

San Pedro Creek and Pacifica State Beach Bacteria TMDL Best Management Practices Implementation Plan and Monitoring Plan Update

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Water Quality Control Board San Francisco Bay Region Municipal Regional
Stormwater National Pollutant Discharge Elimination System (NPDES) Permit
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Prepared by:

City of Pacifica
170 Santa Maria Avenue
Pacifica, CA 94044

County of San Mateo
400 County Center
Redwood City, CA 94063



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Introduction

This Best management Practices (BMP) implementation plan and water quality monitoring plan report update is submitted to fulfill the reporting requirements of Provision C.14 of the Municipal Region Permit (MRP).

San Pedro Creek and Pacifica State Beach, located along the Pacific Ocean in San Mateo County, California (Figure 1), are listed as impaired water bodies on the Clean Water Act (CWA) 303(d) list due to high densities of fecal indicator bacteria (FIB) (e.g., fecal coliform, total coliform, *Escherichia coli*, enterococcus) measured in water samples. High indicator bacteria densities suggest the presence of fecal contamination from wildlife (e.g., birds, deer, raccoons), humans, and/or domestic warm-blooded animals (e.g., dogs, horses). Fecal contamination from some of these sources (primarily humans) is associated with pathogens that, when present, pose potential health risks to people who ingest water from contaminated water bodies and may result in impairment of the water contact recreation (REC-1) Beneficial Use. The source of fecal contamination is critical to understanding the associated human health risk since the amount of risk varies depending on the fecal source. In most cases, human sources are associated with much higher risk than wildlife or domestic animal sources (USEPA 2012).

On November 14, 2012, the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) adopted the San Pedro Creek and at Pacifica State Beach Bacteria TMDL to address the FIB-based impairments. An amendment to the Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan; Regional Water Board 2013) establishing the TMDL was approved by the State Water Resources Control Board (State Water Board) on March 19, 2013, by the State Office of Administrative Law on June 24, 2013, and by the U.S. Environmental Protection Agency (USEPA) on August 1, 2013. The Basin Plan Amendment, which became effective on October 1, 2013, is included as Appendix A.

The San Pedro Creek and Pacifica State Beach Bacteria TMDL establishes load allocations and wasteload allocations in terms of allowable exceedances of water quality objectives for indicator bacteria in marine and freshwater measured at two compliance points. The TMDL Implementation Plan (Section 7.4.1.6 of the Basin Plan) specifies actions needed to attain the TMDL and allocations and requires that they are described in a BMP Implementation Plan. The TMDL also requires development and implementation of a bacteria water quality monitoring plan for the San Pedro Creek watershed to 1) better characterize bacteria contributions; and 2) to assess compliance with wasteload allocations. This report contains both the monitoring plan and BMP Implementation Plan. The San Pedro Creek and Pacifica State Beach Bacteria Monitoring Plan (Monitoring Plan) describes a monitoring program that will address these goals and will be implemented collaboratively by the City of Pacifica (City) and the County of San Mateo (County). The BMP Implementation Plan describes specific actions that the City and County will implement to attain the TMDL.

The introduction of this report (Section 1.0) summarizes the regulatory background, including the TMDL, and describes the environmental setting. Section 2.0 contains the BMP Implementation Plan, including existing and proposed BMPs. Section 3.0 contains the compliance and characterization Monitoring Plan, including data evaluation. Section 4.0 summarizes the tasks, schedule, and milestones that will be implemented collaboratively by the City and County to meet the TMDL. References used in this report are cited in Section 5.0.



Figure 1. San Pedro Creek watershed and Pacifica State Beach location map.

Regulatory Background

Beneficial Uses and Water Quality Objectives

The State Water Board is part of the California Environmental Protection Agency and administers water rights, water pollution control, and water quality functions for the state. It shares authority for implementation of the federal CWA and the state Porter-Cologne Act with the nine Regional Water Boards. The nine Regional Water Quality Control Boards regulate surface water and groundwater quality through development and enforcement of Water Quality Objectives (WQOs) and implementation of plans that will protect the Beneficial Uses of the State's waters. The Basin Plans designate Beneficial Uses, WQOs that ensure the protection of those uses, and programs of implementation to achieve WQOs.

The Water Quality Control Plan for Ocean Waters of California (State Water Board 2012; Ocean Plan) provides the basis for protection of the quality of ocean waters. It is implemented by the State Water

Board and the six coastal Regional Water Quality Control Boards. The Ocean Plan identifies Beneficial Uses of California's ocean waters, establishes narrative and numerical WQOs protective of those Beneficial Uses, identifies areas where discharges are prohibited, and sets forth a program of implementation to ensure that ocean water WQOs are achieved and Beneficial Uses are protected.

