. Regional Detention Systems

Regional detention systems consist of a large basin equipped with outlet structures that regulate rates of water release and can help reduce flow volume and promote sedimentation (McCoy, et al., 2006). They can be used upstream of an infiltration facility, constructed wetland, or disinfection plant to equalize flows and reduce sediment loading. These basins can be shallow, lined with vegetation, and separated into multiple bays to improve their water quality regulating functions. Unlike infiltration systems, regional detention systems do not require favorable soils and can be deep, steep-wall basins, or underground vaults when open space is limited. However, these systems may not be as effective as a stand-alone treatment option for bacteria.

a.2.3 Diversion and/or Treatment

A diversion and/or treatment BMP routes urban runoff away from the storm drain system or waterway and redirects the flow through a series of tanks and pumps into the sanitary sewer system or other treatment system, where the contaminated runoff then receives treatment and filtration before being reused or discharged.

Diversions are usually designed to treat low flows and dry-weather urban runoff but could also treat a portion of wet-weather flow. The unit collects street runoff and, through a series of tanks and pumps, diverts the liquid flow into the sanitary sewer system. The diversion device may stop the flow of polluted urban runoff from a storm drain from reaching the river.

Depending on the water quality of the flow, it may have to pass through a wastewater treatment facility that uses UV irradiation, chlorination, ozonolysis or biocides and peracetic acids. Chlorination, wherein chlorine being a strong oxidant breaks the cell membranes of bacteria and kills them, is one of the most commonly used methods of disinfection. UV light with a wavelength of 220 to 320 nanometers can be used to inactivate pathogens. Ozone is an extremely reactive oxidant that inactivates pathogens through lysis and can be generated onsite as a disinfection tool. After treatment, water can be channeled to receiving waters, to a nearby pond or lake, or routed for a secondary usage.

b. Non-Structural BMPs

Non-structural BMPs are prevention practices designed to improve water quality by reducing bacteria sources through the development of bacteria control programs that include, but are not limited to, prevention, education, and regulation.

b.1. Education and Public Outreach

Education and public outreach may minimize the potential for contamination of stormwater runoff by encouraging local residents to clean up after their pets, pick up litter, minimize runoff from residential and commercial facilities, and control excessive irrigation. The public is often unaware of the fact that excess water discharged on streets and lawns ends up in receiving waters, and that pollutant runoff can lead to contamination of receiving waters.

Local agencies can provide educational materials to the public via television, radio, internet, and print media, such as brochures, flyers, and community newsletters. Local agencies can also create information hotlines to outreach to educators and schools, develop community events, and support volunteer monitoring and cleanup programs.

Storm drain inlet stenciling is another means of educating the public about the direct discharge of stormwater to receiving waters and the effects of polluted runoff on receiving water quality. Storm drain stenciling involves placing a clean water message next to a storm drain to inform the public where the storm drain discharges, and as a result, the public is less likely to use storm drains to dispose of waste.

b.2. Street Cleaning

Street and parking lot cleaning reduce trash and pollutant loading to urban storm drains. This management measure includes employing pavement cleaning practices, such as street sweeping on a regular basis to minimize trash, sediment, debris and other pollutants that might end up in receiving waters.

b.3. Storm Drain Cleaning

Routine cleaning of the storm drain system reduces the amount of trash, bacteria and other pollutants entering the river, prevents clogging, and ensures the flood control capacity of the system. A successful storm drain cleaning program includes regular inspection and cleaning of catch basins and storm drain inlets, increased inspection and cleaning in areas with high trash accumulation, accurate recordkeeping, cleaning immediately prior to the rainy season to remove accumulated trash and other pollutants, and proper storage and disposal of collected material.

b.4. Fish Waste Disposal

Fish waste can cause water quality problems at marinas where large quantities of fish are landed, such as places where fishing tournaments are held or during peak fishing seasons. For boaters, fish can be cleaned offshore where the fish was caught, or at designated fish cleaning stations, or boaters can practice catch- and -release or tag- and -release fishing. To reduce fish waste from entering the water, marina operators can install fish cleaning stations at the marina or at boat launch sites, and display posters to remind anglers to properly dispose of fish parts in clearly designated containers.

b.5. Boat Sewage and Disposal

If a recreational boat has a holding tank equipped with a Y-valve and through-hull fitting, the Y-valve should always be kept closed and locked within the 3-mile limit from shore. Boaters should use the marina's sewage pump-out stations and dump station to empty holding tanks or portable toilets after a day on the water. Clearly marked signs showing the location of pump-out stations and dump stations at the marina and launch ramps can help prevent direct discharge of sewage from boats. To prevent spills, marine operators should inspect and regularly maintain pump-out systems, disinfect all suction connections, and ensure that septic receptacles are emptied when full.

The City of Long Beach Department of Parks, Recreation & Marine regulations' allow for marine managers to place dye tablets in holding tanks, or to supply proof as to how the holding tank is expelled, though this regulation has not been routinely enforced (Long Beach Parks, Recreation & Marine , 2017; Hallinan, 2020).

To help prevent bacteria from entering the waters from boats, dye tablets can also be placed in the holding tanks of all boats entering marinas. This practice was employed in Avalon Harbor, after moored boats were deemed to be a source of excessive fecal coliform bacteria. Upon entering the harbor, a harbor patrol officer boards each vessel and places dye tablets in all sanitary devices. The officer then flushes the devices to ensure that the holding tanks do not leak (City of Avalon, 2020).

Boat owners may also help reduce bacteria from entering the water using additives to help breakdown holding tank contents. Additives increase the rate of breakdown and decrease bacteria and oxygen demand when the contents are legally discharged offshore.

Marina owners/operators and vessel terminal owner/operators can implement marina or vessel terminal regulation to support federal or state regulation. In Alamitos Bay, for instance, marina owners/operators, and vessel terminal owner/operators are required to adhere to all existing local, state and federal regulations pertaining to marine sanitation devices and notify the owners/operators of vessels within Alamitos Bay that it is illegal to discharge the contents of their marine sanitation device into waters of the State. The owners/operators of vessels can be notified by the marina owner/operator that according to Harbors and Navigation Code Section 780, no person shall disconnect, bypass or operate a marine sanitation device so as to potentially discharge sewage into waters of the state unless expressly authorized or permitted and that no person shall occupy or operate a vessel in which a marine sanitation device is installed unless the marine sanitation device is properly secured. The marina owners/operators and vessel terminal owner/operators can also provide owners/operators of vessels occupying or visiting their slips a map identifying the location of pump-out stations and dump stations (Department of Boating and Waterways, 2020).

In addition, the pump-out facilities should have a notice posted identifying the city, county, local public health officer, or boating law enforcement officer responsible for enforcing the Harbors and Navigation Code Section 780, and the telephone number where discharges of sewage from the pump-out facility into waters of may be reported (Department of Boating and Waterways, 2020).

7.3. IMPLEMENTATION SCHEDULE

The implementation schedule is designed to provide responsible entities a timeline sufficient to gather additional monitoring data to better quantify bacteria loading and to implement appropriate BMPs to address the bacteria impairment. The Los Angeles Water Board may reconsider and revise the TMDL based upon data and information submitted under the MS4 permits on progress towards achieving WLAs, or other monitoring data, or new information.

Table 14: Implementation Schedule

Task	Date
Owners and/or operators of marine sanitation devices and sanitary sewer collection systems and OWTS shall attain LAs	Effective date of the TMDL
Individual NPDES permittees, general NPDES permittees, general industrial stormwater permittees, and general construction stormwater permittees shall attain WLAs.	Effective date of the TMDL
MS4 permittees shall submit a monitoring plan, including in-stream and outfall monitoring, to the Los Angeles Regional Board for Executive Officer approval. In lieu of a separate monitoring plan, MS4 permittees may provide documentation that the current, or a revised, Coordinated Integrated Monitoring Plan (CIMP) or Integrated Monitoring Plan (IMP) by an individual MS4 permittee will be sufficient to demonstrate compliance with this TMDL.	1 year from the effective date of the TMDL
MS4 permittees shall begin monitoring as outlined in the approved monitoring plan (or the CIMP or IMP sufficient to demonstrate compliance with this TMDL).	No later than 6 months after the monitoring plan is approved by the Executive Officer

Task	Date
MS4 permittees shall submit an implementation plan to the Los Angeles Regional Board for Executive Officer approval. In lieu of a separate implementation plan, MS4 permittees may provide documentation that the current, or a revised, WMP will be sufficient to implement this TMDL.	2 years from the effective date of the TMDL
Owners and/or operators of irrigated agricultural land, golf courses and any other nonpoint sources shall achieve LAs	3 years from the effective date of the TMDL
MS4 permittees shall achieve WLAs	15 years from the effective date of the TMDL

8. MONITORING PROGRAM

To comply with the Los Cerritos Channel and Estuary, Alamitos Bay, and Colorado Lagoon Indicator Bacteria TMDL, monitoring programs will be designed to measure pollutant load reduction and demonstrate water quality improvement. The TMDL monitoring programs consist of two components: (1) Receiving water monitoring to assess implementation progress and attainment of numeric targets, and (2) compliance monitoring of discharges to determine compliance with the WLAs. Monitoring requirements may be included in subsequent permits or other orders and are subject to Los Angeles Water Board approval. Responsible entities may build upon existing monitoring programs, such as an Executive Officer approved Integrated Monitoring Program (IMP) or Coordinated Integrated Monitoring Program (CIMP), when developing the TMDL effectiveness and compliance monitoring plans.

