# Economic Analysis of Proposed Water Quality Objectives for Pathogens in the State of California

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# Abbreviations

| | |
|---|---|
| BEACH Act | Beaches Environmental Assessment and Coastal Health Act |
| CSO | Combined sewer overflow |
| CT | Contact time |
| cu. yd. | Cubic yard |
| CWA | Clean Water Act |
| CZARA | Coastal Zone Act Reauthorization Amendments |
| DRBC | Delaware River Basin Commission |
| EO | Executive Order |
| U.S. EPA | Environmental Protection Agency |
| FC | Fecal coliform |
| FS | Fecal streptococcus |
| mgd | Million gallons per day |
| MS4 | Municipal separate storm sewer system |
| NPDES | National pollutant discharge elimination system |
| O&M | Operation and maintenance |
| PCS | Permit compliance system |
| POTW | Publicly owned treatment work |
| RB4 | Los Angeles Regional Board |
| SIC | Standard industrial classification |
| sq. ft. | Square feet |
| SSM | Single sample maximum |
| SSO | Sanitary sewer overflow |
| TMDL | Total maximum daily load |
| WQS | Water quality standards |

# Executive Summary

The State Water Resources Control Board is proposing to amend the statewide *Water Quality Control Plans for Inland Surface Waters, Enclosed Bays and Estuaries* and the *Water Quality Control Plan for Ocean Waters of California* to include updated water quality objectives for bacteria to protect human health for the beneficial use of water contact recreation (REC-1) in fresh and marine waters. Exhibit ES-1 shows the proposed objectives for fresh and marine waters. Under a contract with the United States Environmental Protection Agency, Abt Associates provided the State Water Board with an analysis of economic factors related to the proposal, including compliance with the water quality objective options, available methods to achieve compliance with these options, and the costs of those methods.

**Exhibit ES-1: Proposed Bacteria Objectives**

| Applicable Waters | Indicator Parameter | Geometric Mean[1] (cfu/100 mL) | STV[2] (cfu/100 mL) |
|---|---|---|---|
| *Freshwater Bacteria Objectives* | | | |
| All waters where the salinity is less than 10 ppth 95 percent or more of the time except Lake Tahoe | *E. coli* | 100 | 320 |
| Lake Tahoe | *E. coli* | 17 | 55 |
| All waters where the salinity is equal to or greater than 10 ppth 95 percent or more of the time | Enterococci | 30 | 110 |
| *Marine Bacteria Objectives* | | | |
| Ocean Waters | Enterococci | 30 | 110 |

1. Based on a 6-week rolling geometric mean, calculated weekly.
2. Calculated monthly

Abt Associates evaluated probable costs associated with adoption of the objectives by developing the following for a sample selection of NDPES permittees affected by the proposed policy: (1) treatment costs associated with complying with more stringent objectives, and (2) incremental costs associated with changes in bacteria monitoring requirements. Based on sample results, Abt estimated annual statewide costs associated with the proposed policy (Exhibit ES-2). Negative cost values indicate a likely cost savings relative to existing policy.

**Exhibit ES-2. Statewide Policy Compliance Costs (2016$)**

| Scenario | Annualized Costs ($/year; 20 years) | |
|---|---|---|
| | 3% Interest Rate | 7% Interest Rate |
| Disinfection Modification Costs | $935,000 | $988,000 |
| Monitoring Costs | - $789,000 | - $789,000 |
| Total Net Costs | $146,000 | $199,000 |

# 1 Introduction

The California State Water Resources Control Board (State Water Board) is proposing a statewide policy for bacteria for California fresh waters and ocean waters. This report describes the economic considerations associated with the proposed policy. Specifically, the State Water Board analyzed whether the proposed objectives are currently being attained, what methods are available to achieve compliance with the objectives, and the costs of those methods.

## 1.1 Need for the Proposed Rule

Under the Clean Water Act (CWA), states have primary authority for establishing designated uses for water bodies, and for developing water quality criteria to protect those designated uses. Under Section 303(c)(2)(B) of the CWA, whenever a state adopts new water quality standards, or reviews or revises existing water quality standards, it must adopt numeric water quality criteria if the absence of such criteria could reasonably be expected to interfere with a designated use of a water body.

In 1986, U.S. EPA revised its ambient water quality criteria for bacteria, recommending that *E. coli* and enterococci be used as indicators of health risks from bacteria in marine and fresh water instead of fecal coliform. U.S. EPA based its revised criteria on a review of epidemiological studies relating gastrointestinal illness to specific bacterial indicators.

In 2012, pursuant to Clean Water Act section 304(a), U.S. EPA issued new recreational water quality criteria recommendations for protecting human health in all coastal and non-coastal waters designated for primary contact recreation use. While some Regional Water Boards have adopted new bacteria indicators (*E. coli* and/or enterococci) none have adopted the 2012 U.S. EPA Recommended Recreational Water Quality Criteria. The 2012 U.S. EPA recreational water quality criteria document recommends bacteria indicators for inland surface waters and ocean waters at two different risk levels that are protective for recreational activities.

The proposed policy, contained in *Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Bacteria Objectives with Provisions* (hereafter, the Proposed Policy), are the State Water Board's proposal to adopt the updated criteria into the *Water Quality Control Plans for Inland Surface Waters, Enclosed Bays and Estuaries and Ocean Waters of California*. The Proposed Policy seeks to establish consistent statewide objectives for California waters and establishes procedures for implementing the objectives.

## 1.2 Scope of the Analysis

The Porter-Cologne Water Quality Act requires the Regional Water Boards to take "economic considerations," among other factors, into account when they establish water quality objectives. The other factors include the past, present, and probable future beneficial uses of water; environmental characteristics of the hydrographic unit under consideration; water quality conditions that could reasonably be achieved through the coordinated control of all factors affecting water quality in the area; the need for housing; and the need to develop and use recycled water. The objectives must ensure the reasonable protection of beneficial uses, and the prevention of nuisance.

To meet the economic considerations requirement, the State Water Board (1999; 1994) concluded that, at a minimum, the Regional Water Boards must analyze:

- Whether the proposed objective is currently being attained;
- If not, what methods are available to achieve compliance; and
- The cost of those methods.

If the economic consequences of adoption are potentially significant, the Regional Water Boards must explain why adoption is necessary to ensure reasonable protection of beneficial uses or prevent nuisance. The Boards can adopt objectives despite significant economic consequences; there is no requirement for a formal cost-benefit analysis.[1]

Under a contract with the U.S. EPA, Abt Associates provided the State Water Board with an analysis of economic considerations. Specifically, Abt Associates identified baseline requirements, potentially affected entities, likely incremental compliance actions, and costs for these entities under the proposed Policy.

## 1.3 Organization of this Report

This report is organized as follows:

- **Section 2** – describes the current applicable objectives and requirements that provide the baseline for the analysis of the incremental impact of the Policy.
- **Section 3** – describes the proposed Policy.
- **Section 4** – identifies whether the proposed objectives are currently being met and whether there are any incremental impacts of meeting the objectives.
- **Section 5** – describes the methods for compliance and their costs.
- **Section 6** – provides estimates of potential incremental statewide costs of the proposed Policy.

Appendices provide detailed information on total maximum daily load (TMDL) implementation plans, and incremental compliance/costs associated with numeric water quality based effluent limits (WQBELs).

[1] Water quality objectives establish concentrations protective of beneficial uses and the fishable/swimmable goals of the CWA, and thus are based on science and not economics. Economics can play a role in establishing water quality standards through the analysis of use attainability [removal of a beneficial use which is not an existing use under 40 CFR 131.10(g)]. However, the applicable economic criterion in such an analysis is not efficiency (i.e., maximizing net benefits, based on cost-benefit analysis) but distributional impacts (a determination of whether there will be substantial and widespread economic and social impacts from implementing controls more stringent than those required by sections 301(b) and 306 of the CWA). This criterion may also be employed at the local level in the evaluation of temporary variances.

# 2 Baseline for the Analysis

This section describes the applicable baseline for evaluating the potential incremental costs of the proposed Policy options, including current water quality criteria for pathogens, potential sources of pathogens, and the current levels of impairment of inland surface waters, enclosed bays, estuaries, and ocean waters in California.

## 2.1 Water Quality Objectives for Bacterial Indicators in Fresh Waters

Pathogen objectives for California fresh waters are established in the individual basin plans of the nine Regional Water Quality Control Boards, while objectives for marine waters are established in the *Water Quality Control Plan for Ocean Waters of California* (Ocean Plan, 2015). Exhibit 2-1 summarizes the bacteria objectives for each Region and the Ocean Plan.

**Exhibit 2-1. Summary of Regional and Ocean Plan REC-1 Bacteria Objectives**

| Regional Water Board | Indicators | Geometric Mean[a] | Maximum |
|---|---|---|---|
| ***Freshwater Objectives*** | | | |
| North Coast (1) | Fecal coliform | 50/100 mL[b] | 400/100 mL[c] |
| San Francisco Bay (2) | Fecal coliform<br>Total coliform<br>*E. coli*[e]<br>Enterococci[e] | 200/100 mL<br>240/100 mL[b]<br>126/100 mL<br>33/100 mL | 400/100 mL[d]<br>10,000/100 mL<br>235 – 576/100 mL[f]<br>61 – 151/100 mL[f] |
| Central Coast (3) | Fecal coliform | 200/100 mL | 400/100 mL[c] |
| Los Angeles (4) | *E. coli*<br>Fecal coliform<br>Total Coliform | 126/100 mL<br>200/100 mL<br>1,000/100 mL | 235/100 mL<br>400/100 mL<br>10,000/100 mL |
| Central Valley (5)<br>Sacramento and San Joaquin Basins<br>Folsom Lake<br>Tulare Lake Basin | <br>Fecal coliform<br>Fecal coliform<br>Fecal coliform | <br>200/100 mL<br>100/100 mL<br>200/100 mL | <br>400/100 mL[c]<br>200/100 mL[c]<br>400/100 mL[c] |
| Lahontan (6)[g] | Fecal coliform | 20/100 mL | 40/100 mL[c] |
| Colorado River (7) | *E. coli*<br>Enterococci<br>Fecal coliform | 126/100 mL<br>33/100 mL<br>200/100 mL | 400/100 mL[f]<br>100/100 mL[f]<br>400/100 mL[c] |
| Santa Ana (8) | Fecal coliform | 200/100 mL | 400/100 mL[c] |
| San Diego (9) | Fecal coliform<br>*E. coli*[e]<br>Enterococci[e] | 200/100 mL<br>126/100 mL<br>33/100 mL | 400/100 mL[c]<br>235 – 576/100 mL[h]<br>61 – 151/100 mL[h] |
| ***Ocean Water Objectives*** | | | |
| Ocean Plan | Fecal Coliform<br>Total Coliform<br>Enterococci | 200/100 mL<br>1,000/100 mL<br>35/100 mL | 400/100 mL<br>10,000/100 mL<br>104/100 mL |

a. Based on at least 5 samples over a 30-day period.
b. Based on median of samples, not geometric mean
c. 10% of samples cannot exceed maximum
d. Based on the 90th percentile value
e. Included in Basin Plans as supplemental criteria to either fecal coliform or total coliform criteria.
f. The maximum E. coli and enterococci criteria for the Colorado River are 235/100 mL and 61/100 ml, respectively
g. The bacteria objectives for Region 6 apply to all waters independent of designated beneficial uses.
h. Maximum values determined based on frequency and density of recreational use.

## 2.2 Sources of Bacteria to California Waters

There are a number of sources of bacteria to fresh waters and marine waters, including municipal and industrial point sources, storm water, and various natural and human-caused nonpoint sources.

### 2.2.1 Municipal and Industrial Dischargers

POTWs collect and treat domestic, commercial, and industrial wastewater. This wastewater must be disinfected prior to discharge to a receiving water to remove high levels of bacteria. Based on POTW indicator codes and receiving water body names in U.S. EPA's Integrated Compliance Information System (ICIS; 2017) database, there are 224 POTWs and federally-owned municipal wastewater treatment plants discharging to waters within the state. In addition, there are 79 industrial permittees. U.S. EPA classifies 40% of these facilities as minor dischargers (i.e., facilities discharging less than 1 million gallons per day (MGD) and not likely to discharge toxic pollutants in toxic amounts). Exhibit 2-2 provides a summary of these dischargers by receiving water type.