Several Beneficial Uses are designated for San Pedro Creek and Pacifica State Beach including water contact recreation (REC-1) and noncontact water recreation (REC-2), which are defined in the Basin Plan as:

- **REC-1:** *"Uses of water for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and uses of natural hot springs."*
- **REC-2:** *"Uses of water for recreational activities involving proximity to water, but not normally involving contact with water where water ingestion is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities."*

REC-1 use of water with fecal contamination could cause gastrointestinal and other types of illnesses if pathogens (i.e., certain viruses, bacteria, or protozoa) are present. Testing water samples for specific pathogens is generally not practical for a number of reasons (e.g., concentrations of pathogens from fecal contamination may be small but still of concern, laboratory analysis is often difficult and expensive, and the number of possible pathogens is large). Therefore, the presence of pathogens is inferred by testing for "pathogen indicator" organisms. Since the 1950's, numerous epidemiological investigations have been conducted to evaluate the relationship between illness rates and suitable pathogen or fecal indicators. The United States Environmental Protection Agency (USEPA) recommends using *E. coli* and enterococci as indicators of fecal contamination based on historical and recent epidemiological studies (USEPA 2012).

The Basin Plan (2013) Table 3-1 establishes REC-1 WQOs for fecal coliform, total coliform, and enterococci, and REC-2 WQOs for fecal coliform. Table 3-2 of the Basin Plan refers to USEPA (1986) for *E. coli* and enterococci ambient water quality criteria. The Ocean Plan (2012) establishes REC-1 WQOs for total coliform, fecal coliform, and enterococci in ocean water that are identical to California Department of Public Health (CDPH) standards and that equate to USEPA (1986) ambient water quality criteria for enterococci in marine water. Criteria listed by both agencies are based on sampling protocols where five equally-spaced samples are collected over a 30-day period and the geometric mean (GM) is calculated. A statistical threshold value (STV) is also listed. The STV is intended to be a value that should not be exceeded by more than a designated percentage of the samples used to calculate the GM, but is typically used as a single sample maximum (SSM) by regulators. Basin Plan (2013) and Ocean Plan (2012) WQOs for pathogen indicators in freshwater/estuarine water and ocean water are listed in Table 1. WQOs referenced in the TMDL are shown in bold font in Table 1.

The USEPA (1986) ambient water quality criteria for *E. coli* and enterococci were derived from epidemiological studies of bathers recreating at surface water beaches that received bacteriological contamination via treated human wastewater. The criteria distinguish between different levels of beach

usage and establish STVs corresponding to the 75th, 82nd, 90th, and 95th percentiles of the expected water quality sampling distribution. The San Pedro Creek and Pacifica State Beach Bacteria TMDL adopts the most conservative “designated bathing beach” criteria (i.e., 75th percentile STV). In 2012, USEPA published new recreational water quality criteria that supersede the 1986 recommendations. Neither the Basin Plan (2013) nor the Ocean Plan (2012) have been updated to reference or reflect the new USEPA (2012) criteria¹. The USEPA (2012) GM criteria remain similar to 1986 criteria; however, the SSM (or STV) no longer distinguishes between different levels of beach usage and is set at the updated 90th percentile STV. USEPA (2012) considers the 90th percentile protective of all primary contact recreation. USEPA (2012) also suggests a Beach Action Value (BAV) as a conservative, precautionary tool for making beach notification decisions. The BAV is not a recommended water quality criterion, but could be used as a “do not exceed” value for beach advisories. The more conservative BAV for *E. coli* in freshwater is equal to the “designated bathing beach” (75th percentile STV) criteria from USEPA (1986).

Table 1. Bacteriological objectives and criteria for water recreation in freshwater and ocean water.

	Freshwater/Estuarine				Ocean/Marine Water		
	Total Coliform	Fecal Coliform	<i>E. coli</i>	Enterococci	Total Coliform	Fecal Coliform	Enterococci
	(MPN/100ml)	(MPN/100ml)	(CFU/100ml)	(CFU/100ml)	(MPN/100ml)	(MPN/100ml)	(MPN/100ml)
REC-1							
GM	240 ^{a, f}	200 ^a	125 ^b , 126 ^d	33 ^b , 35 ^d	1,000 ^c	200 ^c	35 ^{b, c}
SSM	10,000 ^a	--	--	--	10,000 ^{c, e}	400 ^c	104 ^c
75 th PCTL (designated beach)	--	--	235 ^b	61 ^b	--	--	104 ^{b, c}
82 nd PCTL (moderate bathing use)	--	--	298 ^b	89 ^b	--	--	124 ^{b, c}
90 th PCTL (light bathing use)	--	400 ^a	406 ^b	108 ^b	--	--	276 ^{b, c}
95 th PCTL (infrequent bathing use)	--	--	576 ^b	151 ^b	--	--	500 ^{b, c}
STV	--	--	410 ^d	130 ^d	--	--	130 ^d
BAV	--	--	235 ^d	70 ^d	--	--	70 ^d
REC-2							
Mean		2,000	--	--	--	--	--
90 th PCTL		4,000	--	--	--	--	--