8.1. RECEIVING WATER MONITORING

Responsible entities are required to develop and implement a comprehensive Receiving Water Monitoring Plan within one year of the effective date of this TMDL to assess numeric target attainment and to determine the effectiveness of implementation actions on receiving water quality. An IMP or CIMP developed by the responsible entities in accordance with their MS4 permit(s), which has been approved by the Los Angeles Water Board, satisfies the requirements for a Receiving Water Monitoring Plan, where the IMP/CIMP addresses the applicable waterbody-pollutant combinations of this TMDL consistent with the implementation schedule.

Monitoring shall commence within six months of approval of the Receiving Water Monitoring Plan. Monitoring requirements shall be incorporated into the regulatory mechanisms for each responsible entity upon issuance, renewal, or modification or through separate investigatory orders. Monitoring procedures, analysis, and quality assurance shall be developed in accordance with the California Surface Water Ambient Monitoring Program (SWAMP) Inland Water Sample Collection for Microbial Samples and continue beyond the final implementation date of the TMDL unless the Executive Officer approves a reduction or elimination of such monitoring.

In the Los Cerritos Channel subwatershed, the responsible entities include Los Angeles County, Los Angeles County Flood Control District, the City of Bellflower, the City of Cerritos, the City of Downey, the City of Lakewood, the City of Paramount, the City of Long Beach, the City of Signal Hill, and Caltrans. Responsible entities shall outline a bacteria monitoring program for *E. coli* for areas above Atherton Street and *Enterococcus* for Atherton Street to Anaheim Street and flow rate.

In the Los Cerritos Channel Estuary subwatershed, the responsible entities include Los Angeles County Flood Control District, the City of Long Beach, and Caltrans. Responsible entities shall outline a bacteria monitoring program for *Enterococcus* and flow rate.

In the Alamitos Bay and Colorado Lagoon subwatersheds, the responsible entities include Los Angeles County Flood Control District, the City of Long Beach, and Caltrans. Responsible entities shall outline a bacteria monitoring program for *Enterococcus*.

The sampling frequency and locations must be adequate to assess attainment of numeric targets in the receiving water. Responsible entities shall conduct weekly sampling at a minimum to support calculation of the geometric mean or assessment of compliance with the STV.

At a minimum, one sampling station shall be located in the Los Cerritos Channel, one in the Los Cerritos Channel Estuary, one in Colorado Lagoon (before the confluence with Marine Stadium), and four in Alamitos Bay (one at Mother's Beach, one at B-14 sampling location or nearby, one at B-31 sampling location or nearby, and one in Marine Stadium). All sampling locations shall be spatially independent, which means more than 200 meters apart.

If the sampling results are greater than the allowable STV or geometric mean targets, the water body segment shall be considered not attaining the TMDL.

8.2. COMPLIANCE MONITORING

To assess attainment of the WLAs, compliance monitoring shall include monitoring for *E. coli* and *Enterococcus* in the Los Cerritos Channel subwatershed, and *Enterococcus* in the Los Cerritos Channel Estuary subwatershed, Alamitos Bay subwatershed, and Colorado Lagoon subwatershed.

TMDL compliance monitoring requirements shall be incorporated into the regulatory mechanisms for each responsible entity upon issuance, renewal, or modification, or through separate investigatory orders. Monitoring procedures, analysis, and quality assurance shall be comparable to SWAMP Inland Water Sample Collection for Microbial Samples and continue beyond the final implementation date of the TMDL unless the Executive Officer approves a reduction or elimination of such monitoring.

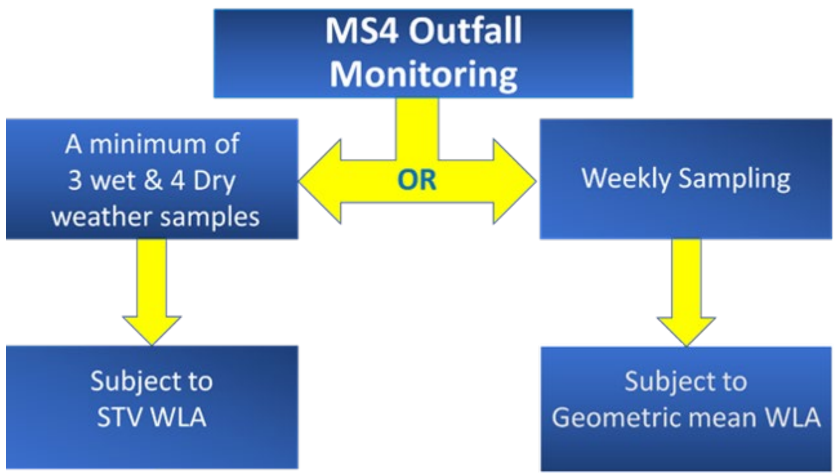
8.2.1. MS4 COMPLIANCE MONITORING

Responsible entities for the MS4 WLAs shall submit an outfall monitoring plan to be approved by the Executive Officer. The outfall monitoring plan shall include an adequate number of representative outfalls to be sampled and a sampling frequency. An IMP or CIMP developed by the responsible entities in accordance with their MS4 permit(s), which has been approved by the Los Angeles Water Board, satisfies the requirements for an outfall monitoring plan, where the IMP/CIMP addresses the applicable waterbody-pollutant combinations of this TMDL consistent with the implementation schedule.

In the Los Cerritos Channel subwatershed, the responsible entities include Los Angeles County, Los Angeles County Flood Control District, the City of Bellflower, the City of Cerritos, the City of Downey, the City of Lakewood, the City of Paramount, the City of Long Beach, the City of Signal Hill, Caltrans, any current and future permittees enrolled under the Phase II MS4 permit. Responsible entities shall outline a bacteria monitoring program for *E. coli* in the Los Cerritos Channel subwatershed to demonstrate compliance with the freshwater MS4 WLAs. Responsible entities shall also outline a monitoring program for *Enterococcus* at the compliance point assigned to comply with the WLA assigned to the transition between the Los Cerritos Channel and the Los Cerritos Channel Estuary.

In the Los Cerritos Channel Estuary subwatershed, Alamitos Bay subwatershed, and Colorado Lagoon subwatershed, the responsible entities include Los Angeles County Flood Control District, the City of Long Beach, Caltrans, and any current and future permittees enrolled under the Phase II MS4 permit. Responsible entities shall outline a bacteria monitoring program for *Enterococcus*.

The applicable WLA for MS4 discharges depend on the number of samples collected, as referenced in Section 6 (Allocations Section). MS4 responsible entities shall monitor representative outfalls either on a weekly basis and be subject to the geometric mean WLA or monitor the representative outfalls at a minimum of three wet weather events and four dry weather events during the calendar year and be subject to the STV (see below flow chart). The wet weather is defined as rainfall of 0.1 inch or more plus the 3 days following the rain event. Wet weather sampling shall target the first significant rain event of the calendar year. Dry weather samples shall be collected two times in the summer season (April 1-October 31), and two times in the winter season (November 1-March 31). discharges to Los Cerritos Channel above Atherton Street are suspended during days



If MS4 permittees pursue a downstream compliance approach, wherein the WLAs for with rainfall greater than or equal to 0.5 inches and the following 24 hours, compliance monitoring shall occur at both the outfall discharging to Los Cerritos Channel above Atherton Street and in the Channel below Atherton Street. For practical purposes, MS4 permittees may use the existing mass emission station LCC1, located at Stearns Street, about 3000 feet upstream of Atherton Street, for the in-channel portion of compliance determination.

8.2.2. FOR OTHER POINT SOURCES

Individual NPDES permittees, general NPDES permittees, general industrial stormwater permittees, and general construction stormwater permittees shall conduct monitoring as part of their permit requirements for all applicable bacteria water quality objectives to ensure that they are attaining WLAs.