**Exhibit 2-2. NPDES Permittees Discharging in California**

| Facility Type | Major/Minor Category | | Total |
|---|---|---|---|
| | Major Facilities | Minor Facilities | |
| *Inland Surface Waters, Bays, and Enclosed Estuaries,* | | | |
| Industrial | 17 | 50 | 67 |
| POTWs | 134 | 60 | 194 |
| Federal | 1 | 3 | 4 |
| *Subtotal* | *152* | *113* | *265* |
| *Pacific Ocean* | | | |
| Industrial | 8 | 4 | 12 |
| POTWs | 21 | 4 | 25 |
| Federal | 0 | 1 | 1 |
| *Subtotal* | *29* | *9* | *38* |

Source: U.S. EPA (2017).

Another potential source of pathogens to fresh water associated with POTWs may result from combined sewer overflows (CSOs) or sanitary sewer overflows (SSOs). CSOs generally occur in response to wet weather events (i.e., during and following periods of rainfall or snowmelt). Combined sewer systems are usually designed to discharge flows that exceed conveyance capacity directly to receiving water bodies. Discharges of pathogens from CSOs are covered under U.S. EPA's CSO Control Policy. The CSO Control Policy contains provisions for developing site-specific NPDES permits for combined sewer systems that overflow due to wet weather events, and establishes nine minimum technology-based controls. There are two permitted CSO dischargers within the state to ocean waters (CA0037681, CA0037664) and one to inland surface waters (CA0079111). These permittees are included in the summary above under POTWs (Exhibit 2-2).

SSOs can be induced by rainfall or snowmelt when excess inflow and infiltration causes the conveyance capacity of the sanitary sewer to be exceeded. SSOs also occur as a result of other, dry weather causes such as blockages, line breaks, vandalism, mechanical failures, and power failure. Regional Water Boards prohibit SSOs unless they have authorized such discharges through a NPDES permit. Due to the number of causes of SSOs and that they are not usually permitted discharges, it is difficult to estimate the number and volume of each overflow. However, the State Water Board does not anticipate that any incremental SSO controls (or costs) would be needed to meet the proposed water quality standards for bacteria, compared to the current bacteria standards in each region. Controls for SSOs include sewer system cleaning and maintenance; reducing infiltration and inflow through system rehabilitation and repairing broken or leaking service lines; enlarging or upgrading sewer, pump station, or sewage treatment plant capacity and reliability; and constructing wet weather storage and treatment facilities to treat excess flows. These controls result in reducing or eliminating SSOs, and therefore, would reduce bacteria levels, regardless of the indicator measured.

There are a number of industrial facility types that have the potential to discharge bacteria to fresh waters. For example, facilities that treat domestic waste such as apartment complexes, mobile home parks, camping sites, resorts, and correctional facilities may discharge bacteria. Based on U.S. EPA's ICIS database (2017), there are 79 industrial discharges permitted to discharge to surface waters within the state. Of these, 39 permittees possess pathogen effluent limitations. U.S. EPA classifies 25 (approximately 64%) of these facilities as minor dischargers (i.e., facilities discharging less than 1MGD and not likely to discharge toxic pollutants in toxic amounts).

### 2.2.2 Storm Water Discharges

There are various types of storm water dischargers, including MS4, construction sites, and industrial activities. Regional Water Boards regulates stormwater under two different types; general and individual permits. General permits often require compliance with standards through an iterative approach based on stormwater management plans (SWMP), rather than through the use of numeric effluent limits. In other words, permittees implement best management practices (BMPs) identified in their SWMPs. Then, if those BMPs do not result in attainment of water quality standards, Regional Water Boards require additional practices until pollutant levels are reduced to the appropriate levels. Because Regional Water Boards use this iterative approach that increases requirements until water quality objectives are met, current levels of implementation may not reflect the maximum level of control required to meet existing standards. The State Water Board has four existing programs for controlling pollutants in stormwater runoff to surface waters: municipal, industrial, construction, and California Department of Transportation (Caltrans).

#### 2.2.2.1 Municipal

The municipal program regulates stormwater discharges from municipal separate storm sewer systems (MS4s). The MS4 permits require the discharger to develop and implement a SWMP (or equivalent), with the goal of reducing the discharge of pollutants to the maximum extent practicable (MEP). MEP is the performance standard specified in Section 402(p) of the CWA. The management programs specify the BMPs that will be used to address public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping for municipal operations.

The municipal program is divided up into two different types of permittee; Phase I and Phase II. There are 22 NPDES permits for Phase I MS4s in California. Refer to Appendix A for a summary of MS4 permit requirements related to pathogens and bacteria. In addition, there are 235 small MS4s required to reduce the discharge of pollutants and comply with any TMDL requirements.

In California, typical permit requirements that are now being included in all Phase I MS4 permits and the Phase II General Permit include:

- Specific thresholds for “Priority Projects” that must include both source and treatment control BMPs in the completed projects;
- A list of source control (both nonstructural and structural) BMPs and treatment control BMPs to be included or considered;
- Specific water quality design volume and/or water quality design flow rate for treatment control BMPs;
- A requirement for flow control BMPs when there is potential for downstream erosion; and
- Adopt a standard model or template for identifying and documenting BMPs including a plan for long-term operations and maintenance of BMPs.

#### 2.2.2.2 Caltrans

In 1996, Caltrans requested that the State Water Board consider adopting a single NPDES permit for stormwater discharges from all Caltrans properties, facilities, and activities that would cover both the MS4 requirements and the statewide construction general permit requirements. The State Water Board issued the Caltrans general permit in 1999 and a renewed permit in 2012 (Order 2012-0011-DWQ; NPDES No. CAS000003). The permit requires Caltrans to control pollutant discharges to the MEP and implement a stormwater program designed to achieve compliance with water quality standards, over time through an iterative approach. If discharges are found to be causing or contributing to an exceedance of an applicable objective, Caltrans is required to revise its BMPs (including use of additional and more effective BMPs).

The Order stipulates that the permittee must comply with applicable TMDLs and water quality standards, including those for pathogens, but states that Caltrans is a relatively minor source of bacterial pollutants. The permit provides for a prioritization strategy wherein the agency will identify and control the largest sources of bacteria first.

#### 2.2.2.3 Industrial

Under the industrial program, the State Water Board issues a general NPDES permit that regulates discharges associated with ten broad categories of industrial activities (Order No. 2014-0057-DWQ; NPDES No. CAS000001). This general permit requires the implementation of management measures that will achieve the performance standard of best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT). The permit also requires that dischargers develop a Stormwater Pollution Prevention Plan (SWPPP) and a monitoring plan. Through the SWPPP, dischargers must identify sources of pollutants, and describe the means to manage the sources to reduce stormwater pollution. For the monitoring plan, facility operators may participate in group monitoring programs to reduce costs and resources. The permit includes monitoring requirements for bacteria and requires that permittees comply with water quality standards and applicable TMDLs.

#### 2.2.2.4 Construction

Under the construction storm water program, the State Water Board issues a general NPDES permit that regulates discharges associated with storm water discharges associated with construction and other land disturbance activities (Order No. 2009-0009-DWQ; NPDES No. CAS000002). This general permit requires the implementation of management measures that will achieve the performance standard of best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT). The permit also requires that dischargers develop a Stormwater Pollution Prevention Plan (SWPPP) and a monitoring plan. The permit requires that permittees comply with all applicable water quality standards.

### 2.2.3 Nonpoint Sources

Runoff from livestock operations are controlled at the Regional Water Board level by nonpoint source BMPs and other methods.  The nonpoint source pollution program typically relies on discharger implementation of management practices to control pollution sources.  Nonpoint source pollution results from contact between pollutants and land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification.  Generally, preventing or minimizing generation of nonpoint source discharges most effectively controls nonpoint source pollution.

In 2004, the State Water Board adopted a *Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program*.  The Policy outlines the five key elements that must be included in a nonpoint source pollution implementation program.  One key element is a description of the management practices and other program elements that will be implemented to achieve and maintain water quality standards.  The policy also confirms that all discharges or threatened discharges to waters of the state must be regulated by the water boards.  The policy reiterates that the regulatory tools for non-point source discharges are waste discharge requirements (permits), waivers of waste discharger requirements, and prohibitions.

## 2.3 Impaired Waters

A 2004 policy (Resolution No. 2004-0063; as amended by Resolution 2015-0005) establishes procedures for including California waters on the state 303(d) list as impaired. There are 764 fresh and salt water bodies on California's 2012 303(d) list that are impaired from elevated levels of fecal indicator bacteria (fecal coliform, total coliform, and *E. coli*). The 303(d) list identifies impairment for bacteria, bacteria indicators, enteric viruses, enterococci, fecal coliform, high coliform count, pathogens, and total coliform. Exhibit 2-3 summarizes the number of impaired water bodies by region.

**Exhibit 2-3. Summary of California's 2012 303(d) List of Freshwater and Saltwater Fecal Indicator Bacteria Impairments**

| Regional Water Board | Water Body Type | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bay & Harbor | Coastal & Bay Shoreline | Estuary | Lakes/ Reservoirs | Rivers/ Streams | Wetlands (Freshwater & Tidal) | Total |
| North Coast (1) | 0 | 12 | 0 | 0 | 17 | 0 | **29** |
| San Francisco Bay (2) | 2 | 18 | 1 | 0 | 11 | 0 | **32** |
| Central Coast (3) | 2 | 36 | 11 | 3 | 158 | 1 | **211** |
| Los Angeles (4) | 5 | 61 | 18 | 1 | 65 | 2[a] | **152** |
| Central Valley (5) | 0 | 0 | 1 | 1 | 62 | 0 | **64** |
| Lahontan (6) | 0 | 0 | 0 | 0 | 25 | 0 | **25** |
| Colorado River (7) | 0 | 0 | 0 | 1[b] | 9 | 0 | 10 |
| Santa Ana (8) | 2 | 1 | 1 | 3 | 36 | 0 | 43 |
| San Diego (9) | 4 | 157 | 6 | 0 | 31 | 0 | 198 |
| Total | **15** | **285** | **38** | **8** | **414** | **1** | **764** |

Source: SWRCB (2015)

[a] These wetlands are tidal wetlands.

[b] This lake is Saline Lake.

Of the 764 impaired water bodies listed as impaired for fecal indicator bacteria on the 303(d) list, 617 (81%) possess target TMDL completion dates, which range from 2004 to 2026.

There are a number of different causes of impairment for pathogens, including natural sources, point and nonpoint sources, and urban runoff. Exhibit 2-4 summarizes the potential sources of impairments as listed on the 303(d) list (SWRCB, 2015). Note that some segments have multiple potential sources.

**Exhibit 2-4: Sources of Pathogen Impairment**

| Potential Sources | Number of Water Body Segments |
|---|---|
| Agriculture | 17 |
| Miscellaneous | 1 |
| Municipal Wastewater | 3 |

**Exhibit 2-4: Sources of Pathogen Impairment**

| Potential Sources | Number of Water Body Segments |
|---|---|
| Natural Sources | 30 |
| Recreation Areas/Activities | 5 |
| Unpermitted Discharges | 4 |
| Unspecified Nonpoint Sources | 88 |
| Unspecified Point Sources | 16 |
| Urban Runoff | 30 |
| Unknown | 564 |
| Waste Storage & Disposal | 6 |
| Source: SWRCB (2015). | |

Exhibit 2-5 provides a summary of Bacteria TMDLs developed for REC-1 impairment. As part of the TMDL development process, Regional Water Board staff can develop site-specific objectives that are adopted by the Regional Water Board in their Basin Plans, or establish numeric targets that are not adopted in Basin Plans.