BAV = Beach Action Value, GM = geometric mean, PCTL = percentile, REC-1 = water contact recreation, REC-2 = noncontact water recreation, SSM = single sample maximum, STV = statistical threshold value

Bold values are the WQOs referenced in the San Pedro Creek and Pacifica State Beach TMDL

^a Basin Plan (Regional Water Board 2013)

^b USEPA (1986)

^c Ocean Plan (2012)

¹ The State Water Board is beginning a process to update WQOs based on USEPA (2012) recreational water quality criteria and provide efficient and consistent statewide implementation guidance.

^d USEPA (2012)

^e Total coliform density shall not exceed 1,000 when the fecal coliform/total coliform ratio exceeds 0.1 (Ocean Plan 2012).

^f The total coliform WQO of 240 MPN/100ml is the median, not the GM.

Total Maximum Daily Load

Section 303(d) of the federal Clean Water Act (CWA) requires states to identify waters that do not meet applicable WQOs and prioritize such waters for the purposes of developing TMDLs. Impaired water bodies and the pollutants for which they are impaired are placed on the State's CWA 303(d) list. Placement on the 303(d) list generally leads to the development of a TMDL. A TMDL is a plan and process to restore water quality in an impaired water body. TMDLs examine the water quality problems, identify sources of pollutants, and specify actions to restore water quality. TMDLs and their associated implementation plans are adopted by Regional Water Quality Control Boards as amendments to the Region's Water Quality Control Plan.

Pacifica State Beach and San Pedro Creek were added to the State's 303(d) list in 2002 due to indicator bacteria densities that exceeded REC-1 WQOs. The listings were primarily based on monitoring conducted by the County Health Department which collects (or coordinates the collection of) year-round weekly samples at the creek mouth and at the beach about 300 feet northwest of the creek mouth (Linda Mar #5). *E. coli* results from the creek mouth and enterococci results from Linda Mar #5 measured from May 1998 to May 2014 are graphed in Figure 2. A second beach station located about 1,500 feet northwest of the creek mouth (Linda Mar #6) was monitored through September 2008 and then discontinued due to budget constraints and consistently good water quality. Beach samples are analyzed for total coliform, *E. coli*, and enterococci, and creek mouth samples are analyzed for total coliform and *E. coli*. Results of the County Health Department monitoring are used to inform beach warning and closure decisions.

The Final Staff Report for the Proposed Basin Plan Amendment (Regional Water Board 2012) summarizes bacteriological data collected by the San Pedro Creek Watershed Coalition in 2006. This study, which was funded by a grant from the State Water Board (Proposition 13), confirmed *E. coli* and total coliform densities exceeding REC-1 WQOs in wet and dry season samples collected throughout the urbanized portion of the San Pedro Creek watershed (Davis and Chan 2008).

More recent sampling for *E. coli* was conducted by Regional Water Board staff at ten stations in the San Pedro Creek watershed in 2013 during two five-week periods in the wet and dry seasons. Exceedances of REC-1 *E. coli* WQOs were found in all sampled urban reaches during the dry season. However, during the wet season, *E. coli* exceedances were primarily confined to lower watershed stations (unpublished data). Grab samples for fecal coliform and *E. coli* analyses were collected in July 2013 from five stations along the main stem in compliance with the Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (MRP; Order R2-2009-0074) (SMCWPPP 2014a). In addition, the City sampled two stations along the main stem of San Pedro Creek in February and March 2014 for total coliform, *E. coli*, and enterococci. The combined results of these monitoring efforts confirmed FIB densities that exceeded REC-1 WQOs. Box plots showing the mean, median, quartiles, and variability for *E. coli* measured at stations along the creek are shown in Figure 3. Data are grouped into three categories: dry season – dry events, wet season – dry events, and storm samples (i.e., during or within 24-hours after a rain event). In general, *E. coli* results in the creek are highly variable and, based

on examination of these plots, show no major spatial or seasonal trends with the exception of stations above urban areas (see Figure 8 for station locations).