8.2.3 FOR NONPOINT SOURCES

The Conditional Waiver for irrigated agriculture lands or other regulatory mechanism shall require bacteria monitoring for discharges from irrigated agricultural lands. Monitoring shall be implemented as part of WDRs or waiver requirements, and through implementation of the Nonpoint Source Implementation and Enforcement Policy, for other nonpoint sources.

9. COST CONSIDERATIONS

The purpose of this section is to provide the Los Angeles Water Board with a reasonable range of potential costs of implementing this TMDL and to address potential concerns associated with the implementation costs. Cost ranges for potential implementation options were estimated using data currently available. Future changes in technology and policy may cause costs to change from estimates presented.

Many of the structural and non-structural BMPs to address bacteria loading will also reduce the loading of other pollutants, such as metals, which would assist in meeting the requirements of the Colorado Lagoon Organochlorine Pesticides, Polychlorinated Biphenyls, Sediment Toxicity, Polycyclic Aromatic Hydrocarbons, and Metals TMDL.

9.1. STRUCTURAL BMPS COST

In this section, staff estimated the cost of structural BMPs for MS4 Permittees. While discharges from industrial and nonpoint sources also contribute to bacteria in the Alamitos Bay, Colorado Lagoon, and Los Cerritos Channel and Estuary, MS4 discharges are the focus of this assessment.

9.1.1. DATA

Data on the volume of stormwater capture required to comply with this TMDL was derived from the Reasonable Assurance Analyses (RAAs) of the Long Beach Nearshore WMP and Los Cerritos Channel WMP. The Alamitos Bay and Los Cerritos Channel Estuary subwatersheds lie within the jurisdiction of the Long Beach Nearshore WMP. The Los Cerritos Channel subwatershed comprises the Los Cerritos Channel WMP jurisdiction. The Colorado Lagoon subwatersheds were omitted from the analysis because restoration of Colorado Lagoon has already been occurring in order to meet the TMDL for Organochlorine Pesticides, Polychlorinated Biphenyls, Sediment Toxicity, Polycyclic Aromatic Hydrocarbons, and Metals. It is expected that completion of Phase 2A of the Colorado Lagoon restoration, an open, earthen hydraulic water channel to reconnect the Lagoon to Marine Stadium, will allow for compliance with bacteria standards.

Unit construction costs for BMPs were obtained from Texas Water Development Board (2005) and Gold et al. (2015), a peer-reviewed study by UCLA and supported by the Los Angeles Bureau of Sanitation. Gold et al. (2015) was selected as a data source because they compiled complete construction costs and volume of water treated, mainly from Southern California projects. Texas Water Development Board (2005) was also utilized because cisterns are often used to capture stormwater, and it was one of the limited data sources on cistern unit costs. Values from Gold et al. (2015) are shown in Table 15. Median values were used in this analysis. The unit cost for cisterns was derived by averaging unit cost values of cisterns of varying materials, such as fiberglass, metal, concrete, etc., as presented in Texas Water Development Board (2005), resulting in an average unit cost of $556,666 per acre-foot in 2019 dollars. Assumptions for non-construction capital costs; e.g. management, engineering, contingency, and operations and maintenance costs were based on assumptions made in multiple enhanced watershed management programs (EWMPs) and WMPs.

Table 15: BMP Construction Unit Costs

BMP Type	BMP Category	25% Quartile (2019$)	Median Cost (2019$)	75% Quartile (2019$)	Unit
Infiltration Trench	Regional	$155,619.24	$281,797.00	$777,161.54	$/ac-ft
Dry Pond	Regional	$205,623.02	$274,787.12	$734,167.64	$/ac-ft
Vegetated Swale	Distributed	$250,953.55	$470,596.32	$865,953.30	$/ac-ft
Bioretention Basin	Distributed	$574,809.80	$682,294.56	$758,935.86	$/ac-ft
Porous Pavement	Distributed	$493,962.57	$733,232.99	$755,664.59	acre

9.1.2. METHODOLOGY

a. Capacity

Staff estimated costs associated with meeting this TMDL for the Alamitos Bay and Los Cerritos Channel and Estuary subwatersheds. Although the Statewide Bacteria Provisions became effective after the Long Beach Nearshore and Los Cerritos Channel RAAs were completed in 2015, staff expects that because the Statewide Bacteria Provisions provide objectives which are very close to the 2001 Bacteria Objectives, the effect of the Statewide Bacteria Provisions on compliance costs is minimal.

Reasonable Assurance Analyses conducted by the Long Beach Nearshore and Los Cerritos Channel WMP groups did not specifically model the required volume of stormwater capture to meet this particular TMDL, however, the groups did model the required volume for zinc, the limiting pollutant for Toxics TMDLs within the Long Beach Nearshore WMP's jurisdiction and for the Los Cerritos Channel Metals TMDL. Furthermore, the Long Beach Nearshore RAA modeled the additional volume needed to meet the Beaches Bacteria TMDL after meeting the Dominguez Channel and Greater Los Angeles and Long Beach Harbors Waters Toxics TMDL (Harbor Toxics TMDL). In subwatersheds where these TMDL areas overlapped, staff calculated a "bacteria multiplier" or the average percent additional volume needed above the volume needed to meet the Harbor Toxics TMDL as shown in Table 16 (Long Beach Nearshore Watershed Management Program, 2016). The bacteria multiplier, 3.5%, was then multiplied by the volume required to address zinc across all Alamitos Bay, Los Cerritos Channel, and Los Cerritos Estuary subwatersheds in order to derive the required additional capture volume to meet this TMDL. While BMPs that will be implemented to meet Toxics and Metals TMDLs will also contribute to meeting this Bacteria TMDL, costs that would be incurred to meet the Toxics and Metals TMDLs are omitted from the analysis because these costs would be incurred even without the Bacteria TMDL.

Table 16: Capacity Required to Meet Existing Harbor Toxics and Beaches Bacteria TMDLs

Subwatershed ID	Capacity for Harbor Toxics (ac-ft)	Capacity for Beaches Bacteria (ac-ft)	Percent additional capacity to meet Bacteria
553248	71.41	0	0.0%
553348	14.84	1.36	9.2%
800348	4.37	0	0.0%
800448	2.81	0.26	9.3%
800548	27.49	0.05	0.2%
800648	12.52	0.29	2.3%
Average			**3.5%**

b. Capital Cost

Capital costs accounted for construction costs and non-construction costs, such as management, design, etc. For construction costs, the volume required to capture zinc was multiplied by the bacteria multiplier and median BMP unit construction costs, as shown in Equation 1.

Equation 1

$$\begin{aligned} &Construction\ Cost \\ &\quad = Zinc\ capture\ volume\ \times \%\ extra\ Bacteria\ capture\ volume \\ &\quad \times BMP\ Unit\ \ Cost \end{aligned}$$

For the Alamitos Bay and Los Cerritos Channel Estuary subwatersheds, the Long Beach Nearshore RAA had data on capacity and BMP type (Regional or LID) by subwatershed, as shown in Table 17 (Long Beach Nearshore Watershed Management Program, 2016). To generate a range of construction cost estimates, the bacteria capture volume was multiplied by the cheapest and costliest BMP option as identified in Gold et al. (2015) and Texas Water Development Board (2005), depending on whether Regional or LID BMP categories were identified for the subwatershed. The cheapest BMP options for Regional and LID BMPs were dry pond and vegetated swale, respectively. The costliest BMP options for Regional and LID BMPs were cistern and bioretention basin, respectively. Porous pavement was not used in the analysis because its unit cost is by area rather than volume.

Table 17: BMP Capacity by Alamitos Bay and Los Cerritos Channel Estuary Subwatersheds

RAA Sub-watershed ID	BMP Category	Target BMP Capacity for Sub-watershed (ac-ft)
549548	Regional BMP	18.1
549948	Regional BMP	5.7
550048	Regional BMP	1.4
550148	Regional BMP	14.5
550248	Regional BMP	21.6
553448	Regional BMP	6.3
800148	Regional BMP	4.2
549548	LID	18.1
549748	LID	2.3
549948	LID	5.7
550048	LID	1.4
550148	LID	14.5
550248	LID	21.6
550348	LID	0.1
553348	LID	2.4
553448	LID	6.3

The Los Cerritos Channel RAA identified capacity and BMP type (Green Streets, LID, and Regional) by municipality, as shown in Table 18 (Los Cerritos Channel Watershed Management Group, 2017). Similar to the analysis of Alamitos Bay and Los Cerritos

Channel Estuary subwatersheds, a range of construction costs were estimated by multiplying bacteria capture volume by the cheapest and costliest BMP option per category. Green Streets and LID were considered to be in the same distributed/LID BMP category.