**Exhibit 2-5: Summary of Bacteria TMDLs in California[1]**

| TMDL | Status/State Board Resolution No. | Pollutant |
|---|---|---|
| **Region 1** | | |
| Russian River Pathogen Indicator Bacteria TMDL | In development | Indicator Bacteria |
| **Region 2** | | |
| Richardson Bay Pathogens TMDL | Resolution No. 2009-0063 | Pathogens |
| Napa River Pathogen TMDL | Water Board Resolution No. R2-2006-0079 | Pathogens |
| San Pedro Creek and Pacifica State Beach Bacteria TMDL | Resolution No. 2013-0007 | Bacteria |
| Sonoma Creek Pathogens TMDL | Resolution No. R2-2006-0042 | Pathogens |
| Tomales Bay Pathogen TMDL | Resolution No. R2-2005-0046 | Pathogens |
| San Francisco Bay Beaches Bacteria TMDL | In development | Bacteria |

## Exhibit 2-5: Summary of Bacteria TMDLs in California[1]

| TMDL | Status/State Board Resolution No. | Pollutant |
|---|---|---|
| **Region 3** | | |
| Aptos/Valencia Creek Pathogen TMDL | Resolution No. 2010-0038 | Pathogens |
| Arroyo de la Cruz Fecal Indicator Bacteria TMDL | Certified by Executive Officer | Indicator Bacteria |
| Cholame Creek Fecal Indicator Bacteria TMDL | Certified by Executive Officer | Indicator Bacteria |
| Corralitos Creek Pathogen TMDL | Resolution No. 2011-0019 | Pathogens |
| Morro Bay Pathogen TMDL | Resolution No. 2003-0060 | Pathogens |
| Pajaro River Fecal Coliform TMDL | Resolution No. 2010-0015 | Fecal Coliform |
| Lower Salinas River Fecal Coliform TMDL | Resolution No. 2011-0040 | Fecal Coliform |
| Lower San Antonio Fecal Indicator Bacteria TMDL | Certified by Executive Officer | Indicator Bacteria |
| San Lorenzo Creek (Monterey County) Fecal Indicator Bacteria TMDL | Certified by Executive Officer | Indicator Bacteria |
| San Lorenzo River Watershed Pathogen TMDL | Resolution No. 2011-0010 | Pathogens |
| San Luis Obispo Creek Pathogen TMDL | Resolution No. 2005-0037 | Pathogens |
| Santa Maria Watershed TMDL - Fecal Indicator Bacteria | Resolution No. 2012-0055 | Pathogens |
| Soquel Lagoon Pathogen TMDL | Resolution No. 2010-0031 | Pathogens |
| Tularcitos Fecal Indicator Bacteria TMDL | Certified by Executive Officer | Indicator Bacteria |
| Watsonville Slough Pathogen TMDL | Resolution No. 2006-0067 | Pathogens |
| **Region 4** | | |
| Santa Monica Bay Beaches Bacteria TMDL (Dry Weather Only) | Resolution No. 2002- 0149 | Bacteria |
| Santa Monica Bay Beaches Bacteria TMDL (Wet Weather) | Resolution No. 2003 - 0022 | Bacteria |
| Marina del Rey Back Basins Bacteria TMDL | Resolution No. 2003 - 0072 | Bacteria |
| Los Angeles Harbor Bacteria TMDL | Resolution No. 2004- 0071 | Bacteria |
| Malibu Creek Bacteria TMDL | Resolution No. 2005-0072 | Bacteria |
| McGrath Beach Coliform TMDL | Cease & Desist Order | Coliform |
| Avalon Bay Bacteria TMDL | Cease & Desist Order | Bacteria |
| Long Beach City Beaches and Los Angeles River Estuary Total Maximum Daily Loads for Indicator Bacteria | U.S. EPA Established | Indicator Bacteria |
| **Region 5** | | |
| Stockton Urban Waterbodies Pathogen TMDL | Implemented through MS4 permit | Pathogens |
| **Region 7** | | |
| New River Pathogen TMDL | Resolution No. 2002 - 0042 | Pathogens |
| Coachella Valley Stormwater Channel Bacterial Indicators TMDL | Resolution No. 2011-0030 | Bacteria Indicators |
| **Region 8** | | |
| Knickerbocker Creek Bacterial Indicators | In Development | Bacteria Indicators |
| Incorporate Bacterial Indicator TMDLs for Middle Santa Ana River Watershed Waterbodies | In Development | Bacteria Indicators |
| Bacterial Indicator TMDLs for Canyon Lake | Other Action | Bacteria Indicators |
| TMDL for Fecal Coliform in Newport Bay. | In Development | Fecal Coliform |
| **Region 9** | | |

## Exhibit 2-5: Summary of Bacteria TMDLs in California[1]

| TMDL | Status/State Board Resolution No. | Pollutant |
|---|---|---|
| Revised TMDL for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek) | Resolution No. 2010-0064 | Indicator Bacteria |
| Bacteria Impaired Waters TMDL for San Diego Bay and Dana Point Harbor Shorelines | Resolution No. 2009-0053 | Bacteria |

1. Current list as of May 2015.

# 3 Description of Proposed Policy

This section describes the February 2017 draft proposed Policy water quality objectives and implementation procedures as outlined in the draft proposed amendment to *Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California*, and to the Ocean Plan. The proposed Policy identifies the applicable waters as those of State of California with water contact recreation beneficial use (REC-1). This necessarily includes the geographies of the nine Regional Water Boards within California. Note that the February 2017 draft Policy used to develop this report is not the most current version of the Policy—some elements of the language used below and taken from the February 2017 draft have been updated in the final proposed Policy. However, all changes are consistent with the analysis herein.

## 3.1 Water Quality Objectives

The proposed Policy would establish water quality objectives for bacteria to support water contact recreation beneficial uses (REC-1). The objectives supersede all existing numeric bacteria objectives to the extent a conflict exists, unless the proposed Policy expressively provide that those conflicting objectives shall remain in effect.

Water quality objectives are expressed as a geometric mean and a statistical threshold value (STV). The geometric mean is defined as the $n^{th}$ root of the product of n numbers. The STV approximates the 90th percentile of the water quality distribution of a bacterial population that should not be exceeded by more than 10 percent of the samples taken.

### 3.1.1 Inland Surface Waters

The State Water Board has proposed to establish *E. coli* as the sole indicator organism for bacteria in freshwaters[2], including for Lake Tahoe where site specific objectives are established. Enterococci is the sole indicator for estuarine inland surface waters. The proposed Policy also proposes to establish U.S. EPA's estimated illness rate of 32 per 1,000 primary contact recreators to protect public health.

**Exhibit 3-1: Freshwater Bacteria Objectives**

| Applicable Waters | Indicator Parameter | Geometric Mean[1] (cfu/100 mL) | STV[2] (cfu/100 mL) |
|---|---|---|---|
| All waters where the salinity is less than 10 ppth 95 percent or more of the time except Lake Tahoe | *E. coli* | 100 | 320 |
| Lake Tahoe | *E. coli* | 17 | 55 |
| All waters where the salinity is equal to or greater than 10 ppth 95 percent or more of the time | Enterococci | 30 | 110 |

[2] Freshwaters are defined as those where salinity is less than 10 parts per thousand (ppth) 95 percent or more of the time.

1. Based on a 6-week rolling geometric mean, calculated weekly.
2. Calculated monthly

### 3.1.2 Ocean Waters

The State Water Board has proposed to establish enterococci as the sole indicator organism for bacteria in ocean waters. The proposed Policy also proposes to establish U.S. EPA's estimated illness rate of 32 per 1,000 primary contact recreators to protect public health.

**Exhibit 3-2: Marine Bacteria Objectives**

| Applicable Waters | Indicator Parameter | Geometric Mean[1] (cfu/100 mL) | STV[2] (cfu/100 mL) |
|---|---|---|---|
| Ocean Waters | Enterococci | 30 | 110 |

1. Based on a 6-week rolling geometric mean, calculated weekly.
2. Calculated monthly

## 3.2 Implementation Procedures

The State Water Board is considering adopting procedures for implementing the objectives, including general procedures for all inland surface waters, enclosed bays, estuaries, and ocean waters. The implementation options would not immediately supersede the implementation plans of any existing bacteria TMDL; however, Regional Water Boards may update existing TMDLs to align with the proposed standards as time and resources permit.

Under the proposed Policy, two options are provided which allow permittees to address natural sources of bacteria in the context of a TMDL. These include a Reference System/Antidegradation Approach and a Natural Source Exclusion Approach. These allow dischargers to address and account for natural sources of bacteria, rather than to treat their discharges more than necessary. In addition, the Policy allows for temporary suspension of REC-1 objectives during specific conditions (i.e., high flows in freshwater waterbodies) when REC-1 uses are unsafe and, therefore, temporarily unattainable, known as a High Flow Suspension, Seasonal Suspension or to designate a waterbody as possessing a Limited Water Contact designation.

The proposed Policy also allows for the adoption of variances from the proposed water quality standards when adopted by the Regional and State Water Boards and approved by U.S. EPA.

### 3.2.1 Water Quality-based Effluent Limitations

Wastewater point sources typically receive numeric water quality-based effluent limitations (WQBELs) following a determination of reasonable potential (RP) to cause or contribute to an excursion above a water quality objective. In practice, permittees treating municipal wastewater or other pathogen-rich wastes are determined to possess RP as a matter of course, as bacteria are a clear pollutant of concern for these discharges.

The State Board and Regional Water Boards implement dilution credits for bacteria according to the procedures described in the Ocean Plan (for marine discharges) and in their respective Basin

Plans. Seven of the Regional Water Boards have some mixing zone provisions in their Basin Plans, and none of the Regional Water Boards specifically prohibit mixing zones.

Where a mixing zone is authorized under these policies for bacteria objectives, WQBELs are calculated by multiplying the water quality standard by the authorized dilution credit. Where dilution is not authorized, effluent limitations are calculated as end-of-pipe limitations—the WQBEL is set equal to the applicable objective.

### 3.2.2 Reference System/Antidegradation Approach and Natural Sources Exclusion Approach

The proposed Policy includes methods for accounting for natural sources of bacteria which implementing bacteria water quality standards in a TMDL addressing municipal storm water and nonpoint source discharges (other than on-site wastewater treatment system discharges). Regional Water Boards may account for natural sources of bacteria by developing TMDLs that utilize two alternative approaches: a Reference System/Antidegradation Approach or a Natural Sources Exclusion approach.

In the context of TMDL development to attain bacteria water quality objectives, the Reference System/Antidegradation Approach has two implementation goals:

1. Bacteriological water quality is at least as good as that of a natural reference system, and
2. No degradation of existing water quality is allowed, where it is better than the natural system.

Under this approach, the exceedance frequency of the bacteria objective's STV may be tailored to match the exceedance frequency in a selected reference system or the targeted waterbody, whichever is less.

The Natural Source Exclusion Approach requires the control of all anthropogenic sources of bacteria and the identification and quantification of natural sources of bacteria. If a TMDL utilizes the natural sources exclusion approach, all anthropogenic sources of bacteria must be identified and controlled to ensure those sources of bacteria do not cause or contribute to an exceedance of the applicable bacteria objective's STV.  A certain frequency of exceedance of the STV is permitted based on the residual exceedance frequency at a specific water body.  The residual exceedance frequency is defined based on the background level of exceedance due to natural sources.

### 3.2.3 Alternative REC-1 Beneficial Use Designations

The proposed Policy includes several alternative designations which Regional Water Boards may implement when REC-1 uses may not be appropriate or attainable at all times. These include a high flow suspension, seasonal use designations, a limited use designation, and variances from water quality standards.

#### 3.2.3.1 High Flow Suspension of the REC-1 Beneficial Use

In California, the "swimmable" goal expressed in section 101(a)(2) of the Clean Water Act is classified by the REC-1 beneficial use.  When such activities are not safe due to high water flows or high water velocity in a water body designated for REC-1 beneficial use protection, the applicable water quality objective for bacteria is not needed to attain or maintain the use.

A Regional Water Board may adopt a high flow suspension of the REC-1 beneficial use as an alternative to reclassifying a water body or segment thereof to apply a less stringent water quality objective for bacteria. The high flow suspension may reflect when waters are considered unsafe for recreational water contact activities during high flow or high-velocity conditions.

If a high flow suspension is being considered, the Regional Water Board must conduct a use attainability analysis as defined and described in 40 CFR §131.3(g) and 131.10(g), respectively, if the high flow suspension of the REC-1 beneficial use results in a less stringent water quality objective for bacteria. The Regional Water Board's adoption of a high flow suspension of the REC-1 beneficial use is subject to U.S. EPA review and approval.

#### 3.2.3.2 Seasonal Use of the Rec-1 Beneficial Use

A Regional Water Board may adopt a seasonal use of the REC-1 beneficial use as an alternative to reclassifying a water body or segment thereof to require a less stringent water quality objective for bacteria. The seasonal use of the REC-1 beneficial use may reflect low water flows or temperatures or conditions that freeze water. If a seasonal use is adopted, the water quality objective for bacteria should be adjusted to reflect the seasonal use, however, such water quality objective shall not preclude the attainment and maintenance of a more protective use in another season.