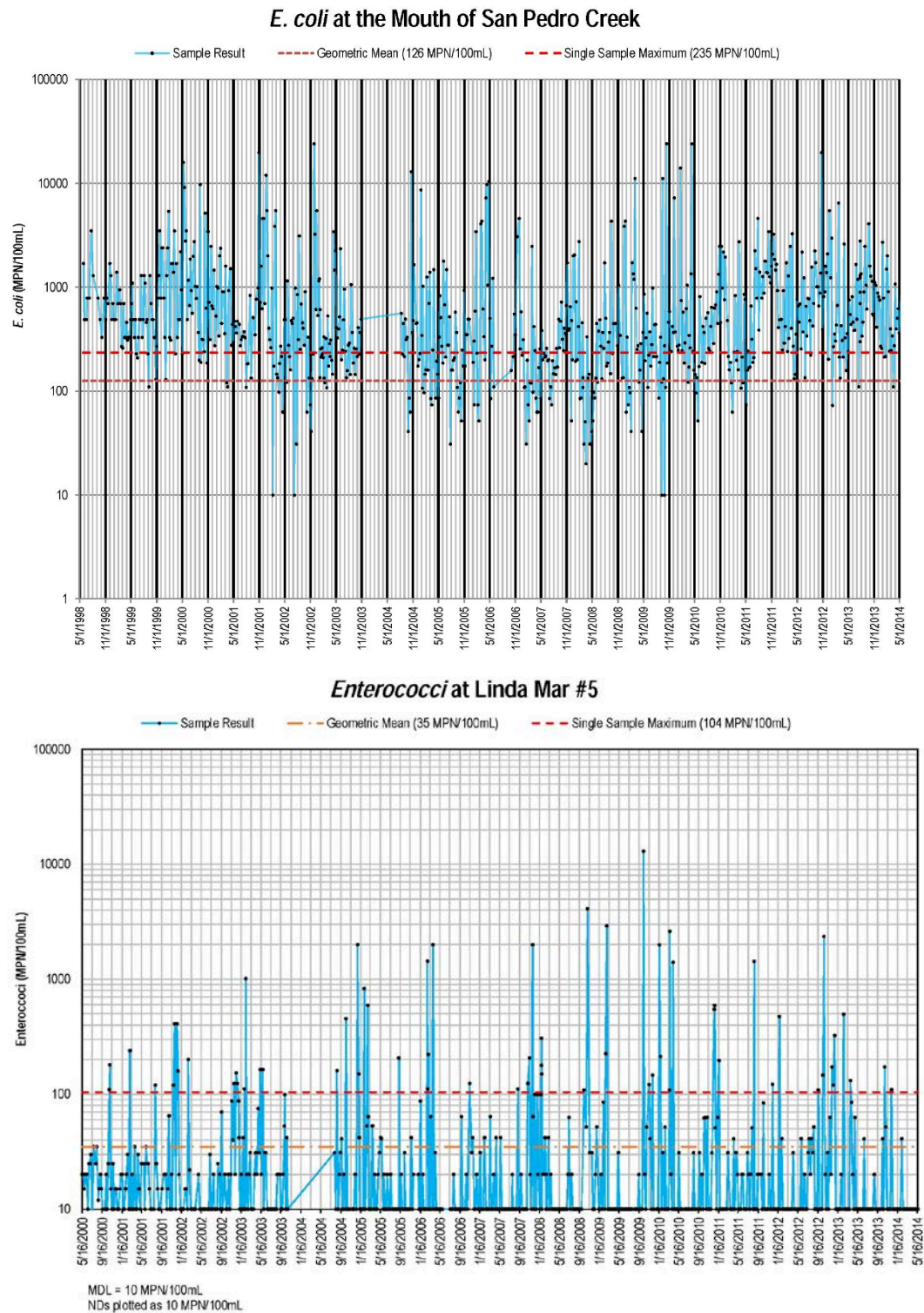


Figure 2. *E. coli* at San Pedro Creek mouth and enterococci at Linda Mar #5 reported by County Environmental Health (1998 – 2014).