Table 18: BMP Capacity by Permittees in the Los Cerritos Channel WMP

Municipality	**BMP Type**	**Volume** (ac-ft)
Bellflower	Right-of-Way	58.1
	LID on Public Parcels	4.5
	Regional BMP	55.6
Cerritos	Right-of-Way	1.0
	LID on Public Parcels	0.0
	Regional BMP	0.6
Downey	Right-of-Way	5.3
	LID on Public Parcels	0.0
	Regional BMP	4.8
Lakewood	Right-of-Way	121.5
	LID on Public Parcels	11.8
	Regional BMP	36.2
Long Beach	Right-of-Way	121.7
	LID on Public Parcels	21.8
	Regional BMP	65.3
Paramount	Right-of-Way	22.8
	LID on Public Parcels	6.4
	Regional BMP	25.8
Signal Hill	Right-of-Way	11.2
	LID on Public Parcels	1.2
	Regional BMP	16.2

Non-construction capital costs were derived from examining capital cost assumptions stated in EWMPs where non-construction capital costs were assumed to be some percentage of construction costs (Marina del Rey, Santa Monica Bay J2 & J3, Upper Santa Clara River, LA River Upper Reach 2). The average assumption was that non-construction capital costs were about 70% of construction costs. Hence, staff used the 70% non-construction assumption for this analysis. While some portion of volume capture will need to occur on private land, land acquisition costs were not considered in this analysis. Due to the ruling from *Los Angeles Waterkeeper, et al., v. Pruitt, et al.*, No. 2:17-cv-03454-SVW-KS, 2018 WL 4191520 (C.C. Ca. 2018), privately owned commercial, industrial, and institutional (CII) sites, such as shopping centers, parking lots, office buildings, etc., in Los Cerritos Channel subwatersheds, will be required to implement stormwater BMPs, so municipalities will not need to acquire this land. In addition, other private landowners and municipalities can engage in public-private partnerships that allow for BMPs to be implemented with minimal land usage costs. Gaining exemption from the Measure W parcel tax could incentivize private landowners to enter into stormwater partnerships with municipalities.

c. Operations and Maintenance

Assumptions for operations and maintenance (O&M) costs as stated in EWMPs were also examined in order to apply to this analysis. Assumptions for annual O&M ranged from 1.5% of capital costs (Dominguez Channel) to 2% of capital costs (Malibu Creek, Palos Verdes Peninsula Cities) to 6% of Green Streets capital costs (North Santa Monica Bay). South Bay Beach Cities used a range of 2%-6% of capital costs depending on BMP type. Ultimately, for this analysis we assumed that O&M cost equals 2% of capital cost.

d. Present Value Discounting

As costs for meeting Toxics and Metals TMDLs in the Alamitos Bay and Los Cerritos Channel and Estuary subwatersheds are omitted from this analysis, additional Bacteria costs will not be incurred until after meeting the Toxics and Metals TMDLs. For Alamitos Bay and Los Cerritos Channel Estuary, the Long Beach Nearshore WMP states that Harbor Toxics attainment will occur in 2032. For Los Cerritos Channel, their WMP states that the Los Cerritos Channel Metals attainment will occur in 2026. Therefore, as the final compliance year is 15 years from the effective year 2022, staff assumed Bacteria costs for Alamitos Bay and Los Cerritos Channel Estuary subwatersheds would be incurred from 2032-2037, and Bacteria costs for Los Cerritos Channel subwatersheds would be incurred from 2026-2037. For this analysis, costs were assumed to be spread out equally over the WMP group's respective time ranges. These costs were then discounted to present value in 2019 dollars at a rate of 3% as per guidance from State Water Board (2019).

9.1.3. RESULTS

Capital costs for Alamitos Bay, Los Cerritos Channel Estuary, and Los Cerritos Channel subwatersheds are shown in Table 19. For Alamitos Bay and Los Cerritos Channel Estuary, construction costs range from about $1.26-2.09 million, and non-construction costs range from $0.88-1.46 million. This results in total capital costs from $2.11-3.56 million. For Los Cerritos Channel, construction costs range from about $6.13-9.71 million, and non-construction costs range from $4.29-6.80 million. This results in total capital costs from $10.41-16.51 million. Total capital costs for Alamitos Bay, Los Cerritos Channel Estuary, and Los Cerritos Channel range from $12.56-20.07 million.

Table 19: Estimate Bacteria TMDL Capital Cost, 2019$ at 3% Discount Rate with 2037 Compliance

Subwatershed	Construction Cost		Non-Construction		Total Capital Cost	
	Low	High	Low	High	Low	High
Alamitos Bay & LCC Estuary	$1,259,949	$2,092,854	$881,963	$1,464,998	$2,141,910	$3,557,851
LCC	$6,126,155	$9,713,508	$4,288,308	$6,799,455	$10,414,463	$16,512,963
Total	**$7,386,104**	**$11,806,361**	**$5,170,271**	**$8,264,453**	**$12,556,373**	**$20,070,814**

Total compliance costs accounting for capital and O&M costs are shown in Table 20. O&M costs for Alamitos Bay subwatersheds range from about $0.26-0.43 million, and O&M costs for Los Cerritos Channel subwatersheds range from about $2.50-3.96 million. After summing with capital costs, total compliance cost for Alamitos Bay and Los Cerritos Channel Estuary is about $2.40-3.98 million, and total compliance cost for Los Cerritos Channel is $12.91-20.48 million. This results in total compliance cost for the Bacteria TMDL region to be about $15.31-24.46 million.

Table 20: Estimated Bacterial TMDL Total Compliance Cost, 2019$ at 3% Discount Rate with 2037 Compliance

Subwatershed	Capital Cost		Operations and Maintenance		Total Compliance Cost	
	Low	High	Low	High	Low	High
Alamitos Bay & LCC Estuary	$2,141,910	$3,557,851	$257,029	$426,942	$2,398,939	$3,984,793
LCC	$10,414,463	$16,512,963	$2,499,471	$3,963,111	$12,913,934	$20,476,074
Total	**$12,556,373**	**$20,070,814**	**$2,756,500**	**$4,390,053**	**$15,312,873**	**$24,460,868**

A breakdown of compliance costs broken down by Los Cerritos Channel Permittees is shown in Table 21. Total compliance costs range from $0.03-0.06 million for Cerritos to $4.63-7.27 million for Long Beach. Some portion of Los Cerritos Channel's compliance costs will be incurred by privately owned commercial, industrial, and institutional facilities rather than the municipalities, though the amount is currently unclear.

Table 21: Estimated Bacteria TMDL Compliance Cost by Los Cerritos Channel Permittees, Assuming 3% Discount Rate with 2037 Compliance

LCC Permittees	Capital Costs		Operations and Maintenance		Total Compliance Cost	
	Low	High	Low	High	Low	High
Bellflower	$1,953,891	$3,217,169	$468,934	$772,121	$2,422,825	$3,989,290
Cerritos	$27,754	$44,386	$6,661	$10,653	$34,415	$55,039
Downey	$166,537	$274,633	$39,969	$65,912	$206,506	$340,545
Lakewood	$3,174,172	$4,852,298	$761,801	$1,164,551	$3,935,973	$6,016,849
Long Beach	$3,733,049	$5,863,731	$895,932	$1,407,295	$4,628,980	$7,271,026
Paramount	$909,782	$1,497,383	$218,348	$359,372	$1,128,129	$1,856,754
Signal Hill	$449,278	$763,364	$107,827	$183,207	$557,105	$946,571
Total	**$10,414,463**	**$16,512,963**	**$2,499,471**	**$3,963,111**	**$12,913,934**	**$20,476,074**

Cost estimates are based on data currently available, and actual costs may differ due to usage of BMPs not included in this analysis (see Section 9.1.4), unexpected obstacles in BMP implementation, or improvements in technology and policy that may make BMP implementation more cost-effective. Furthermore, this analysis relies on assumptions in EWMPs to estimate non-construction and O&M costs. These assumptions were based on experience in implementing public stormwater projects. BMP implementation by private commercial facilities in Los Cerritos Channel may have different construction, non-construction, and O&M costs.

9.1.4. OTHER BMPS

There are other BMPs that may be implemented that were not considered in the cost estimation. Some of these BMPs are described below.

a. Media Filtration

The construction cost of a sand/organic filter system depends on the media type, drainage areas, expected efficiency, and other design parameters. Estimated cost of a sand filter is $18,500 in 1997, or $27,919 in 2019 dollars for a 1 acre area, and annual costs for maintenance average to 5% of the construction cost (California Storwater Quality Association, 2003).

b. Diversion and/or Treatment

The Long Beach Nearshore WMP indicated that low flow diversions have been installed at Appian Way and Belmont Pump Stations to address dry-weather bacteria in Alamitos Bay. The Appian Way project cost $585,750 in 2014, and the Belmont project cost $500,000 in 2008 (City of Long Beach, 2015; City of Long Beach, 2008). It is unclear whether more low-flow diversions will be constructed, and the number of low-flow diversions necessary to attain the water quality objectives for this TMDL is unknown. Flow modeling may determine the optimum number of low-flow diversions necessary to comply with the WLAs.

c. Pump-Out Stations

Costs for equipment and installation can vary, depending on if the pump station is fixed or if it is a pump-out boat. Other factors that vary cost is, the need for sewage lift stations to accommodate fluctuating water levels, the need for special on shore holding tanks to hold concentrated waste, the cost of connection to a sewer system, pump size, and other factors.