If a seasonal use alteration is being considered, the Regional Water Board must conduct a use attainability analysis as defined and described in in 40 CFR §131.3(g) and 131.10(g), respectively, if the seasonal use of the REC-1 beneficial use requires a less stringent water quality objective for bacteria. The Regional Water Board's adoption of a seasonal use of the REC-1 beneficial use is subject to U.S. EPA review and approval.

#### 3.2.3.3 Limited Water Contact Recreation (LREC-1) Designation

A Regional Water Board may designate a water body or water body segment(s) with the Limited Water Contact Recreation (LREC-1) beneficial use.

> Limited Water Contact Recreation (LREC-1): Uses of water that support limited recreational activities involving body contact with water, where the activities are predominantly limited by physical conditions such as very shallow water depth or restricted access and, as a result, body contact with water and ingestion of water is infrequent or insignificant.

The Regional Water Board must conduct a use attainability analysis as defined and described in 40 CFR §131.3(g) and 131.10(g), respectively, if the Regional Water Board wishes to replace a designated REC-1 beneficial use with the LREC-1 beneficial use and the LREC-1 beneficial use requires a less stringent water quality objective for bacteria than that applicable to the previously applicable REC-1 use.

### 3.2.4 Water Quality Standards Variances

U.S. EPA's water quality standards regulations establish an explicit regulatory framework for the adoption of a water quality standards variance. States may use a variance to implement adaptive management approaches to improve water quality (40 C.F.R. § 131.14).

Under the proposed Policy, Regional Water Boards may adopt a variance under the federal rule, which provides:

1. A variance may be adopted on a case-by-case basis, is subject to public participation requirements applicable to the revision of a water quality standard, and is subject to U.S. U.S. EPA review and approval.
2. A variance may be adopted for a permittee(s) or water body/waterbody segment(s) but only applies to the permittee(s) or water body/waterbody segment specified in the variance.
3. A variance from applicable water quality standards may be allowed in certain cases where meeting the specific water quality objective is not currently attainable. A variance from a water quality objective will be allowed for temporary non-attainment of water quality standards due to one or more of the reasons listed in 40 CFR §131.10 (use-attainability factors).
4. A variance from a water quality objective shall be for the specific pollutant(s) and time-limited. Variances are to be adopted instead of removing a designated beneficial use for a water body where such use is not now attainable but can be expected to be attainable with reasonable progress towards improving water quality. Accordingly, the underlying beneficial use and water quality objective addressed by the variance shall be retained unless the Regional Water Board adopts and U.S. EPA approves a revision to the underlying water quality standard. All other applicable water quality standards not specifically addressed by the variance remain applicable.
5. A variance, once adopted and approved by U.S. EPA, shall be the applicable water quality standard for the limited purpose of developing NPDES permit limits and requirements under section 301(b)(1)(C) of the Clean Water Act and for certifications issued under section 401 of the Clean Water Act. A variance may not be adopted if the beneficial use and water quality objective addressed in the variance can be achieved by implementing technology-based effluent limits required under section 301(b) and 306 of the Clean Water Act.

# 4 Estimated Compliance

This section contains an evaluation of attainment of the water quality objectives based on available discharge data and the potential impacts to dischargers of bacteria.

## 4.1 Incrementally Impaired Waters

In order to determine how the proposed Policy may affect the impairment status of water quality segments, the listing status of waterbodies were assessed using the proposed water quality standards for bacteria. Using surface water monitoring data retrieved from the California Environmental Data Exchange Network (CEDEN), State Water Board staff performed an analysis of the incremental impairment status of state waterbodies (SWRCB, 2017).

The procedure utilized by State Water Board staff entailed use of simplified, conservative procedure for computing six-week rolling geometric means and single sample maximums on an individual water quality segment basis. Surface water data utilized in the analysis spanned approximately 10 years and dated from October 2000 through September 2010.

Calculated geomeans and single-sample maximums were compared to the freshwater 1986 U.S. EPA REC-1 criteria and to the Ocean Plan REC-1 objectives to determine baseline 303(d) listing assignments. Although many Regional Water Boards vary in their assignment of indicator type and objectives, for the purposes of this analysis State Board Staff elected to use the 1986 criteria to simplify and clarify the analysis. In principle, the Regional Water Board REC-1 freshwater objectives maintain a consistent level of stringency with the 1986 U.S. EPA recommended criteria.

Of a total of 229 freshwater and marine waterbodies analyzed, 90 indicated possible impairments possibly justifying 303(d) list impairments. Under the Policy scenario, 91 waterbodies demonstrated possible impairments, resulting in a net incremental impairment of one waterbody.

Given 90 baseline impairments and 1 incremental impairment (i.e., ~1.1% relative to baseline), we developed an estimate of incremental impairments based on the current 2012 303(d) list. If incremental impairments result in a 1% increase in the number of impaired waterbodies, then approximately 9 net additional impaired waterbodies may be expected under the Policy scenario.

If an additional number of TMDLs are needed under the revised criteria, there may be an increase in government regulatory costs. U.S. EPA (2001b) estimates that TMDL development costs per water body typically range from under $26,000 to over $500,000[3] depending on the number of TMDLs, the level of complexity, and the extent to which impaired waters are clustered together for TMDL development.[4]

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3 Not updated from original dollar years (2000$).

4 U.S. EPA (2001) anticipates that in the future, states will increasingly adopt efficient practices when developing TMDLs, thus potentially reducing develop costs.

## 4.2 Municipal and Industrial Wastewater

The proposed Policy will only have incremental impacts on wastewater treatment facilities where existing, baseline bacteria WQBELs are less stringent than WQBELs which would be implemented under the proposed Policy. To assess these incremental impacts, Abt compared existing effluent limitations for existing non-storm water, point source permittees authorized to discharge in California (as documented in Section 2.2.1), and compared these WQBELs to limits under the Policy scenario.

Existing bacteria WQBELs under the baseline scenario vary both in terms of formulation of their limitations (i.e., in terms of the magnitude and averaging period) and in terms of the indicator parameter used. In addition, the parameter indicators utilized in baseline effluent limitations often differ from the indicator bacteria stipulated under the proposed Policy (e.g., total coliform limitations under baseline, and enterococcus limitations under the proposed Policy). Given the difficulty in making direct comparisons based on monitoring data between effluent limitation sets specified using different indicator parameter, Abt assumed that all wastewater treatment plants are currently in compliance with baseline effluent limitation. Under this assumption, baseline compliance costs of municipal and industrials NPDES dischargers are, by definition, zero. This is a conservative assumption since it biases estimates of net incremental costs of the Policy upward.

In order to allow for direct comparison with the Policy scenario, baseline and Policy WQBELs were compared based on the stringency of their design condition. For example, the proposed REC-1 objectives are designed based on an illness rate of 32 illnesses per 1,000 primary contact recreators. When baseline limitations were based on human health standards or an equivalent design illness rate, it was assumed that no incremental impact existed for the facility. Many of the baseline, existing REC-1 objectives (Exhibit 2-1) are based on the 1976 or 1986 U.S. EPA recommended criteria which were designed on the basis of an illness rate which are nominally equivalent to the illness rate on which the proposed objectives are based (i.e., 32 illnesses per 1,000 contact recreators). When the baseline illness rate was less stringent than 32 per 1,000 primary contact recreators level, it was assumed that a potential impact existed for permittees possessing limits based on the less stringent level.

In order to identify incremental impacts under the Policy, Abt reviewed all pathogen limitations currently contained in California NPDES permits, as documented in U.S. EPA's ICIS-NPDES DMR Loading Tool[5]. Abt identified plants with limitations which were established on either of the following circumstances:

- California objectives based on U.S. EPA's 1976 or 1986 REC-1 which were based on an illness rate nominally consistent with the Proposed objectives; or
- California human health objectives which are more stringent than the proposed objectives.

[5] Source: https://echo.epa.gov/tools/data-downloads/icis-npdes-dmr-and-limit-data-set; Retrieved 5/25/2017

Plants with limitations which arose from either of the preceding circumstances were assumed to possess baseline limits at least as stringent proposed objectives and, therefore, Policy compliance costs were assumed to be zero since no technological changes or substantial operational changes would be necessary.

All other facilities, which were identified as potentially possessing effluent limitations less stringent than the proposed objectives, are summarized in Exhibit 4-1. All identified facilities were municipal treatment plants discharging to marine or estuarine waters—no industrial permittees or dischargers to freshwaters were identified as having a potential incremental impact. Five randomly selected plants were assessed for incremental compliance levels under the baseline, existing limitations and under the Policy scenario (Appendix B). The representative sample frame plants represent 17% of the total number of plants with potential incremental impacts (i.e., those listed in Exhibit 4-1) and 21% of the total design capacity.

**Exhibit 4-1. NPDES Permittees Likely to Receive More Stringent Effluent Limitations Under the Proposed Policy.**

| NPDES Permit | Name | Major/Minor | Design Capacity (MGD) | Receiving Water |
|---|---|---|---|---|
| CA0037702 | EAST BAY MUD MAIN WWTP | Major | 120 | Central San Francisco Bay |
| CA0037869 | EBDA COMMON OUTFALL | Major | 107.8 | Lower San Francisco Bay |
| CA0037664 | CCSF- SOUTHEAST WATER POLLUTION CONTROL PLANT[1] | Major | 85.4 | San Francisco Bay, Islais Creek, Mission Creek |
| CA0037648 | CENTRAL CONTRA COSTA WWTF | Major | 53.8 | Suisun Bay |
| CA0038539 | WEST COUNTY AGENCY COMMON OUTFALL | Major | 41 | Central San Francisco Bay |
| CA0037621 | SUNNYVALE WATER POLLUTION CONTROL PLANT | Major | 40 | Moffett Channel, South San Francisco Bay |
| CA0048216 | WATSONVILLE WWTF | Major | 36 | Pacific Ocean, Monterey Bay Marine Sanctuary |
| CA0038369 | SOUTH BAYSIDE SYSTEM AUTHORITY WWTP | Major | 29 | Lower San Francisco Bay |
| CA0037711 | SOUTHERN MARIN WWTP | Major | 24.7 | Raccoon Strait In Central San Francisco Bay |
| CA0037613 | DUBLIN-SAN RAMON WWTF | Major | 23.9 | Lower San Francisco Bay |
| CA0038091 | BENICIA WWTP | Major | 18 | Carquinez Strait |

**Exhibit 4-1. NPDES Permittees Likely to Receive More Stringent Effluent Limitations Under the Proposed Policy.**

| NPDES Permit | Name | Major/Minor | Design Capacity (MGD) | Receiving Water |
|---|---|---|---|---|
| CA0037788 | BURLINGAME WWTP | Major | 16 | Lower San Francisco Bay |
| CA0037541 | SAN MATEO WWTF[1] | Major | 15.7 | Lower San Francisco Bay |
| CA0038130 | SOUTH SAN FRANCISCO-SAN BRUNO | Major | 13 | Lower San Francisco Bay |
| CA0038628 | CENTRAL MARIN SAN. AGENCY WWTF | Major | 10 | Central San Francisco Bay |
| CA0037532 | MILLBRAE WPCP | Major | 9 | Lower San Francisco Bay |
| CA0038008 | CITY OF LIVERMORE SEWAGE TREATMENT PLANT | Major | 8.5 | Lower San Francisco Bay |
| CA0037958 | NOVATO WWTP | Major | 7 | San Pablo Bay |
| CA0038067 | SAUSALITO-MARIN WWTP | Major | 6 | Central San Francisco Bay |
| CA0038318 | SFIA, MEL LEONG SANITARY AND INDUSTRIAL TREATMENT PLANTS | Major | 3.4 | Lower San Francisco Bay |
| CA0037753 | SD NO. 5 OF MARIN COUNTY WWTP[1] | Minor | 2.3 | Raccoon Strait In Central San Francisco Bay |
| CA0110116 | TREASURE ISLAND WWTF | Major | 2 | Central San Francisco Bay |
| CA0048151 | PISMO BEACH WWTF[1] | Major | 1.9 | Pacific Ocean |
| CA0047899 | MONTECITO SD WWTP | Major | 1.5 | Pacific Ocean |
| CA0048828 | SCOTTS VALLEY WWTP | Major | 1.5 | Pacific Ocean (Monterey Bay Nat Marine Sanctuary) |
| CA0037826 | RODEO SANITARY DISTRICT | Major | 1.14 | San Pablo Bay |
| CA0047961 | SAN SIMEON ACRES WWTF | Minor | 0.45 | Arroyo Del Padre Juan |
| CA0037427 | PARADISE COVE WWTP | Minor | 0.04 | San Francisco Bay |
| CA0037885 | PORT COSTA WWTP | Minor | 0.033 | Carquinez Strait |
| | | **Total Design Capacity =** | **679.063** | -- |

[1.] Sample frame plants (see Section 5.1). Total sample frame design capacity is 145.3 MGD.