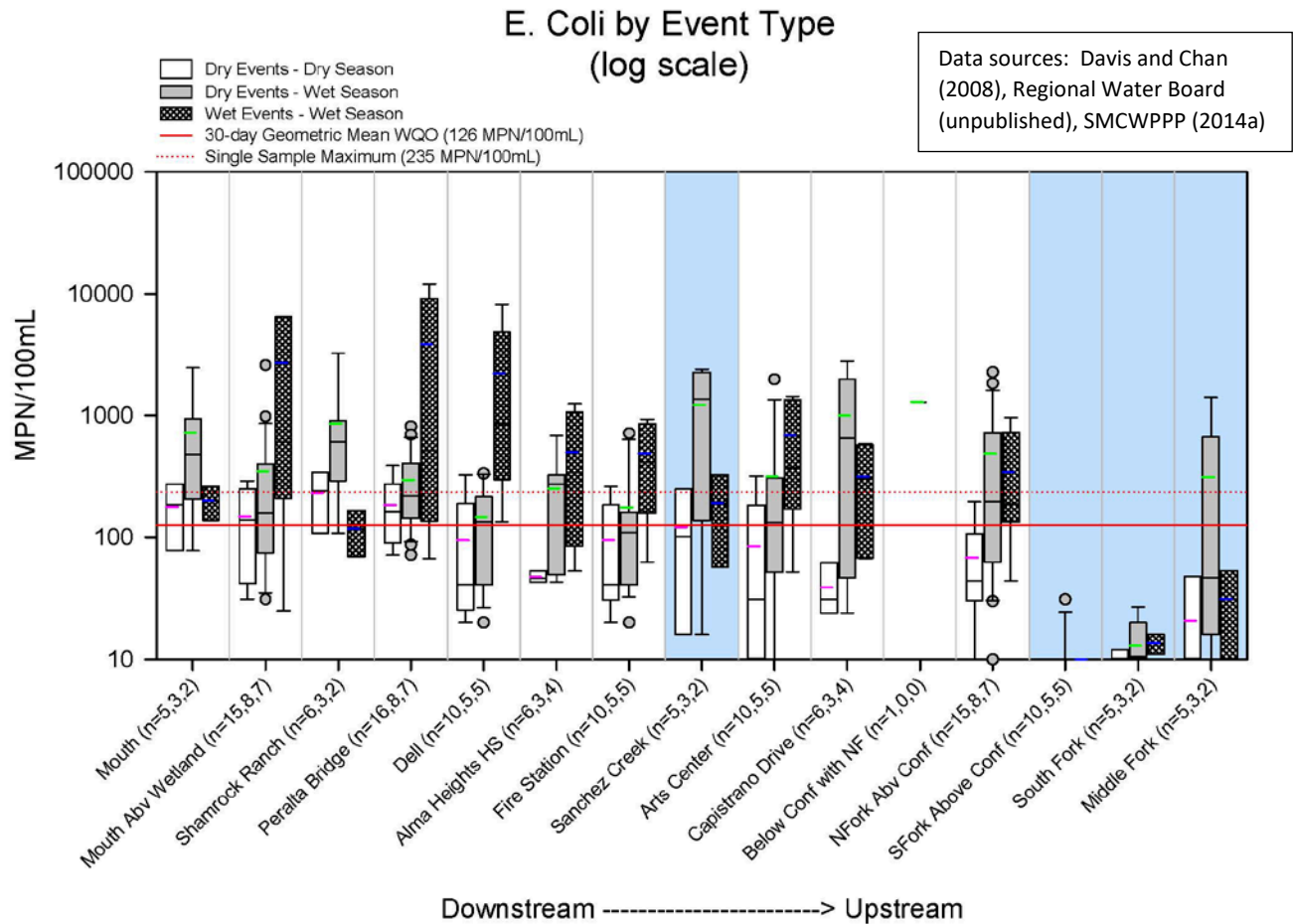


Figure 3. *E. coli* densities measured at stations along San Pedro Creek (2006 – 2013).

Bacteria Sources

The TMDL Final Staff Report includes the results of a bacteria source assessment. Controllable sources of bacteria in the watershed were identified as Pacifica's sanitary sewer system (including sanitary sewer overflows), horse facilities, and municipal stormwater runoff and dry weather flows (Regional Water Board 2012). Wildlife is identified as a non-controllable source of bacteria in the watershed. These findings are primarily based on a microbial source tracking (MST) analysis using *E. coli* DNA that was conducted by the San Pedro Creek Watershed Coalition as a central goal of their 2006 study (Davis and Chan 2008).

The results were grouped into 10 source type categories based on potential significance for pollution source management purposes. Source types in order of frequency of detection in San Pedro Creek samples were: avian (37.8%), canine (14%), suburban wildlife (mainly raccoons) (10%), rodents (9%), human (8%), wildlife (8%), unknown (6%), feline (primarily domestic cats) (4%), horse (3%), bovine (0.2%). For purposes of this TMDL BMP Implementation Plan it is assumed that the potentially controllable sources include canine, human, and horse which were associated with 25% of the detected markers. (In this discussion it is assumed that domestic cat waste is largely uncontrollable).

Of these potentially controllable sources, per the TMDL, regulatory measures are already in place or will be implemented by the Regional Water Board to address the majority of the human component (Cease and Desist Order, Consent Decree) and the horse component (Clean-Up and Abatement Order, Confined Animal Waste Discharge Requirements). Therefore the primary remaining potentially controllable source available for new control measures is canine, i.e., domestic dogs. The BMP Implementation Plan (Section 2.0) therefore focuses extensively on pet waste public education and outreach measures.

However, it needs to be noted that even if 100% of the potentially controllable “sources” (based on the number of detected markers in the samples collected for the San Pedro Creek Water Coalition Study), 75% of the “sources” are by definition uncontrollable. While it is not possible to equate these results of detectable source markers to source loadings, it does make the point that there is a very high level of background “sources” in the watershed contributing to FIB concentrations measured at the compliance stations. The perennial nature of San Pedro Creek and the extensive riparian habitat along the Creek provides a desirable environment for attracting and sustaining wildlife and avian populations. The extensive residential development throughout much of the watershed provides suitable conditions for attracting and maintaining populations of suburban wildlife and rodents.