Depending on the size and style of the pump-out station fixed pump-out stations range in purchase price from $15,000 to $20,000 and installation price from $1,500 to $3,000 (Holmes, 2020).

9.2. NON-STRUCTURAL BMPS COST

Data is not available that would allow for an analysis of non-structural costs attributable solely to this Bacteria TMDL, especially since these costs would technically be incurred after meeting Metals and Toxics TMDLs. It would also be difficult to separate out costs of activities attributed only to this TMDL, such as enforcement of litter ordinances, public education, and improved street cleaning.

9.3. MONITORING

There is insufficient data to assess full monitoring costs in Alamitos Bay, Colorado Lagoon, and Los Cerritos Channel. Based on prices of bacteriological analyses from a local laboratory, the cost per sample is dependent on the testing method. To analyze a sample for *Enterococcus* the cost per sample is $60 if analyzed by IDEXX and $97.50 if analyzed by multi-tube technique.

10. BENEFITS CONSIDERATIONS

A wide range of health, economic, and environmental benefits will result from the Bacteria TMDL. There was insufficient data to conduct a quantitative benefits analysis for just the Alamitos Bay, Colorado Lagoon, and Los Cerritos Channel and Estuary areas. It was also not possible to conduct a benefits analysis of BMPs implemented solely for this Bacteria TMDL and not any other TMDLs that overlap in the same areas. To the extent possible, benefits that will occur during the progression of meeting this TMDL are discussed qualitatively below.

10.1 HEALTH AND RECREATION

As Alamitos Bay and Colorado Lagoon are heavily used by residents and visitors for water recreation, the avoided health costs of gastrointestinal illness resulting from lower bacteria levels may be significant. Mother’s Beach is popular for swimming and located where water from Los Cerritos Channel flows out and meets Alamitos Bay, making beachgoers there especially susceptible to stormwater pollution. In addition, people boat, kayak, and paddleboard in Alamitos Bay. A portion of boaters in Alamitos Bay are also anglers as it is a popular location for fishing. Marine Stadium has long been used for training and competitive events by paddlers. While there are no quantitative studies of this specific geographic area, other studies can provide a general idea of avoided costs. One study of recreational exposures in marine water impacted by MS4 discharges following storm events in San Diego County estimated gastrointestinal illness risks at 1.2 illnesses (based on epidemiological study) and 1.5 illnesses (based on quantitative microbial risk assessment) per 1000 wet weather recreation events (surfing) (Soller, Schoen, Steele, & Griffith, 2017). Another study of south Huntington Beach and north Newport Beach found that an illness rate of about 0.8% among bathers at those beaches resulted in about $3 million each year in health-related expenses (Dwight, Fernandez, Baker, Semenza, & Olson, 2005).

While people can only recreate in close proximity to Los Cerritos Channel in the Los Cerritos Channel Estuary subwatershed, at Channel View Park, a potential scenario where water quality in the channel is improved and watershed restoration is implemented in sections of the channel, as suggested in Long Beach's Climate Action and Adaptation Plan (City of Long Beach, 2020), could lead to expanded recreation opportunities for municipalities located along Los Cerritos Channel. In monetized value, for the average visitor to a park, trail, or recreation center, the value of each visit is about $3.04, adjusted to 2019 dollars. Expanded recreation opportunities would also lead to increased public health benefits. The difference in average annual medical care costs between active (those who do moderate to vigorous exercise) and inactive adults ages 18-64 is $1,242 in 2019 dollars. For adults 65 and over, this difference is about double, at $2,490 in 2019 dollars (The Trust for Public Land, 2017). The more attractive that Los Cerritos Channel can become as a location for recreation and exercise, the more these benefits can accrue.

The Colorado Lagoon and Los Cerritos Channel subwatersheds include wetlands, which are important habitats for birds and wildlife and are visited by wildlife watchers. While the number of wildlife watchers who visit these sites is unknown, birdwatching events have been advertised online by local nonprofits. According to the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, about 34% of Americans participated in wildlife watching in 2016 (U.S. Fish and Wildlife Service, 2016).

In addition to the wetlands in the Los Cerritos Channel subwatershed being a recreation site, there is likely a public willingness-to-pay for improvement of the wetlands. There are no known studies of these specific wetlands, but Loomis et al. (1991) found that the average California household would be willing to pay about $588 in 2019 dollars to reduce the percentage of resident waterfowl in San Joaquin Valley wetlands exposed to contaminated agricultural drainage water from 70% to 20%. While the contamination source and geography differ, the study suggests that there is a positive willingness-to-pay to lessen pollution flowing to the wetlands in the Los Cerritos Channel subwatershed.

10.2 WATER SUPPLY

Infiltration BMPs implemented in response to the Bacteria TMDL can help replenish groundwater basins and build drought resilience. According to Porse et al. (2018), Los Angeles County "receives 55-60% of its annual water supplies from imported sources." With stormwater used as a resource to replenish local groundwater basins, local reliance on imported water can be reduced, thereby controlling the costs incurred from importing water. The potential for water usage from stormwater is significant, with Diringer et al. (2020) from Pacific Institute estimating that stormwater capture from paved surfaces and rooftops in urbanized Southern California and the Bay Area could add about 6-10% more annual water supply in those areas. Moreover, Porse et al. (2018) found that even after accounting for full-cycle costs, which include costs for all stages from the capture to end-use of water, stormwater capture can still be cheaper than importing water. Imported water costs around $1,476-$1,790 per acre foot, whereas the cost for existing large stormwater capture is $995 per acre foot.

10.3 FLOOD MITIGATION

Stormwater BMPs along Los Cerritos Channel would help protect against increased flood risk resulting from sea-level rise and increased precipitation intensity brought on by climate change. Long Beach's Proposed Climate Action and Adaptation Plan stated that levees next to Los Cerritos Channel may need to be elevated or modified and that watershed restoration along the channel could provide environmental, neighborhood, and recreational co-benefits for local communities (City of Long Beach, 2020). As almost the entire channel is densely lined by residences and schools, the benefits of flood risk mitigation are potentially large and will continue to increase in the future.

10.4 URBAN HEAT

Another co-benefit of the Bacteria TMDL is reduced urban heat island effects from heat retained by buildings and pavement, which climate change will continue to exacerbate. Nature-based solutions that incorporate trees and vegetation can decrease local temperatures, particularly if they are distributed throughout an area. Reduced temperatures during hot weather not only makes it more comfortable for people to recreate outside, but it can also save lives during extreme heat waves. De Guzman et al. (2020) found that relative to the average mortality rate, during an average five-day heat wave in Los Angeles County there are 4.1% more deaths on the first day and 11.9% more deaths on the fifth day. Using these results, they found that if Los Angeles County had tree coverage at 40%, as opposed to the baseline of 16%, during a September 2010 dry Santa Ana event there would have been a 29% reduction in mortality, equivalent to saving 23 lives. While the study only modeled mortality, it can reasonably be expected that hospitalizations and health conditions brought on by heat stress would be reduced with lower extreme temperatures as well. In addition to trees, other green infrastructure such as bioswales, rain gardens, and green roofs can also reduce temperatures (Georgetown Climate Center, n.d.). Greatest marginal benefits for green infrastructure to reduce heat would occur in areas further inland where temperatures are higher, there is less green infrastructure, and average incomes are lower. In metropolitan areas nationwide, lower median household incomes are associated with less urban tree cover (Schwarz, et al., 2015). In areas where the federal government historically appraised as "declining" or "hazardous" largely because of the presence of minorities, current average incomes tend to be lower and temperatures tend to be hotter because of historic disinvestment in these neighborhoods (Hoffman, Vivek, & Pendleton, 2020). In the northern part of Los Cerritos Channel subwatershed, there are areas that were long ago marked as "declining" in Bellflower and Paramount (U.S. EPA, 2021).

10.5 PROPERTY VALUES

Property values near Alamitos Bay and Colorado Lagoon would likely increase as a result in reductions in bacteria in those waterbodies. The economic water quality literature has found that home buyers are willing to pay more for reduced levels of fecal coliform (Papenfus, 2019), E. coli (Netusil, Kincaid, & Chang, 2014), and enterococcus (Kung, Guignet, & Walsh, 2017). Beach postings resulting from excessive enterococcus levels also negatively affect home values, potentially as far as a few kilometers away (Kung, Guignet, & Walsh, 2017).