As stated above, Abt assumed that the potentially affected regulated entities already comply with the existing regulations to avoid double counting the cost of already existing rules.  Thus, we estimated the incremental cost from the baseline irrespective of the entities' current ability to comply or not with existing regulations and policies. Effectively, this conservative assumption results in zero baseline costs for the potentially affected plants other than for monitoring.

The most recent three years of available effluent monitoring data (2014 – 2016) for bacteria indicators was then obtained from U.S. EPA's ICIS-NPDES DMR Loading Tool[6], and the ability of each sample facility to comply with the policy-scenario limitations was assessed. When a dilution credit was authorized in the existing NPDES permit, it was assumed that an equivalent credit would be authorized under the proposed Policy scenario.

Of the five permittees in the sample population under the Policy scenario, San Mateo (CA0037541) demonstrated potential non-compliance, and insufficient enterococcus data was available to evaluate the compliance for Pismo Beach WWTF (CA0048151). On this basis, Abt determined San Mateo may require additional control measures to meet the proposed bacteria objectives.

## 4.3 NPDES Stormwater

Unlike municipal and industrial point sources, California typically does not require nonpoint sources and municipal storm water dischargers to achieve numeric WQBELs.  The regulatory baseline for evaluating the potential impact of the proposed objectives includes some requirements for nonpoint sources and storm water dischargers to implement BMPs and wasteload allocations as part of TMDLs (see Section 2).

The proposed policy includes several designated use adjustments which may reduce incremental impacts for permitted storm water dischargers. For instance, the high flow adjustment will in many cases result in REC-1 standards being applicable only during low flow conditions when bacterial loading may be lower. In addition, the policy allows for consideration of natural background considerations and reference conditions when developing a new TMDL or adjusting an existing one.

[6] Source: https://echo.epa.gov/tools/data-downloads/icis-npdes-dmr-and-limit-data-set; Retrieved 5/25/2017

# 5 Compliance Methods and Costs

This section describes available methods for compliance with the objectives, and the costs of those methods.

## 5.1 Municipal and Industrial Wastewater

Several approaches can be taken to controlling discharges of bacteria in municipal and industrial wastewater treatment facilities. Disinfection processes can be upgraded or adjusted to produce the levels of bacteria inactivation necessary for compliance with the projected effluent limits based on the proposed objectives. Process optimization usually involves process analysis and process modifications. Process analysis is an investigation of the performance limiting factors of the treatment process, and is a key factor in achieving optimum treatment efficiency. Performance limiting factors for chlorination may include operator training, response to changes in wastewater quality, treatment efficiency of other individual treatment units, maintenance activities, automation, and process control testing. The cost of process analysis includes the cost of additional monitoring throughout the treatment process, and a treatment performance evaluation.

Process modifications include activities short of adding new treatment technology units (conventional or unconventional) to the treatment train. For chlorination, process modifications might include adjusting the chlorine dose, improving mixing conditions (e.g., addition of baffles to chlorine contract chamber to increase or improve contact time efficiency), increasing contact time (e.g., adding a contact basin), equalizing flow, training operators, and installing automation equipment including necessary hardware and software. Several months of adjustments may be needed to achieve a desired level of process optimization due to potential difficulties (e.g., synchronizing chlorine dose with varied levels of pollutant concentrations such as biochemical oxygen demand, total suspended solids, and flow).

In determining the necessary controls, we considered the relative magnitude of the maximum and median observed monitoring values and pathogen limitations under the proposed Policy.

### 5.1.1 Control Costs

Based on evaluation of the sample facilities, we estimated costs for process optimization and effluent monitoring for bacteria.

#### 5.1.1.1 Process Optimization

The cost of process optimization can be estimated using available estimates from the literature. For most of the facilities, the specific information regarding the chlorination process, such as chlorine dose used, volume of contact chamber, contact time, mixing conditions, type of chlorine used, or maintenance procedures is not readily available. Therefore, we assumed that, on average, facilities are operating at a minimal treatment level [e.g., 4 mg/L chlorine dose, 15 minute average contact time, poor mixing, cleaning once every two years (Metcalf and Eddy, 1991)].

We estimated that process analysis would consist of a four-week study of the facility's treatment processes, including monitoring the wastewater at different stages throughout the treatment plant, and determining the process modifications necessary.  Based on the average labor rate in California for an environmental engineer [$60 per hour, which includes employer benefits (BLS, 2005a; 2005b; 2004)], process analysis costs may be approximately $9,600 (160 hours × $60/hour).

Process modification costs may include additional chlorine and chlorine storage facilities, cleaning contact basins, installing of baffles to assist mixing in the contact basin, and increasing contact time, depending on current treatment performance.  We calculated these costs for the sample facilities based on average flows.

In modifying their chlorination process, staff estimated that facilities would increase their chlorine dose to 8 mg/L (Metcalf and Eddy, 1991).  The additional amount of chlorine needed in pounds per year equals the difference in dose, 4 mg/L (8 mg/L - 4 mg/L = 4 mg/L) times the average flow in mgd, number of days in a year (365), and a conversion factor (8.34 to convert from mg/L to lbs/million gallons).  Facilities using more than 8,000 lbs/year of chlorine would most likely use 1-ton cylinders of chlorine, and facilities using less than 8,000 lbs/year would use 150-lb cylinders of chlorine.  Storage space for the additional chlorine would also be needed.  To calculate the storage area, we estimated that a large cylinder would have an area of 150 square feet, and a small cylinder would have an area of 50 square feet, and multiplied this area by the additional number of cylinders that would need to be stored in a given time period (e.g., per week, per month, or per quarter).

As another component of modifying their chlorination process, we estimated that facilities would need to clean their contact basins twice per year, instead of once every two years.  Facilities over 20 mgd are assumed to require 6 labor hours per mgd, and facilities less than or equal to 20 mgd would require 15 labor hours per mgd.  However, based on best professional judgment, we assumed that cleaning would not take more than 400 labor hours at a time (e.g., 4 employees working full time for 2.5 weeks).  The California-specific average labor rate for a water and liquid waste treatment plant and system operator, which includes employer benefits, is $39 per hour (BLS, 2005c; 2005d; 2004).

We also estimated that modifications would include increasing chlorine contact time (CT). Facilities can increase CT by expanding the size of their contact basin.  To estimate the incremental contact basin costs, the staff assumed that the CT, based on treating the average flow, would increase from 15 minutes to 30 minutes (Metcalf and Eddy, 1991).  We assumed a length to width ratio for the contact basin of 20, a depth of 10 feet, and a freeboard of 3 feet.  The following equation calculates the additional basin volume necessary:

$$\text{Volume} = (CT_2 - CT_1) \times Q_{Avg}$$

where,

$CT_1$ = current contact time (15 min)

$CT_2$ = projected contact time (30 min)

$Q_{avg}$ = average flow (ft3/min).

The additional concrete volume need for the expanded basin is based on the dimensions of the basin (e.g., width to length ratio of 20 and depth of 10 feet), assuming a wall thickness of 1 foot.

Finally, we estimated that facilities would install baffles to improve mixing conditions. Each baffle would be spaced about every 3 feet along the length of the basin and would be 1 foot wide. We used the dimensions of the basin after the increase in contact time, minus 3 feet on the length to allow for water to flow into the next baffle channel, to calculate the surface area of the baffles. For example, a contact basin that is about 20 feet wide by 400 feet long and 10 feet deep would need about 4 baffles [(20-3)/4=4]. The surface area of one of those baffles is 3,970 square feet [(400-3)×10 = 3,970].

The estimated process modification costs include both capital and operation and maintenance (O&M) costs. Exhibit 5-1 summarizes the type of costs associated with each component, and the source of the cost estimates.

**Exhibit 5-1. Process Modification Cost Components**

| Modification | Capital ($2005)[1] | O&M ($2005)[1] | Source |
|---|---|---|---|
| Increase chlorine dose | Additional chlorine storage space: $/sq. ft. = Area$^{-0.110548}$×$163.91 | Additional chlorine: $1,700/1-ton cylinder $370/150-lb cylinder | AACE (2002); Kuehne Chemical (2002); Roberts Oxygen (2002) |
| Increase maintenance | NA | Additional labor to clean basins: $39/hour | BLS (2004; 2005c; 2005d) |
| Improve mixing | Installation of baffles in chlorination contact basin: $48/sq. ft. of baffle[2] | NA | Environetics Inc (2003) |
| Increase contact time | Additional contact basins: $460/cu. yd. of concrete | NA | RS Means (2005) |

sq. ft. = square foot
cu. yd. = cubic yard
1. Costs escalated to 2016 dollars using the Engineering News Record Construction Cost Index and the Employment Cost Index. Capital and O&M unit costs for increasing chlorine dose are escalated from 2002 dollars. Capital costs for improvements in mixing are escalated from 2003 dollars.
2. Includes installation cost equal to 30% of baffle cost.

Appendix C summarizes the process modification design values for plants in the sample population with process modifications needed to comply with the proposed Policy. Under the Policy, only one plant of the five, the San Mateo WWTP, is anticipated to require process modifications. . Exhibit 5-2 summarizes capital and optimization & maintenance (O&M) costs, on an annualized basis, for the San Mateo WWTP.

**Exhibit 5-2. Summary of Sample Annualized Process Modification Costs**

| Plant | NPDES No. | Annualized Costs ($/year; 20 years; 2016$) | |
|---|---|---|---|
| | | 3% Interest Rate | 7% Interest Rate |
| ***Proposed Policy Controls*** | | | |
| San Mateo WWTP | CA0037541 | $200,000 | $211,000 |

#### 5.1.1.2 Effluent Monitoring

The level of effort (i.e., frequency of sampling) for a given parameter is unlikely to change appreciably due to adoption of the proposed Policy. However, since only one indicator parameter must be monitored under the Policy, the overall level of effort is likely to decrease relative to baseline.

In order to estimate this effect, we selected two POTWs subject to the Ocean Plan and two POTWs discharging to inland surface waters and computed the difference in sampling effort under the two scenarios. Monitoring effort for pathogens is dependent on the type of facility and the types of limitations imposed, but is unlikely to be related to compliance feasibility or the size of the facility.

Exhibit 5-3 displays typical unit sampling costs for *E. coli*, fecal coliform, total coliform, and enterococcus. We based monitoring frequencies on bacteria monitoring requirements in existing permits, or weekly monitoring if bacteria monitoring is not currently required.

**Exhibit 5-3. Sample Monitoring Costs for *E. coli*, Fecal Coliform, and Total Coliform (2016$)**

| *E. coli* | Fecal Coliform | Total Coliform | Enterococcus | Source |
|---|---|---|---|---|
| $23 | $42 | $33* | -- | Patel (2006) |
| $59 | $52* | $52* | -- | BioVir Laboratories (2004) |
| $48 | $53 | $71 | -- | Baker (2006) |
| $29 | $29 | $29 | -- | EMSL Analytical, Inc. (2004) |
| $56* | $57* | $57* | -- | Sierra Environmental Monitoring, Inc. (2006) |
| -- | -- | -- | $53 - $80 | SWRCB (2011) |
| **$43** | **$47** | **$49** | **$67** | **Average** |

* Represent an average cost across various analytical methods.

*Pacific Ocean Permittees:* The Pismo Beach WWTF (CA0048151) monitors for total coliform 1/week and fecal coliform 5/week, resulting in an estimated total annual monitoring cost of $14,700 for pathogens under baseline. Under the proposed policy, we assumed weekly monitoring for enterococcus which results in an annual estimate cost of $3,500. The Avalon WWTP (CA0054372) monitors for total coliform 1/week, fecal coliform 1/week, and enterococcus 1/month; resulting in an estimated annual monitoring cost of $5,800. Under policy, this cost drops to approximately $3,500 assuming 1/week enterococcus monitoring.