While it can neither be proven nor disproven based on the available data, the 2006 San Pedro Creek MST study, and subsequent MST studies (summarized below), and results from the International Stormwater BMP Database (also summarized below), raise two important considerations regarding the BMP Implementation Plan. First, the primary remaining potentially controllable source that is not already being addressed by other regulatory measures, is pet (primarily dog) waste. Second, even if the three major potentially controllable sources (human, dog, horse) were eliminated over time, it is not clear that on-going contributions from uncontrollable sources would not cause or contribute to continued excursions above the REC-1 WQOs in the Creek and therefore also at the Creek mouth, given the uncertainties in and limitations of the reference approach employed by the TMDL.

More recently (and not reported in the TMDL Final Staff Report), in 2009-2010, Stanford University researchers sampled eight stations along the main stem of San Pedro Creek within the urban zone and two stations upstream of urban land uses (Sassoubre et al. 2011). Sampling was conducted in June, September, and February. MST analyses were conducted using state of the art, widely tested methods and modeling tools that were less-widely available at the time of the 2006 San Pedro Creek Watershed Coalition study. *Bacteroidales* source tracking tools using human- and horse-specific assays were applied to identify whether these species contribute fecal contamination to the creek. The human- and horse-specific markers were not detected in any samples, suggesting that other species (e.g., wildlife, avian, insects) found in the watershed were the source of fecal contamination and *Bacteroidales* in San Pedro Creek. As noted above, the 2006 MST study found that bird markers were most prevalent (i.e., detected in the greatest number of samples) (Davis and Chan 2008).

Bacteria Allocations

The TMDL for Bacteria in San Pedro Creek and at Pacifica State Beach became effective on October 1, 2013. Irrespective of MST findings that suggest low to unidentifiable contributions of human and other controllable sources to the bacteria load in San Pedro Creek, the TMDL uses a reference system approach to setting load allocations and wasteload allocations. It establishes load allocations for horse facilities and wasteload allocations for stormwater runoff and dry weather flows, expressed in terms of allowable exceedances of single-sample objectives measured at two compliance stations: Pacifica State

Beach and the mouth of San Pedro Creek. The monitoring data used to determine allowable exceedance rates were from reference systems/watersheds in Southern California: Leo Carrillo State Beach for Pacifica State Beach, and several Southern California Coastal Water Research Project (SCCWRP) freshwater system studies for San Pedro Creek. The allowable exceedance rates differ depending on season (wet or dry) and rainfall conditions. The TMDL includes WQOs for fecal indicator bacteria (i.e., *E. coli*, fecal coliform, and total coliform in freshwater and WQOs for fecal coliform, enterococcus, and total coliform in marine water). Exceedances are based on WQOs for *E. coli* and enterococci derived from the more conservative USEPA (1986) ambient water quality criteria for designated bathing beaches rather than the updated USEPA (2012) recreational water quality criteria (Table 1). WQOs referenced in the TMDL are shown in bold in Table 1. Allowable exceedances are listed in Table 2. The TMDL requires that allocations for Pacifica State Beach are attained within eight years of the TMDL effective date (i.e., October 1, 2021), and allocations for San Pedro Creek are attained within 15 years of the TMDL effective date (i.e., October 1, 2028).

It is important to acknowledge that the San Pedro Creek and Pacifica State Beach Bacteria TMDL criteria were developed for FIB and do not distinguish among sources of FIB. As noted above, it is also important to understand that FIB do not directly represent actual pathogen concentrations and that animal fecal waste is much less likely to contain pathogens of concern to humans than human fecal waste. The City of Santa Barbara in partnership with the University of California, Santa Barbara is aggressively researching and implementing actions to eliminate FIB. In a recent publication (2012), they noted the following:

Beach warnings in California are based on levels of fecal indicator bacteria, as mandated by the USEPA and State Assembly Bill AB411.....While eliminating all fecal indicator bacteria may lead to fewer beach warnings, it can be an impractical or impossible task in many locations.

Fecal indicator bacteria can come from animal sources, including wildlife, decaying plant material, and even growth on gutters, storm drain pipes, and sand grains. Indicator bacteria growing in the environment are unlikely to pose health risks to humans, and the risk associated with recreational contact with animal fecal sources in water is unknown. The USEPA reports that there has never been a documented outbreak of animal-associated illness among swimmers at marine beaches. The vast majority of fecal indicator bacteria are not themselves pathogens (microbes that cause illness), and the majority of pathogens are not indicator bacteria.

Among types of fecal contamination at coastal urban beaches, untreated human waste has the greatest potential to sicken beach goers. Most illnesses would likely cause mild-to-moderate gastrointestinal (GI) problems, but untreated waste also has the potential to transmit more harmful pathogens.