While inland property values would likely not be directly affected by decreased bacteria levels in Alamitos Bay, Colorado Lagoon, and Los Cerritos Channel and Estuary, green infrastructure located inland that ultimately reduces stormwater flow and bacteria could also increase property values (Clements, St. Juliana, David, & Levine, 2013; Heckert & Mennis, 2012). Restoration activities along Los Cerritos Channel could provide new community and recreation space, increasing nearby property values in addition to mitigating future flood risk, as mentioned in Section 10.3. Filling impermeable lots and streets throughout the subwatersheds with green infrastructure, such as bioswales, trees, and rain gardens, would improve neighborhood aesthetics. Although this raises gentrification concerns as areas with little green space and tree coverage are often low-income, heavily minority neighborhoods, and green infrastructure has sometimes been found to precede gentrification (Shokry, Connolly, & Anguelovski, 2020), this does not mean that green infrastructure should be avoided in these neighborhoods. Instead, this highlights the need for sustained collaboration among stormwater managers, city agencies, and members of the local community.

10.6 EMPLOYMENT

Economic Roundtable conducted a study in 2011 that found that job stimulus for every $1 million invested in water efficiency projects was greater than traditional Los Angeles industries, such as motion picture production and new home construction. The study found that 12.6 to 16.6 annualized jobs in recycled water, groundwater, stormwater, graywater systems, and water conservation projects were created for every $1 million invested in these types of projects. The study also showed that approximately 74% of money invested in stormwater projects at the time of the study was spent locally, on businesses located within Los Angeles County. Furthermore, every million dollars invested in stormwater projects in Los Angeles stimulated an estimated $1.99 million in total local sales due to multiplier effects of investing in the local economy. For example, cities pay people to work on stormwater projects, who then spend their incomes on housing, goods, and services (Burns & Flaming, 2011). Furthermore, many of these jobs created would be good-paying jobs that do not require an advanced degree, accessible to those in disadvantaged communities (Los Angeles Alliance for a New Economy (LAANE), 2018).

10.7 OTHER ECOSYSTEM SERVICES

A broad range of other environmental benefits can accrue from the Bacteria TMDL. Retained stormwater can be put into soil where soil biota, macrophytes, and stream interflow systems improve water quality and ecosystems supported by baseflow or high groundwater. Ecosystem benefits of nature-based BMPs include habitat improvement, increased food sources, carbon sequestration, pollutant uptake, and reduced ozone (Nowak, 2006). Improved baseflow results in decreased water temperatures and prolonged dry weather flows, and increased amounts and types of soil biota will aid in carbon sequestration and pollutant uptake (Klaus, 2015).

11. REFERENCES

Ackerman, D., Schiff, K. C., Trim, T., & Mullin, M. (2003). *Characterization of water quality in the Los Angeles River.*

Ackerman, D., Stein, E. D., & Schiff, K. (2005). *Dry-season Water Quality in the San Gabriel River Watershed.*

Bay Area Stormwater Management Agencies Association. (2012, August 23). Rain Barrels and Cisterns Storm Water Control for Small Projects.

Burns, P., & Flaming, D. (2011, December). *Water Use Efficiency and Jobs.* Retrieved from Economic Roundtable: https://economicrt.org/wp-content/uploads/2011/12/Water_Use_Efficiency_and_Jobs_2011.pdf

California Historical Landmark. (2020, January 9). *CHL No. 1014 Long Beach Marine Stadium - Los Angeles*. Retrieved from https://www.californiahistoricallandmarks.com/landmarks/chl-1014

California Storwater Quality Association. (2003). *California Storwater BMP Handbook: TC-40 Media Filter.* California Storwater Quality Association.

Central Coast Water Board. (2012, February 23). Total Maximum Daily Loads for Fecal Indicator Bacteria in Santa Maria River Watershed. Central Coast Regional Water Quality Control Board.

City of Avalon. (2020, January 30). *Avalon California Pollution Reduction in the Bay*. Retrieved from http://www.cityofavalon.com/content/3180/3269/3274.aspx

City of Long Beach. (2008). *PW-Belmont Pumping Station.* Retrieved December 2020, from City of Long Beach: http://longbeach.legistar.com/LegislationDetail.aspx?ID=273878&GUID=94C5FB2D-4FF6-46DD-8E69-9D0290031893&Options=&Search=&FullText=1

City of Long Beach. (2015). *Contract: Appian Way Low Flow Diversion Project - Total Amount Of Bid Plus Additive Bid A: $488,125.* Retrieved December 2020, from City of Long Beach: http://longbeach.legistar.com/LegislationDetail.aspx?ID=2168926&GUID=85656285-4BD3-4252-A754-0C90D0E2F98C

City of Long Beach. (2020, October 26). Alamitos Bay Water Quality Enhancement Project Update Memorandum.

City of Long Beach. (2020, November). *Climate Action and Adaptaion Plan Appendices.* Retrieved from Long Beach: http://www.longbeach.gov/globalassets/lbds/media-library/documents/planning/caap/lb-caap-proposed-plan-appendices-121020

City of Los Angeles. (2010, March 24). Rainwater Harvesting Program: Overview, Results and Recommendations.

Clements, J., St. Juliana, A., David, P., & Levine, L. (2013, December). *The Green Edge: How Commercial Property Investment in Green Infrastructure Creates Value.* Retrieved March 2021, from Natural Resources Defense Council: https://www.nrdc.org/sites/default/files/commercial-value-green-infrastructure-report.pdf

De Guzman, E., Kalkstein, L. S., Sailor, D., Eisenman, D., Sheridan, S., Kirner, K., . . . Chen, Y. (2020). *Rx for Hot Cities: Climate Resilience Through Urban Greening and Cooling in Los Angeles.* Beverly Hills: TreePeople.

Department of Boating and Waterways. (2020, January 28). *2018 California Code Harbors and Navigation Code-Division 3 Vessels-Chapter 6 Vessel Sanitation*.

Retrieved from Justia US Law: https://law.justia.com/codes/california/2018/code-hnc/division-3/chapter-6/
Devinny, J. S., Kamieniecki, S., & Stenstrom, M. (2004). *Alternative Approaches to Storm Water Quality Control.* University of Southern California. Center of Sustainable Cities.
Diringer, S. E., Shimabuku, M., & Cooley, H. (2020). Economic evaluation of stormwater capture and its multiple benefits in California. *PLoS ONE*.
Dwight, R. H., Fernandez, L. M., Baker, D. B., Semenza, J. C., & Olson, B. H. (2005). Estimating the economic burden from illnesses associated with recreational coastal water pollution—a case study in Orange County, California. *76*(2).
Feinberg, J. J. (2020, January 2). Personal Communication.
Friends of Colorado Lagoon. (2019, December 18). *Friends of Colorado Lagoon-Colorado Lagoon Habitat Restoration*. Retrieved from http://www.coloradolagoon.org/restoration.html
Georgetown Climate Center. (n.d.). *Green Infrastructure Strategies and Techniques*. Retrieved from Georgetown Climate Center: https://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/green-infrastructure-strategies-and-techniques.html
Griffith, J., Cao, Y., Raith, M., Engeln, M., & Steele, J. (2014). *San Gabriel River Watershed Water Quality Project Report.*
Haile, R., Witte, J., Gold, M., Cressey, R., McGee, C., Millikan, R., . . . Wang, G. (1999). The Health Effects of Swimming in Ocean Water Contaminated by Storm Drain Drain Runoff . *Epidemiology*, 10(4): 355-363.
Hallinan, E. (2020, January 23). Manager, Marinas and Beaches Parks Recreation and Marine. *Personal Communication*.
Halverson, N. V. (2004). *Review of Constructed Subsurface Flow vs. Surface Flow Wetlands.* Westinghouse Savannah River Company .
Heckert, M., & Mennis, J. (2012). The Economic Impact of Greening Urban Vacant Land: A Spatial Difference-In-Differences Analysis.
Hoffman, J. S., Vivek, S., & Pendleton, N. (2020). The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas. *Climate*.
Holmes, D. (2020, 12 February). Manager, Grants & Loans California State Parks Division of Boating & Waterways. *Personal Communication*.
Klaus, G. (2015). *Soil - A Precious Natural Resource.* Bern: Federal Office for the Environment.
Kung, M., Guignet, D., & Walsh, P. (2017, April 27). *Comparing Pollution Where You Live and Play.* Retrieved from NCEE Working Paper Series, U.S. EPA: https://www.epa.gov/environmental-economics/working-paper-comparing-pollution-where-you-live-and-play-hedonic-analysis
Long Beach Nearshore Watershed Management Program. (2016, January 22). Long Beach Nearshore Watershed 2017-2018 Annual Report.
Long Beach Nearshore Watershed Management Program. (2021, June 30). Watershed Management Program for the Nearshore Watersheds. City of Long Beach.
Long Beach Parks, Recreation & Marine . (2017). *Long Beach Marina Rules and Regulations.* Long Beach: Marine Bureau.