*Inland Surface Water Permittees:* The Chester WWTP (CA0077747) monitors total coliform organisms 1/week, resulting in an estimated baseline, annual monitoring cost of $2,500. Assuming 1/week monitoring for *E. coli* under the proposed policy, annual costs are $2,300. The Redway WWTF (CA0022781) monitors total coliform bacteria 1/week under the baseline scenario, resulting in an annual cost of $2,500. Assuming 1/week monitoring for *E. coli* under the proposed policy, annual costs are $2,300.

Based on this sample, the average anticipated cost savings for municipal wastewater treatment plants for bacteria monitoring is anticipated to be approximately $3,500 per year (Exhibit 5-4).

Extrapolating this to the total population of sanitary sewage works (i.e., 224 POTWs + federally-owned plants treating domestic wastewater), the incremental savings associated with monitoring costs is estimated at approximately $789,000 per year (note that presented sample costs are rounded and all calculations were performed with exact values).

**Exhibit 5-4. Average Monitoring Costs Summary**

| Permittee | Baseline Cost ($/year)[1] | Proposed Policy Cost ($/year)[1] | Net Cost ($/year)[1] |
|---|---|---|---|
| Pismo Beach WWTF | $14,700 | $3,500 | - $11,200 |
| Avalon WWTP | $5,800 | $3,500 | - $2,300 |
| Chester WWTP | $2,500 | $2,300 | - $280 |
| Redway WWTP | $2,500 | $2,300 | - $280 |
| *Average* | *$6,400* | *$2,900* | ***- $3,500*** |

1. Rounded cost values. Negative net costs indicate an anticipated cost savings under the policy relative to baseline.

Monitoring for pathogens is less common at industrial facilities than at POTWs; however, it is anticipated that the policy would produce a similar reduction in monitoring effort for plants possessing bacteria limitations. Due to a greater variability in monitoring levels at industrial plants, estimating a supportable total incremental monitoring cost for industrial plants is not feasible at this time. Therefore, this analysis conservatively assumes a that the incremental impact associated with industrial point source monitoring is zero.

## 5.2 NPDES Stormwater

Under the Policy, storm water permittees would have broadly similar requirements as compared to the baseline scenario. While general pollution prevention and minimization is required under existing NPDES permits, programs specifically targeting bacteria are not a baseline requirement unless an implementation plan for a TMDL requires one. As shown in Section 2.2.2 and Appendix A, many of the existing MS4s are required to implement control programs designed to control pollutants of concern within their discharge, including bacteria, and some dischargers possess specific numeric action levels for bacteria more stringent than the proposed objectives.

Sufficient data to perform an incremental compliance cost analysis is not available at this time for NPDES storm water permittees. The variety of receiving waters, discharge conditions, and the highly site-specific nature of storm water controls preclude the calculation of control costs or a quantitative assessment of incremental impacts due to the proposed policy. However, it is likely that, due to the implementation procedures contained in the proposed policy, it is possible incremental costs will be relatively low.

The proposed policy includes several designated use adjustments which may reduce compliance costs for permitted storm water dischargers. For instance, the high flow adjustment will in many cases result in REC-1 standards being applicable only during low flow conditions when bacterial loading may be lower. In addition, the policy allows for consideration of natural background considerations and reference conditions when developing a new TMDL or adjusting an existing one. These implementation procedures could result in a decreased incremental control cost in situations where baseline load reductions exceed those required when these implementation provisions are considered.

# 6 Statewide Costs

This section provides descriptions of the methods we used to estimate incremental statewide costs associated with the proposed Policy options and results.

## 6.1 Point Sources

Statewide process modification costs were estimated by scaling the costs for the sample population to that of the set of plants identified as having potential incremental increments (see Section 4.2) under the Policy. These costs, and incremental costs associated with changes in monitoring, are presented in 2016 dollars and have been annualized over a 20-year project horizon (Exhibit 6-1).

**Exhibit 6-1. Statewide Policy Compliance Costs (2016$)**

| Scenario | Annualized Costs ($/year; 20 years) | |
|---|---|---|
| | 3% Interest Rate | 7% Interest Rate |
| Disinfection Modification Costs | $935,000 | $988,000 |
| Monitoring Costs | - $789,000 | - $789,000 |
| Total Net Costs | $146,000 | $199,000 |

Statewide disinfection process modification costs were developed based on an extrapolation of the sample frame costs to the total population of potentially affected facilities, as discussed in Section 4.2, and as follows:

$$Total\ Cost = Total\ Sample\ Cost\ x\ \frac{Total\ Impacted\ Plants\ Design\ Capacity}{Total\ Sample\ Plants\ Design\ Capacity}$$

Where, the design capacity ratio is equal to 679 MGD / 145.3 MGD, or 4.67.

The average anticipated cost savings for municipal wastewater treatment plants for bacteria monitoring is anticipated to be approximately $3,500 per year per facility on average. Extrapolating this to the total population of sanitary sewage works (i.e., POTWs + federally-owned plants treating domestic wastewater), the incremental savings associated with monitoring costs is estimated at approximately $789,000 per year.

Monitoring for pathogens is less common at industrial facilities than at POTWs; however, it is anticipated that the policy would produce a similar reduction in monitoring effort for plants possessing bacteria limitations. Due to a greater variability in monitoring levels at industrial plants, estimating a supportable total incremental monitoring cost for industrial plants is not feasible at this time. Therefore, this analysis conservatively assumes a that the incremental impact associated with industrial point source monitoring is zero.

## 6.2 Nonpoint Sources

Costs for compliance with baseline criteria include costs to regulated stormwater sources and other nonpoint sources associated with implementation of existing programs and TMDLs.

Incremental costs associated with compliance with the potential revised criteria represent the costs of any actions or controls above and beyond those needed to meet baseline requirements. Abt did not estimate incremental costs for nonpoint sources for this analysis; however, if nonpoint sources are the primary source of the pollutants of concern, control of nonpoint sources could result in less stringent limitations and lower costs than estimated for point sources. For situations in which controls beyond those required under the baseline are necessary, controls could include the development and implementation of TMDLs.

## 6.3 Limitations and Uncertainties

There are a number of uncertainties and limitations associated with the data and methods we used to estimate the potential incremental costs of the proposed Policy. Exhibit 6-2 provides a summary of these uncertainties and the potential impact on the cost estimates.

**Exhibit 6-2: Summary of Limitations and Uncertainties of the Analysis**

| Assumption/Uncertainty | Potential Impact on Costs | Explanation |
|---|---|---|
| Assumed weekly monitoring under the policy scenario—Regional Water Boards could elect to require monitoring at greater frequencies. | + | Regional Water Boards have discretion when establishing level of effort associated with monitoring. While weekly monitoring for pathogens is common in California, some permittees will be assigned monitoring frequencies which vary from this level. |
| Compliance control costs for storm water not estimated | ? | If additional controls are required for some dischargers, costs could increase. However, the Policy includes several mechanisms for adjusting the beneficial uses of the waterbody and accounting for natural/background levels of bacteria and reduce the level of control required. |
| Key:<br>"+" = potential costs likely overestimated<br>"-" = potential costs likely underestimated<br>"?" = impact on cost unknown | | |

# 7 References


American Association of Cost Engineers (AACE). 2002. International Parametric Cost Estimating Model for Buildings. Online at http://www.aacei.org/technical/costmodels/BuildingModel.shtml#MODEL

Baker, Mark. 2006. CRG Marine Laboratories. Personal communication. April.

Bureau of Labor Statistics (BLS). 2005a. Table 5. Wages and Salaries (not seasonally adjusted): Employment Cost Index for wages and salaries, civilian and State and local government workers, by industry and occupational group, Civilian workers. Online at http://www.bls.gov/news.release/eci.t05.htm.

Bureau of Labor Statistics (BLS). 2005b. Employer Costs for Employee Compensation. Table 2. Civilian workers, by occupational and industry group, Professional and related. Online at http://www.bls.gov/news.release/ecec.t02.htm.

Bureau of Labor Statistics (BLS). 2005c. Table 5. Wages and Salaries (not seasonally adjusted): Employment Cost Index for wages and salaries, civilian and State and local government workers, by industry and occupational group, Blue collar. Online at http://www.bls.gov/news.release/eci.t05.htm.

Bureau of Labor Statistics (BLS). 2005d. Employer Costs for Employee Compensation. Table 2. State and local government, by occupational and industry group, Professional and related. Online at http://www.bls.gov/news.release/ecec.t02.htm.

Bureau of Labor Statistics (BLS). 2004. State Occupational Employment and Wage Estimates, California. Online at http://www.bls.gov/oes/current/oes_ca.htm.

Environetics Inc. 2003. Personal communication with Mark Pannell, May 2003.

Kuehne Chemical Company. 2002. Personal communication, June 2002.

Metcalf and Eddy. 1991. Wastewater Engineering: Treatment and Reuse, 3rd Ed.

Patel, Versha. 2006. Applied Microbiological Services. Personal communication. April.

RS Means. 2005. Heavy Construction Cost Data.

Roberts Oxygen. 2002. Personal communication, June 2002.

Sierra Environmental Monitoring, Inc. 2006. Price List. Online at http://www.sem-analytical.com/pricelist.htm.

State Water Resources Control Board (SWRCB). 1999. Memorandum (undated) from Sheila Vassey to Stefan Lorenzato, entitled "Economic Considerations in TMDL Development and Basin Planning".

State Water Resources Control Board (SWRCB). 1994. Memorandum, dated January 4, 1994, from William R. Attwater, Chief Counsel, to Regional Water Board Executive Officers and Attorneys, entitled "Guidance on Consideration of Economics in the Adoption of Water Quality Objectives".

State Water Resources Control Board (SWRCB). 2015. 2012 303(d) List. Online at http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml.

State Water Resources Control Board (SWRCB). 2017. Personal communication. March.

United States Environmental Protection Agency (U.S. EPA). 2017. ICIS-NPDES Database. Data for California permittees. <https://echo.epa.gov/tools/data-downloads/icis-npdes-dmr-and-limit-data-set>

United States Environmental Protection Agency (U.S. EPA). 2001. The National Costs of the Total Maximum Daily Load Program (Draft Report). EPA 841-D-01-003. August.

# Appendix A. Phase I MS4 Permit Requirements

## Exhibit A-1: Permit Requirements and SWMP Activities Specific to Bacteria for Phase I MS4s in California

| MS4 Name (NPDES No.) | Affected Water Bodies | Permit Requirements and SWMP Activities |
|---|---|---|
| Region 1 – Santa Rosa, Sonoma County NPDES: CA0025054 | Santa Rosa Creek, Laguna de Santa Rosa (Laguna), Mark West Creek, Lower Russian River | • No specific bacteria requirements in monitoring or TMDL.<br>• Permittees must develop and implement a Standard Urban Storm Water Mitigation Plan. The plan addresses erosion reduction, runoff control, and flow.<br>• Develop and implement Best Management Practices (BMP), structural and non-structural to address stormwater runoff.<br>• Develop and implement a Stormwater Management Plan (SWMP) that includes addressing illicit discharges and illicit connections as well as dumping and animal waste disposal.<br>• The Permittee must develop and implement an industrial/commercial facilities program that includes a source control BMPs, educational outreach and inspection. |
| Region 2 – San Francisco Bay Region, 77 Permittees NPDES (CAS612008) | San Francisco Bay Region Watershed, 6 Regions of Permittees | • Requires the development and implementation of municipal operations that's that ensure development and implementation of appropriate BMPs by all permittees to control and reduce non-stormwater discharges and polluted stormwater to storm drains.<br>• Require routine repair and maintenance activities of BMPs.<br>• Implement and enforce an Industrial and Commercial Site Controls program.<br>• Implement and enforce an illicit discharge detection and elimination program.<br>• Requires monitoring of pathogen indicators once a year during the summer. |
| Region 3 - City of Salinas NPDES: CA0049981 | City of Salinas, Salinas River, Old Salinas River, and Monterey Bay | • The permittees must require the use of Low Impact Development (LID) techniques on all new and redevelopment.<br>• Implement and enforce an Industrial and Commercial Site Controls program.<br>• Implement and enforce an illicit discharge detection and elimination program.<br>• Decrease impervious areas.<br>• The lower Salinas River Watershed has a TMDL for Fecal Coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a log mean of 200 MPN/100mL nor shall more than ten percent of total samples during any 30 day period exceed 40 MPN/100mL.<br>• Evaluate the effectiveness of BMPs in reduction violations of water quality standards.<br>• Require daily street sweeping of roads must be performed.<br>• Eliminate the use of fertilizer within 48-hours prior to a rain event and limits the used in general with no application occurring within five feet of pavement.<br>• Develop and implement MS4 system operations and maintenance plan.<br>• Within 12 months of the order effective date develop and submit a plan to decrease the pollutant loads including pathogen indicators.<br>• Develop and implement a commercial and industrial program.<br>• Perform dry weather screening using the Center for Watershed Protection IDDE Manual or an equivalent. |