There are a number of environmental sources of bacteria that can confound FIB monitoring and source identification studies. For example, biofilms (slime layers) in storm sewers provide a safe environment for enhanced bacterial replication, supply nutrients and water for biofilm bacteria, and offer protection against microbial predators, ultraviolet light, drying, and disinfectants. Sediments in outfalls and streambeds can also be sources (reservoirs) of fecal bacteria (International Stormwater BMP Database, 2010). Diffuse and/or slug loads of fecal coliform sources (e.g., bird and wildlife sources) could be deposited in the Creek and accumulate and grow in sediments and biofilms, during low flow periods, rather than being immediately conveyed downstream. These accumulated bacterial “loads” can be

flushed out into the water column during storm or other sources of elevated flow events (e.g., irrigation runoff), potentially giving a false positive indication of a “hot spot”. This study also made the following observations about FIB concentrations and sources:

“Regardless of whether the source is natural or human-caused, fecal indicator bacteria concentrations in urban stormwater are typically well above primary contact recreation stream standards, regardless of the land use.” ... “Although some of these sources can be reasonably controlled (e.g., wastewater discharges, illicit connections), other sources are much more difficult to control such as raccoons and other animals in storm sewers, beavers, wildlife in open space areas, birds on bridges, and stream and storm sewer sediments and biofilms.”

Table 2. TMDL Allocations based on allowable exceedances of single-sample bacteria objectives for San Pedro Creek and Pacifica State Beach.

	San Pedro Creek		Pacifica State Beach		
	Dry Weather	Wet Weather ^a	Summer Dry Weather (Apr. 1 to Oct. 31)	Winter Dry Weather (Nov. 1 to Mar. 31)	Wet Weather ^a
Allowable Exceedances of Single-Sample Objectives (assuming daily sampling is conducted)	4	26	0	2	30
Allowable Exceedances of Single-Sample Objectives (assuming weekly sampling is conducted)	1	4	0	1	5

^a Wet weather is defined as any day with 0.1 inches of rain or more and the following three days.

Implementation

The TMDL Implementation Plan (Section 7.4.1.6 of the Basin Plan Amendment; Appendix A) specifies actions needed to attain the allocations (some of which are already in place) and parties responsible for each action. Actions for which requirements are already in place include: 1) reduction of sanitary sewer discharges by the measures required under an existing Cease and Desist Order issued to the City of Pacifica and the general waste discharge requirements for sanitary sewer systems; and 2) a Cleanup and Abatement Order issued to one of the three horse facilities in the watershed. New actions include requirements for horse facility owners and operators to obtain coverage under waste discharge requirements to ensure the clean operation of their facilities and new requirements for stormwater management. Actions and BMPs being implemented by the City and County are described in the BMP Implementation Plan below (Section 2.0).

Adaptive Implementation

The TMDL states that “Water Board staff will periodically, in coordination with the implementation schedule, at five, eight and 15 years, evaluate new and relevant information from implementation actions, water quality monitoring results and the scientific literature, including any local reference system studies, USEPA’s revised recommended bacteria criteria, or new or revised State bacteria water quality objectives, and assess progress toward attaining TMDL targets and load allocations, and present

that information to the Water Board. The Water Board will consider a Basin Plan amendment that reflects any necessary modifications to the targets or implementation plan.”

Monitoring

The TMDL requires development and implementation of a comprehensive bacteria water quality monitoring plan for the San Pedro Creek watershed to “1) better characterize bacteria contributions; and 2) assess compliance with the wasteload allocations.” The City and County are encouraged to collaborate on a single cooperative plan that shall be acceptable to the Executive Officer. The Basin Plan Amendment and TMDL Final Staff Report (Regional Water Board 2012) describe specific requirements for the Monitoring Plan, including guidance on station locations and frequency of sampling. As stated in the San Pedro Creek and Pacifica State Beach Bacteria TMDL:

The monitoring plan shall include applicable bacteria water quality objectives and the sampling frequency shall be adequate to assess compliance with the 30-day geometric mean objectives. Responsible parties may build upon existing monitoring program(s) for San Pedro Creek and Pacifica State Beach when developing the bacteria water quality monitoring plan. At a minimum, in addition to the existing San Mateo County sampling stations at the mouth of San Pedro Creek and at Pacifica State Beach, which will be used to evaluate achievement of the designated load and wasteload allocations, at least one sampling station shall be located in each creek reach/subwatershed, such that bacteria contributions from each of the San Pedro Creek’s forks/subwatersheds are distinguished. In addition, indicator bacteria concentrations in the stormwater and dry weather discharges from the Linda Mar and Anza pump stations shall be monitored and characterized sufficient to determine their contribution to exceedances and the effects of any corrective actions. Lastly, monitoring of some of the stormwater outfalls within the watershed may be needed to characterize and identify indicator bacteria loadings from different land uses and locations and the effects of any corrective actions. Monitoring data shall be entered into the State Water Board’s “Beach Watch” database as appropriate.