Loomis, J., Hanemann, M., Kanninen, B., & Wegge, T. (1991). Willingness to Pay to Protect Wetlands and Reduce Wildlife Contamination from Agricultural Drainage. *The Economics and Management of Water and Drainage in Agriculture*, 411-429.

Los Angeles Alliance for a New Economy (LAANE). (2018, March). *Liquid Assets: How Stormwater Infrastructure Builds Resilience, Health, Jobs, and Equity.* Retrieved from LAANE: http://laane.org/wp-content/uploads/2018/03/LAANE_Liquid-Assets_Stormwater-Report.pdf

Los Angeles County Department of Public Works. (2008). *Termino Avenue Drain Project Environmental Impact Report.* State Clearinghouse No. 2000111022.

Los Angeles Department of Water and Power and AES Alamitos LLC. (2010). *National Pollutant Discharge Elimination System 2010 Receiving Water Monitoring Report Haynes and AES Alimitos L.L.C Generating Stations.* Long Beach.

Los Angeles Water Board. (2002a, August 01). Santa Monica Bay Beaches Wet-Weather Bacteria TMDL Staff Report. California Regional Water Quality Control Board, Los Angeles Region.

Los Angeles Water Board. (2002b, January 14). Total Maximum Daily Load to Reduce Bacterial Indicator Densities During Dry Weather at Santa Monica Bay Beaches Staff Report. California Regional Water Quality Control Board, Los Angeles Region.

Los Angeles Water Board. (2003a). Draft Staff Report - Amendment to the Water Quality Control Plan for the Los Angeles Region to Suspend the Recreational Beneficial Uses in Engineered Channels during Unsafe Wet Weather Conditions.

Los Angeles Water Board. (2003b, July 10). Amendment to the Water Quality Control Plan - Los Angeles Region to Suspend the Recreational Beneficial Uses in Engineered Channels during Unsafe Wet Weather Conditions. Regional Board Resolution No. 2003-010.

Los Angeles Water Board. (2003c, September 09). Total Maximum Daily Load to Reduce Bacterial Indicator Densities at Marina del Rey Harbor Mothers' Beach and Back Basins Staff Report. California Regional Water Quality Control Board, Los Angeles Region.

Los Angeles Water Board. (2004, April 30). Los Angeles Harbor Bacteria TMDL (Inner Cabrillo Beach and Main Ship Channel) Staff Report. California Regional Water Quality Control Board, Los Angeles Region.

Los Angeles Water Board. (2006, July 21). Total Maximum Daily Load for Bacterial Indicator Densities in Ballona Creeek, Ballona Estuary, & Sepulveda Channel Staff Report.

Los Angeles Water Board. (2009, July 23). Colorado Lagoon Organochlorine Pesticides, Polychlorinated Biphenyls, Sediment Toxicity, Polycyclic Aromatic Hydrocarbons, and Metals TMDL Staff Report.

Los Angeles Water Board. (2010). *Los Angeles River Watershed Bacteria TMDL Staff Report.*

Los Angeles Water Board. (2015). *San Gabriel River, Estuary and Tributaries Bacteria TMDL Staff Report.*

Los Angeles Waterboard. (2010). Total Maximum Daily Load for Indicator Bacteria in Santa Clara River Estuary and Reaches 3, 5, 6 and 7 Staff Report.

Los Cerriots Channel Watershed Group. (2020). Los Cerritos Channel 2019-2020 Annual Report. Richard Watson Association Inc.

Los Cerritos Channel Authority. (2015). Los Cerritos Wetlands Final Conceptual Restoration Plan. Prepared by Moffatt & Nichol.

Los Cerritos Channel Watershed Management Group. (2015, June 29). Los Cerritos Channel Coordinated Intergrated Montoring Program.

Los Cerritos Channel Watershed Management Group. (2017, September 21). Los Cerritos Channel Watershed Management Program.

Mark, G., Hogue, T., Pincetl, S., Mika, K., & Radavich, K. (2015). Los Angeles Sustainable Water Project: Ballona Creek Watershed. *UCLA Grand Challenges, Sustainable LA*.

McCoy, M., Wolosoff, S., Dresser, C., Susilo, M. K., Rathfelder, K., Leisenring, M., . . . Geotech Consultants. (2006). *Technical Memorandum Task 7.2: Wet Weather Treatment Plan.* County of Los Angeles: County of Los Angeles Watershed Management.

Moffatt & Nichol. (2015). *Modeling of Water Residence Time within Alamitos Bay M&N 7606-14.* City of Long Beach: Moffatt & Nichol.

Netusil, N., Kincaid, M., & Chang, H. (2014). Valuing water quality in urban watersheds: A comparative analysis of Johnson Creek, Oregon, and Burnt Bridge Creek, Washington. *Water Resources Research*, 4254-4268.

Noble, R. T., Dorsey, J. H., Leecaster, M. K., Orozco-Borbon, V., Reid, D., Schiff, K. C., & Weisberg, S. B. (2000). A Regional Survey of the Microbiological Water Quality along the Shoreline of the Southern California Bight. 218-228. Westminster, CA: Annual Report 1999-2000 of the Southern California Coastal Water Research Project.

North Coast Water Quality Control Board. (2019). *Amendment to the Water Quality Control Plan to Incorporate an Action Plan for the Russian River Watershed Pathogen Total Maximum Daily Load and a Discharge Prohibition. Resolution No. R1-2019-0038.*

Nowak, D. J. (2006). Institutionalizing urban forestry as a “biotechnology” to improve environmental quality. *Urban Forestry and Urban Greening*, 93-100.

Pacific Ridgeline Inc. (2015, July 14). Bacteria Special Study Results. Prepared for the Nursery Growers Association Los Angeles County Irrigated Lands Group.

Papenfus, M. (2019). Do housing prices reflect water quality impairments? Evidence from the Puget Sound. *Water Resources and Economics*.

Porse, E., Mika, K. B., Litvak, E., Manago, K. F., Hogue, T. S., Gold, M., . . . Pincetl, S. (2018). The economic value of local water supplies in Los Angeles. *Nature Sustainability*, 289–297.

Pruss, A. (1998). Review of Epidemiological Studies on Health Effects from Exposure to Recreational Water. 27(1): 1-9. *International Journal of Epidemiology*, 27(1): 1-9.

San Francisco Bay Water Quality Control Board. (2019). *Amendment to the Water Quality Control Plan to Establish a Total Maximum Daily Load and Implementation Plan for Bacteria in the Petaluma River Watershed. Resolution No. R2-2019-0030.*

San Francisco Bay Water Quality Control Board. (2021). *San Francisco Bay Region, 2021. Amending the Water Amendment to the Basin Plan to Establish a Total*

Maximum Daily Load and Implementation Plan for Bacteria at the Beaches in Pillar Point Harbor and Venice Beach R2-2021-0002.

San Francisco Water Board. (2020, November). Total Maximum Daily Load for Bacteria In the Petaluma River Watershed. San Francisco Bay Regional Water Quality Control Board.

Schiff, K. J., Morton, J., & Weisberg, S. B. (2001). Retrospective Evaluation of Shoreline Water Quality along Santa Monica Bay Beaches. 248-252. Southern California Coastal Water Research Project Annual Report 1999-2000.

Schwarz, K., Fragkias, M., Boone, G. C., Grove, M. J., McHale, M., Grove, M. J., . . . Cadenasso, M. L. (2015). Trees Grow on Money: Urban Tree Canopy Cover and Environmental Justice. *PLOS ONE*, Vol 10.

Shokry, G., Connolly, J. J., & Anguelovski, I. (2020). Understanding climate gentrification and shifting landscapes of protection and vulnerability in green resilient Philadelphia. *Urban Climate*.

Soller, J. A., Schoen, M., Steele, J. A., & Griffith, J. F. (2017). Incidence of gastrointestinal illness following wet weather recreational exposures: Harmonization of quantitative microbial risk assessment with an epidemiologic investigation of surfers. *280-289*(121).

State Water Board. (2010). *Resolution 2010-0020: State Water Resources Control Board Policy on the use of Coastal and Estuarine Waters for Power Plant Cooling.* State Water Resources Control Board.

State Water Board. (2018a). *Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California Bacteria Provisions and a Water Quality Standards Variance Policy.* State Water Resources Control Board.