## Exhibit A-1: Permit Requirements and SWMP Activities Specific to Bacteria for Phase I MS4s in California

| MS4 Name (NPDES No.) | Affected Water Bodies | Permit Requirements and SWMP Activities |
|---|---|---|
| Region 4 – Long Beach NPDES: CAS004003 | LA River, San Gabriel River,<br>Long Beach Harbor, and San Pedro Bay | • At the time of the issuance of the permit the Permittee receiving water was pathogen bacteria impaired.<br>• Implement pollution prevention measures and BMPs to minimize pollutants entering the stormwater including bacteria.<br>• Prohibits discharges that cause a violation of water quality standards, including contributing to the bacteria impairment.<br>• Develop and implement a Stormwater Management Plan (SWMP) that includes addressing illicit discharges and illicit connections as well as dumping and animal waste disposal.<br>• The Permittee must report progress of implementation of the SWMP annually including the progress of implementation and noncompliance.<br>• The Permittee is required to develop and implement a IDDE plan that prohibits illicit discharges, dumping or disposal or leaves, dirt or landscape materials.<br>• The Permittee must modify the SWMP to comply with waste load allocations develops and approved in pursuant to TMDLs. |
| Region 4 – LA Region, LA and 84 incorporated Cities NPDES: CAS004001 | Santa Monica Bay, Santa Clara River Watershed, Dominguez Channel and Greater Harbors Watershed management area, LA River, San Gabriel River, Los Cerritos Channel, Alamitos Bay, Middle Santa Ana River, Coverage area is 3000 square miles at time of last permit issuance. | • At the time of the issuance of the permit the Permittee receiving water had a bacteria impairment and waste load allocations (WLA). Permittees with co-mingled MS4s are jointly responsible for meeting the WLA.<br>• Permittees shall conduct a Reasonable Assurance Analysis (RAA) for each water body pollutant combination addressed by the Watershed Management Program. Permittees shall demonstrate using the RAA that the activities and control measures identified in the Watershed Control Measures will achieve applicable water quality based effluent limitations and/or receiving water limitations.<br>• The Permittee develop and implement a watershed management program that addressee TMDLs, receiving water limitations.<br>• Permittees subject to the Middle Santa Ana River Watershed Bacteria Indicator TMDL shall submit a Comprehensive Bacteria Reduction Plan (CBRP) for dry weather to the Regional Water Board Executive Office.<br>• Implement pollution prevention measures and BMPs to minimize pollutants entering the stormwater including the treatment and removal of bacteria.<br>• Prohibits discharges that cause a violation of water quality standards, including contributing to the bacteria impairment.<br>• Implement monitoring for the Dry Weather Bacteria TMDL or exceedances of bacteria receiving water limitations or water quality based effluent limitations, demonstrate through a source investigation pursuant to protocols established under California Water Code. |

**Exhibit A-1: Permit Requirements and SWMP Activities Specific to Bacteria for Phase I MS4s in California**

| MS4 Name (NPDES No.) | Affected Water Bodies | Permit Requirements and SWMP Activities |
|---|---|---|
| Region 4 – Ventura County and Incorporated Cities within NPDES: CAS004002 | Ventura River, Santa Clara River, Calleguas Creek, Malibu Creek, and Miscellaneous Ventura Coastal | • The Permittees must require the use of Low Impact Development (LID) techniques on all new and redevelopment.<br>• Implement and enforce an Industrial and Commercial Site Controls program.<br>• Implement and enforce an illicit discharge detection and elimination program.<br>• Decrease impervious areas.<br>• Implement pollution prevention measures and BMPs to minimize pollutants entering the stormwater including the treatment and removal of bacteria.<br>• At the time of the permit issuance the receiving waters had a bacteria impairment.<br>• Permittee is required to reduce bacteria contamination from septic systems.<br>• Harbor Beaches of Ventura County have a bacteria TMDL, as well as Malibu Creek and Lagoon.<br>• Bacteria targets are E.coli shall not have a geometric mean that exceeds 126/100 mg or 235/100mg in a single sample.<br>• Fecal Coliform targets are not to exceed 200/100 for the geometric mean or 400/100 for a single sample.<br>• Harbor Beaches of Ventura WLA for bacteria are from the Basin Plan.<br>• The Permittee must perform both wet and dry weather sampling for bacteria.<br>• The Permittee was required to develop and implement a Standard Urban Storm Water Mitigation Plan (SUSMP) and in it address reduction of pollutants such as bacteria.<br>• BMPs are required to treat or filter to remove bacteria sediments, nutrients, and meet the limitations set in the permit. |
| Region 5 – Cities of Citrus Heights, Elk Grove, Folsom, Galt, Rancho Cordova, Sacramento, and County of Sacramento NDPES: CAS082597 | Sacramento-San Joaquin Delta | • Develop and implement a Stormwater Quality Improvement Plan that includes joint programs that focus on target pollutant programs, monitoring programs, special studies, and regional public outreach. Additionally, each individual Permittee must include in their SQIP an illicit discharge program, commercial and industrial program, municipal operation program, planning and new development program, public outreach, washed stewardship program, and effective assessment and reporting.<br>• Implement BMPs that reduce the discharges and improve surface water quality including bacteria, to the maximum extent practicable (MEP).<br>• The monitoring program must incorporate analytical minimum levels (MLs) established under the State Board's Policy or Implementation of Toxic Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (SIP).<br>• Implement pollution prevention measures and BMPs to minimize pollutants entering the stormwater including the treatment and removal of bacteria.<br>• The Permittees must require the use of Low Impact Development (LID) techniques on all new and redevelopment. |
| Region 5 – County of Kern and City of Bakersfield (CA00883399) | Kern River, Valley Floor Waters | • Develop and implement a Stormwater Management Plan (SWMP) that includes an illicit discharge program, commercial and industrial program, municipal operation program, planning and new development program, spill prevention, illegal dumping, system inspection, site planning procedures, education and training activities, leaking sanitary sewer lines, public outreach, washed stewardship program, and effective assessment and reporting.<br>• City of Bakersfield requires that most new developments include retention basins designed to contain run-off produced by the 100-year, 24-hour storm event and capable of draining by percolation or evaporation within seven days. |

## Exhibit A-1: Permit Requirements and SWMP Activities Specific to Bacteria for Phase I MS4s in California

| MS4 Name (NPDES No.) | Affected Water Bodies | Permit Requirements and SWMP Activities |
|---|---|---|
| Region 5 – Fresno Metropolitan Flood Control District, Cities of Fresno, Clovis, County of Fresno and California State University Fresno (CAS618036) | Approximately 130 basins received 90% of the stormwater. 8 percent goes to San Joaquin River or canals. | • Develop and implement a Stormwater Management Plan (SWMP) that includes an illicit discharge program, commercial and industrial program, municipal operation program, planning and new development program, spill prevention, illegal dumping, system inspection, site planning procedures, education and training activities, leaking sanitary sewer lines, public outreach, washed stewardship program, and effective assessment and reporting.<br>• Permittee must develop and implement a Standard Urban Storm Water Mitigation Plan (SUSMP) for new and redevelopment. The plan must address BMPS that are required to reduce pollutants to the MEP. |
| Region 5 – East Contra Costa County including the Cities of Antioch, Brentwood, Oakley, Costa County NPDES: CAS083313 | Delta Waterways, Marsh Creek, San Joaquin River, Marsh Creek Reservoir, Sand Creek, Kellogg Creek | • Marsh Creek, Sand Creek, and Kellogg Creek are listed as having E. coli as a pollutant/stressor and the Order requires that the permittee implement programs to reduce the level of pollutants in stormwater discharges to the MEP.<br>• Require the development and implementation of municipal operations that's that ensure development and implementation of appropriate BMPs by all permittees to control and reduce non-stormwater discharges and polluted stormwater to storm drains.<br>• Require routine repair and maintenance activities of BMPs.<br>• The Permittees must require the use of Low Impact Development (LID) techniques on all new and redevelopment.<br>• Implement and enforce an Industrial and Commercial Site Controls program.<br>• Implement and enforce an illicit discharge detection and elimination program.<br>• Requires monitoring of pathogen indicators once a year during the summer. |
| Region 5 – City of Modesto NPDES: CAS083526 | Tuolumne River, San Joaquin River, Dry Creek | • Develop and implement a Stormwater Management Plan (SWMP) that includes an illicit discharge program, commercial and industrial program, municipal operation program, planning and new development program, spill prevention, illegal dumping, system inspection, site planning procedures, education and training activities, public outreach, and effective assessment and reporting.<br>• San Joaquin River and Dry Creek are listed as having E. coli as a pollutant/stressor and the Order requires that the permittee implement programs to reduce the level of pollutants in stormwater discharges to the MEP.<br>• Require the development and implementation of municipal operations that's that ensure development and implementation of appropriate BMPs by all permittees to control and reduce non-stormwater discharges and polluted stormwater to storm drains.<br>• Require routine repair and maintenance activities of BMPs.<br>• The Permittees must require the use of Low Impact Development (LID) techniques on all new and redevelopment.<br>• Monitoring is required to provide a baseline of waterbodies and meet needs for the Water Quality Programs. |
| Region 5 – City of Stockton and County of San Joaquin Service Area 54 NPDES: CAS083470 | Limited term renewal of 6 months | • Must comply with pathogen receiving water limitations based on public health standards. |

## Exhibit A-1: Permit Requirements and SWMP Activities Specific to Bacteria for Phase I MS4s in California

| MS4 Name (NPDES No.) | Affected Water Bodies | Permit Requirements and SWMP Activities |
|---|---|---|
| Region 5 – Stockton Port District | San Joaquin River, Tidally influenced. | • Develop and implement a Stormwater Management Plan (SWMP) that includes an illicit and illegal discharges program, commercial and industrial program, municipal operation, construction, public education and outreach, Stormwater planning and development standards, baseline monitoring, water quality based programs, retention basin studies, and BMP effectiveness studies.<br>• Implement pollution prevention measures and BMPs to minimize pollutants entering the stormwater including the treatment and removal of bacteria.<br>• Not allow bacteria concentrations to be present that exceed criteria or threaten public health. The fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, to exceed a geometric mean of 200/100 mL, nor more than ten percent of the total number of fecal coliform samples taken during any 30-day period to exceed 400/100 mL.<br>• Retention Basin monitoring must include testing for bacteria. Monitoring shall occur during at least two wet seasons and two dry seasons within a five day period. Grab samples are required. |
| Region 6 – El Dorado County, Placer County, and City of South Lake Tahoe NPDES: CAG616001 | Lake Tahoe | • Develop and implement stormwater management plan (SWMP) that includes a construction component, commercial, industrial, municipal and residential component, inspection component, IDDE, new development and redevelopment, public education, and training.<br>• The Lake Tahoe TMDL requires new development and re-development project proponents and private property retrofit efforts to first consider opportunities to infiltrate storm water runoff from impervious surfaces. At a minimum, permanent storm water infiltration facilities must be designed and constructed to infiltrate runoff generated by the 20 year, 1-hour storm, which equates to approximately one inch of runoff over all impervious surfaces during a 1-hour period. |
| Region 7 – Riverside County, incorporated Cities in Riverside County within the Whitewater River Basin NPDES: CAS617002 | Whitewater River | • Develop and implement a Whitewater River Region Storm Water Management Plan (SWMP).<br>• Meet the WLA of a log mean (Geomean) of the MPN ≤126/100 ml (based on a minimum of not less than five samples during a 30-day period), or 400 MPN/100 ml for a single sample.<br>• E.coli is listed as a pollutant of concern and pathogen indicator.<br>• The Permittee is required to perform dry weather monitoring at four locations at least twice a year for E. coli as well as other pollutants of concern. Samples gathered can be either grab or composite.<br>• The Permittee is required to perform wet weather testing at five locations at least twice a year for E.coli as well as other pollutants of concerns. Samples gathered can be either grab or composite.<br>• The permittee is required to report annually on the effectiveness of BMPs. |
| Region 8 – San Bernardino County, 17 Co-permittees NPDES: CAS618036 | Big Bear Lake, Santa Ana River basin | • The Permittee is required to perform storm drain outfall monitoring, receiving water monitoring, and dry weather monitoring which includes Bacteria testing.<br>• The Permittee is required to evaluate the effectiveness of BMPs.<br>• Permittee must implement and fully adopt ordinances that would specify control measures for known pathogen or bacterial sources such as animal wastes.<br>• Bacteria was listed as a priority pollutant of concern in the watershed based on findings from water quality monitoring efforts conducted during the previous permit term.<br>• The Permittee must require LID BMP monitoring.<br>• The highest priority of the stormwater plan is the reduction of bacterial contamination. |

## Exhibit A-1: Permit Requirements and SWMP Activities Specific to Bacteria for Phase I MS4s in California

| MS4 Name (NPDES No.) | Affected Water Bodies | Permit Requirements and SWMP Activities |
|---|---|---|
| Region 8 – County of Orange, Orange County Flood Control District and 26 incorporated Cities, NPDES: CAS618030 | San Gabriel River, Huntington Harbor and Bolsa Bay, Santa Ana River, Newport Bay, Irvine and Newport Coastal Area. | • Develop and implement a Drainage Area Management Plan (DAMP) and a Local Implementation Plan (LIP).<br>• At the time of the Permit development, the Permittee had performed or been part of studies that were attempting to ID sources of Bacteria, the studies were inconclusive.<br>• The Permittee must meet WLA as specified in the TMDL.<br>• New development and significant redevelopment must incorporate LID.<br>• By December 30, 2019 in the Newport Bay, the waste load allocation for urban runoff, agricultural runoff, and natural sources is not to exceed a monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL. Additionally, vessels are not allowed to discharge any fecal coliform.<br>• To address the bacteria problems the Permittee can currently divert dry weather flows in some areas to the sanitary sewer. |
| Region 8 – Riverside County Flood Control and Water District Santa Ana Region and 15 incorporated Cities NPDES: CAS618033 | Lake Elsinore, Canyon Cake, Santa Ana River, Cucamonga Creek, Prado Park Lake, Mill Creek | • WLA for Fecal Coliform from Urban Sources for the Dry Season (April 1st through October 31st) 35 5-sample/30-day logarithmic mean less than 180 organisms/100mL and not more than 10% of the samples exceed 36 organisms/100mL for any 30-day period.<br>• WLA for E. Coliform Urban Sources for the Dry Season (April 1st through October 31st) 36 5-sample/30-day logarithmic mean less than 113 organisms/100 mL and not more than 10% of the samples exceed 212 organisms/100mL for any 30-day period.<br>• Develop and implement a Drainage Area Management Plan (DAMP) and a Local Implementation Plan (LIP).<br>• Two TMDL monitoring stations in the Santa Ana River Reach. Permittees must comply with the numeric Bacterial Indicator targets at the monitoring locations.<br>• The Permittee must meet WLA for Bacteria Indicators.<br>• Adopted an order to reduce concentration of Bacteria Indicator in Urban Sources.<br>• Implement specific BMPs to reduce concentrations of Bacterial Indicators from Urban Sources and provide water quality improvements.<br>• Perform specific inspection criteria to identify and manage the Urban Sources most likely causing exceedances of water quality objectives for bacterial indicators.<br>• Treatment facilities must be built in locations and styles to reduce the level of bacterial indicators discharged from Urban Sources.<br>• Remain in compliance with Urban WLA for bacteria indicators.<br>• Develop and implement a comprehensive bacteria reduction plan (CBRP). |

### Exhibit A-1: Permit Requirements and SWMP Activities Specific to Bacteria for Phase I MS4s in California

| MS4 Name (NPDES No.) | Affected Water Bodies | Permit Requirements and SWMP Activities |
|---|---|---|
| Region 9 – Municipal Orange County and 13 incorporated Cities NPDES: CAS0108740 | Laguna Coastal Streams, Aliso Creek, Dana Point Coastal Streams, San Juan Creek, San Clemente Coastal Streams | • Implement specific BMPs to reduce concentrations of pollutants, including bacteria, and provide water quality improvements.<br>• Develop and implement Jurisdictional Runoff Management Plans (JRMPs) and Watershed Runoff Management Plans (WRMPs).<br>• Require BMPs for industrial sites.<br>• Meet WLA as developed in TMDL, incorporated BMPs capable of achieving the interim and final Bacteria Indicator.<br>• Conduct monitoring of Bacteria Indicators as necessary.<br>• WLA for Baby Beach:<br>- Total Coliform<br>- Dry weather 0.86 (Billion MPN/Day)<br>- Wet weather 3,254 (Billion MPN/30 Days)<br>- Fecal Coliform<br>- Dry weather 0.17 (Billion MPN/Day)<br>- Wet weather 112 (Billion MPN/30 Days)<br>- Enterococcus<br>- Dry weather 0.03 (Billion MPN/Day)<br>- Wet weather 114 (Billion MPN/30 Days)<br>• Final Bacteria Indicator Numeric Targets for Baby Beach:<br>- Total Coliform<br>- Dry weather 1000 (30-Day geo mean MPN/100mL)<br>- Dry and wet weather 10,000 (Single sample max MPN/100mL)<br>- Fecal Coliform<br>- Dry weather 200 (30-Day geo mean MPN/Day)<br>- Dry and wet weather 400 (Single sample max MPN/100mL)<br>- Enterococcus<br>- Dry weather 35 (30-Day geo mean MPN/Day)<br>- Dry and wet weather 104 (Single sample max MPN/100mL)<br>• Annually assess effectiveness of JRMP to reduce SW pollutant loadings. |

## Exhibit A-1: Permit Requirements and SWMP Activities Specific to Bacteria for Phase I MS4s in California

| MS4 Name (NPDES No.) | Affected Water Bodies | Permit Requirements and SWMP Activities |
|---|---|---|
| Region 9 – San Diego Region Cities of Murrieta, Temecula, Wildomar, County of Riverside, Riverside County Flood Control and Water Conservation District | Eleven hydrologic units in the San Diego region | • Five of the eleven hydrologic units five were listed as having bacteria impairments at the time the permit was developed.<br>• Develop and implement a Jurisdictional Regional Management Plan (JRMP) and/or a SWMP.<br>• The Permittee must examine all dry weather effluent analytical monitoring results, follow-up investigations must be conducted to identify and control, any non-prohibited discharge category(ies).<br>• The Permittee must conduct effluent monitoring.<br>• Action levels of Non-Stormwater Dry Weather:<br>-Fecal Coliform: 200 MPN/100mL based on five samples during a 30-day period. Additionally, no more than 10% of total samples may exceed 400 MPN/100mL during any 30 day period.<br>-Enterococci: 33 MPN/100mL average monthly limit. Additionally 61 MPN/100mL for instantaneous max<br>• LID BMP are implemented at Priority Development Projects w/proper sizing.<br>• Source control BMPs include prevent illicit discharges, minimize stormwater pollutants of concern, elimination irrigation.<br>• The Permittee must develop and implement a Hydromodification Management Plan (HMP).<br>• Develop and enforce an illicit discharge detection and elimination.<br>• The Permittee must annually report on the activities effectiveness and compliance as applicable based on the JRMP. |
| Region 9 – San Diego Region, 21 permittees including County of San Diego and San Diego Unified Port District | Santa Margarita River, San Luis Rey River, Carlsbad Watershed area, San Diequito River, Mission Bay, San Diego Bay, San Diego River, Tijuana River | • The Permittee is required to develop and implement a Standard Urban Runoff Management Program (SURMP)<br>• Require the LID when possible.<br>• Require the use of BMPs to prevent or reduce the discharge of pollutants into MS4s to the MEP.<br>• Develop a Jurisdictional Urban Runoff Management Program (JURMP).<br>• Develop a dry weather field screening and analytical monitoring procedures including sampling for Enterococcus, total coliform, and fecal coliform.<br>• If dry weather field screening and analytical monitoring results whereby exceedance of criteria will require follow-up investigations be conducted to identify and eliminate the source causing the exceedances.<br>• Conduct dry weather field screening and analytical monitoring. |

# Appendix B. Municipal and Industrial Discharger Estimated Compliance

The exhibits below show the analyses for each of the criteria and implementation options based on numeric WQBELs for dischargers in the sample population.

### Exhibit B-1. Estimated Compliance Under Baseline and Policy Scenarios

| Permit No./Parameters | Max. Monitoring Value (MPN/100 mL) | Baseline | | Policy | | |
|---|---|---|---|---|---|---|
| | | Limit Value (MPN/100 mL) | Limit Type | Limit Value (MPN/100 mL) | Limit Type | In Compliance? |
| **CA0037541 – San Mateo WWTF (Lower San Francisco Bay)** | | | | | | |
| Coliform, fecal general | | | | | | |
| Monthly Median | 157.1 | | | | | |
| Daily Maximum | 500 | 400 | 90th perc. | | | |
| Enterococci | | | | | | |
| Geomean | 33.3 | 35 | Geomean | 30/110 | Geomean/STV | **No** |
| **CA0037621 – Sunnyvale WPCP (Lower San Francisco Bay)** | | | | | | |
| Enterococci | | | | | | |
| Geomean | 9.89 | 35 | Geomean | 35/110 | Geomean/STV | Yes |
| **CA0037664 – CCSF Southeast WPCP (San Francisco Bay)** | | | | | | |
| Coliform, fecal general | | | | | | |
| Monthly Median | 815 | 500 | Monthly Median | | | |
| Daily Maximum | 1600 | 1100 | 90th perc. | | | |
| Enterococci | | | | | | |
| Geomean | 25 | 35 | Geomean | 35/110 | Geomean/STV | Yes |
| **CA0037753 – Sanitary District No. 5 of Marin County WWTP (Central San Francisco Bay)** | | | | | | |
| Coliform, total general | | | | | | |
| Monthly Median | 80 | | | | | |
| Daily Maximum | 110 | 10,000 | Daily Max | | | |
| Enterococci | | | | | | |

## Exhibit B-1. Estimated Compliance Under Baseline and Policy Scenarios

| Permit No./Parameters | Max. Monitoring Value (MPN/100 mL) | Baseline | | Policy | | |
|---|---|---|---|---|---|---|
| | | Limit Value (MPN/100 mL) | Limit Type | Limit Value (MPN/100 mL) | Limit Type | In Compliance? |
| Geomean | 4.2 | 35 | Geomean | 35/110 | Geomean/STV | Yes |
| **CA0048151 – Pismo Beach WWTF (Pacific Ocean)** | | | | | | |
| Enterococci | | | | | | |
| Geomean | 170 | | | 35/110 | Geomean/STV | Unknown |
| Coliform, total general | | | | | | |
| Monthly Median | 898 | 200 | Monthly Median | | | |
| Daily Maximum | 1700 | 2000 | Daily Max | | | |

## Appendix C. Municipal and Industrial Discharger Process Modification Analysis

The exhibits below show the process modification analyses for each of the plants unable to comply with WQBELs under either the baseline or Policy scenario.

### Exhibit C-1. Process Modification Design Summary

| Plant | NPDES No. | Avg. Design Flow (MGD) | Incremental $Cl_2$ Requirement (lbs/year) | Type of Cylinder | No. Cylinders | Storage Area (sq. ft) | Incremental Contact Volume (cu. ft.) | Concrete (cu. yd.) | Baffles (sq ft) |
|---|---|---|---|---|---|---|---|---|---|
| ***Proposed Policy Controls*** | | | | | | | | | |
| San Mateo WWTP | CA0037541 | 15.7 | 191,169 | 1-ton | 8 (Monthly Refills) | 1,200 | 21,861 | 125 | 4,280 |

### Exhibit C-2. Process Modification Cost Summary

| Plant | NPDES No. | Capital Costs | | | | O&M Costs | | Annualized Costs | |
|---|---|---|---|---|---|---|---|---|---|
| | | Study | Storage Area/ Tanks | Baffles | Add. Contact Basins | Basin Cleaning (per year) | Chorine Purchases (per year) | 3% Interest Rate | 7% Interest Rate |
| ***Proposed Policy Controls*** | | | | | | | | | |
| San Mateo WWTP | CA0037541 | $9,525 | $152,687 | $205,143 | $57,694 | $7,402 | $165,176 | $200,223 | $211,401 |