State Water Board. (2018b). *Staff Report for Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries of California (ISWEBE Plan)—Bacteria Provisions and a Water Quality Standards Variance Policy,.* State Water Resources Control Board.

State Water Board. (2020, October 51). *Sanitary Sewer Overflow Program Glossary*. Retrieved from https://www.waterboards.ca.gov/water_issues/programs/sso/glossary.html#SanitarySewerOverflow

State Water Board. (2020a, January 20). *State Water Resources Control Board Division of Water Quality*. Retrieved from http://waternet.waterboards.ca.gov/dwq/sso/docs/index.php

State Water Board. (2020b, January 22). *State Water Resources Control Board Sanitary Sewer Overflows Incident Map*. Retrieved from https://www.waterboards.ca.gov/water_issues/programs/sso/sso_map/sso_pub.shtml

State Water Board. (June 18, 2013). *Resolution 2013-0018: State Water Resources Control Board Policy on the use of Coastal and Estuarine Waters for Power Plant Cooling.* State Water Resources Control Board.

State Water Quality Control Board. (2015, February 3). The Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List.

State Water Resources Control Board. (2004, May). Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program.

State Water Resources Control Board. (2006, May 2). Statewide General Waste Discharge Requirements for Sanitary Sewer System Order No. 2006-0003-DWQ.

State Water Resources Control Board. (2013, August 6). Statewide General Waste Discharge Requirements for Sanitary Sewer Systems Order No. WQ 2013-0058-EXEC.

State Water Resources Control Board. (2016). Adopting the Human Right to Water as a Core Value and Directing its Implementation in Water Board Programs and Activities. Resolution No. 2016-0010.

State Water Resources Control Board. (2019). *Guidance.* Sacramento: State Water Resources Control Board.

SWRPC. (1991). *Southeastern Wisconsin Regional Planning Commission (SWRPC) Costs of Urban Nonpoint Source Water Pollution Control Measures.* Waukesha: Wisconsin Department of Natural Resources through the Wisconsin Nonpoint Source Water Pollution Abatement Program.

Texas Water Development Board. (2005). *The Texas Manual on Rainwater Harvesting.* Austin: Texas Water Development Board.

The Trust for Public Land. (2017, May). *The Economic Benefits of the Public Park and Recreation System in the City of Los Angeles, California.* Retrieved March 2021, from The Trust for Public Land: https://www.tpl.org/sites/default/files/files_upload/CA_LA%20Economic%20Benefits%20Report_LowRes.pdf

U.S. Bureau of Labor Statistics. (2020, December 11). *Average Energy Prices, Los Angeles-Long Beach-Anaheim – November 2020*. Retrieved December 2020, from U.S. Bureau of Labor Statistics: https://www.bls.gov/regions/west/news-release/averageenergyprices_losangeles.htm

U.S. EPA. (1986). *Ambient Water Quality for Bacteria-1986.* Washington, D.C.: Office of Water.

U.S. EPA. (1991). *Guidance for water quality-based decisions: The TMDL process.* U.S. EPA 440/4-91-9001.

U.S. EPA. (2001, January). Protocol for Developing Pathogen TMDLs. *EPA 841-R-00-002.* Washington, D.C.

U.S. EPA. (2021, March 20). *California's Redlined Communities*. Retrieved from Welcome to the CalEPA Redlining and Environmental Justice Tool: https://cawaterdatadive.shinyapps.io/Redline-Mapping/

U.S. EPA. (n.d.). *Recreational Water Quality Criteria.* Washington, D.C.: Office of Water.

U.S. Fish and Wildlife Service. (2016). *2016 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.* Washington, D.C.: U.S. Fish and Wildlife Service.

Urban Water Resources Research Council. (2014, August). Pathogens in Urban Stormwater Systems. Environmental and Water Resources Institute. American Society of Civil Engineers.

Wade, T., Pai, N., Eisenberg, J., & Colford Jr., J. (2003). Do U.S. Environmental Protection Agency Water Quality Guidelines for Recreational Waters Prevent Gastrointestinal Illness? A Systematic Review and Meta-Analysis. *Environmental Health Perspectives*.

Water Research Foundation. (2020). *International Stormwater BMP Database: 2020 Summary Statistics Project No. 4968.*

12. ABBREVIATIONS AND DEFINITIONS

- Bacteria Provisions or Statewide Bacteria Provisions: The bacteria water quality objectives contained in Chapter III of the ISWEBE Plan and Chapter II of the Ocean Plan and the implementation sections contained in Chapter IV of the ISWEBE Plan and Chapter III of the Ocean Plan.

- Bacteria Water Quality Objective(s): The bacteria water quality objectives set forth in Chapter III.E.2 of the ISWEBE Plan.

- Basin Plan: Water Quality Control Plan - Los Angeles Region

- BMP: Best Management Practices

- CALENDAR MONTH(S): A period of time from a day of one month to the day before the corresponding day of the next month if the corresponding day exists, or if not to the last day of the next month (e.g., from January 1 to January 31, from June 15 to July 14, or from January 31 to February 28).

- Calendar year: A period of time defined as twelve consecutive calendar months.

- Caltrans: California Department of Transportation

- CIMP: Coordinated Integrated Monitoring Program

- CEQA: California Environmental Quality Act

- CFR: Code of Federal Regulations

- cfu: colony forming units

- CWA: Clean Water Act

- E. coli: Escherichia coli

- ENCLOSED BAYS: Indentations along the coast which enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 % of the greatest dimension of the enclosed portion of the bay

- EFDC: Environmental Fluid Dynamics Code

- Estuaries and coastal lagoons: Waters at the mouths of streams that serve as mixing zones for fresh and ocean waters during a major portion of the year. Mouths of streams that are temporarily separated from the ocean by sandbars shall be considered as estuaries. Estuarine waters will generally be considered to extend from a bay or the open ocean to the upstream limit of tidal action but may be considered to extend seaward if significant mixing of fresh and saltwater occurs in the open coastal waters

- FIB: Fecal Indicator Bacteria
- Freshwater: waters with salinity equal to or less than 1 ppth 95 percent or more of the time during the calendar year
- Geometric Mean (GM): The geometric mean is a type of mean or average that indicates the central tendency or typical value of a set of numbers by using the product of their values (as opposed to the arithmetic mean which uses their sum). The geometric mean is defined as the nth root of the product of n numbers. The formula is expressed as: GM = $\sqrt{(x1)(x2)(x3)\ldots(xn)n}$, where x is the sample value and n is the number of samples taken.
- HGS: Haynes Generating Station
- IMP: Integrated Monitoring Program
- ISWEBE: Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries of California
- LAs: Load Allocations
- mL: Milliliters
- MPN: Most Probable Number
- MS4: Municipal Separate Storm Sewer Systems
- NPDES: National Pollutant Discharge Elimination System
- Ocean waters: The territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries and coastal lagoons. If a discharge outside the territorial waters of the State could affect the quality of the waters of the State, the discharge may be regulated to assure no violation of the Ocean Plan will occur in ocean waters
- OAL: Office of Administrative Law
- OTC: Once Through Cooling
- OWTS: Onsite Wastewater Treatment Systems
- ppth: parts per thousand
- Water Contact Recreation (REC-1): 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 (REC-2): 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.

- Saline: waters with salinity greater than 1 ppth more than 5 percent of the time during the calendar year

- SCAG: Southern California Association of Governments

- Site-Specific Water Quality Objective: A water quality objective that reflects site-specific conditions. It may be appropriate to develop a water quality objective for a site when it is determined that the otherwise applicable objective is inappropriate for the water body (i.e., based on site-specific conditions the applicable objective does not protect the beneficial use or a less stringent objective is warranted).

- Statistical Threshold Value (STV): The STV for the bacteria water quality objectives is a set value that approximates the 90th percentile of the water quality distribution of a bacterial population. For the bacteria water quality objectives, the STV for E. coli is 320 cfu/100 mL and the STV for Enterococcus is 110 cfu/100 mL

- Summer Season: April 1st to October 31st

- SWAMP: Surface Water Ambient Monitoring Program

- SWPPP: Stormwater Pollution Prevention Plan

- TMDL: Total Maximum Daily Load

- Upper Los Cerritos Channel watershed: Los Cerritos Channel subwatershed, Los Cerritos Channel Estuary subwatershed, Alamitos Bay subwatershed, Colorado Lagoon subwatershed, and Los Cerritos Channel Coastal subwatershed

- U.S. EPA: United States Environmental Protection Agency

- WDRs: Waste Discharge Requirements

- Winter: November 1st to March 31st

- WLAs: Waste Load Allocations

- WQBELs: Water Quality-Based Effluent Limitations

- WQOs: Water Quality Objectives