Environmental Setting

San Pedro Creek Watershed

San Pedro Creek is a perennial stream that flows westward to the Pacific Ocean through the City of Pacifica in San Mateo County, California (Figure 4). The creek drains roughly eight square miles of the western side of Montara Mountain and has five major tributaries, all of which contain perennial flows fed by springs. The North, Middle and South Forks extend into the upper reaches of the watershed. The North Fork headwaters are comprised of several steep first order streams that drain into an extensive network of underground culverts flowing through an urbanized valley. The Middle and South Fork tributaries also drain steep hillsides into a low gradient stream flowing through the upper end of San Pedro Valley; however, their subwatersheds are entirely within public open-space (e.g., San Pedro Valley County Park). The North Fork and combined Middle/South Fork drainages are roughly equal in size, about 2.4 square miles each. There are two smaller tributaries in the watershed, Sanchez Creek and an unnamed tributary flowing through Shamrock Ranch, which drain into the lower reaches of the main stem. The main stem of San Pedro Creek flows for about 2.5 miles through a broad valley floor, which is mostly developed to the banks of the creek. About one-fifth of the total watershed area is urbanized with the remainder comprised mainly of open space and recreational uses. The overall imperviousness

of the watershed is approximately 15 percent and about 64 percent of the creek channel is unmodified (STOPPP 2001 and 2002).

Runoff from urban areas within the watershed is collected in the municipal separate storm drain system (MS4) that is owned and maintained by the City. This network of drainage ditches and pipes conveys stormwater runoff and dry season flows to San Pedro Creek. Flows originating from approximately 300 acres of relatively dense residential and commercial land use in the lower watershed are conveyed to two pump stations located at Pacifica State Beach. The storm drain network and pump station locations are mapped in Figure 4; major outfall catchment boundaries delineated by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP² 2014) are shown for context. The lower watershed is characterized by high groundwater and aging infrastructure which results in year-round infiltration into and discharges from the MS4. Dry season (April through October) and winter dry weather flows from this area are pumped out of the lower San Pedro Creek watershed by the Linda Mar and Anza pump stations (Figure 4) to the City of Pacifica Calera Creek Water Recycling Plant (WWTP). Wet weather flows from this area are pumped directly to the beach at locations northeast of the mouth of San Pedro Creek.

San Pedro Creek contains the northern-most population of naturally producing steelhead trout (*Oncorhynchus mykiss*) in San Mateo County. Although degradation of physical habitat and the presence of fish barriers such as bridge culverts may threaten the steelhead population, restoration efforts are helping to reestablish and enhance habitat. For example, in 2005 the City removed a fish passage and migration barrier at Capistrano Avenue Bridge and restored approximately 1,300 linear feet of channel. The City also implemented the San Pedro Creek Flood Control Project which reconstructed a meandering channel and active floodplain in the lower 3,100-feet of San Pedro Creek. Protection of steelhead habitat is a high priority for many stakeholders and part of the reason why the Basin Plan Amendment (Section 7.4.1.3; Appendix A) stated that *“It is not the intent of this TMDL to require treatment or diversion of water bodies or to otherwise require treatment of natural sources of indicator bacteria.”*

Pacifica State Beach

San Pedro Creek drains to the Pacific Ocean at the southwest end of Pacifica State Beach. Also known as Linda Mar Beach, this wave-dominated, 0.75-mile long, crescent shaped beach is a popular surfing location. Pacifica State Beach is owned by California State Parks and managed and operated by the City. It is served by three daily-fee parking lots and a full-time beach ranger. Dogs are allowed on the beach but must be on leash. In 2006, in part to reduce litter, the City established an ordinance prohibiting smoking on the beach. Like many coastal California beaches, Pacifica State Beach has experienced beach erosion, possibly as the result of shoreline armoring. Managed retreat efforts include the San Pedro Creek Flood Control Project and removal of vulnerable structures on the beach.

A recent study was conducted to investigate entrainment of pollution from coastal discharges into the surf zone (Wong et al. 2013). Rhodamine WT dye was released into San Pedro Creek on three occasions and measured at several points inside the surf zone along the beach. Measured dye concentrations and corresponding measured and modeled concentrations of FIB (total coliform, *E. coli*, and enterococci) suggest complex mixing dynamics between creek and ocean waters, dependent on tidal stage, discharge

² SMCWPPP was formerly named the San Mateo Countywide Stormwater Pollution Prevention Program (STOPPP).

rates, and surf zone alongshore velocity, with FIB dilution increasing with distance from the creek mouth.

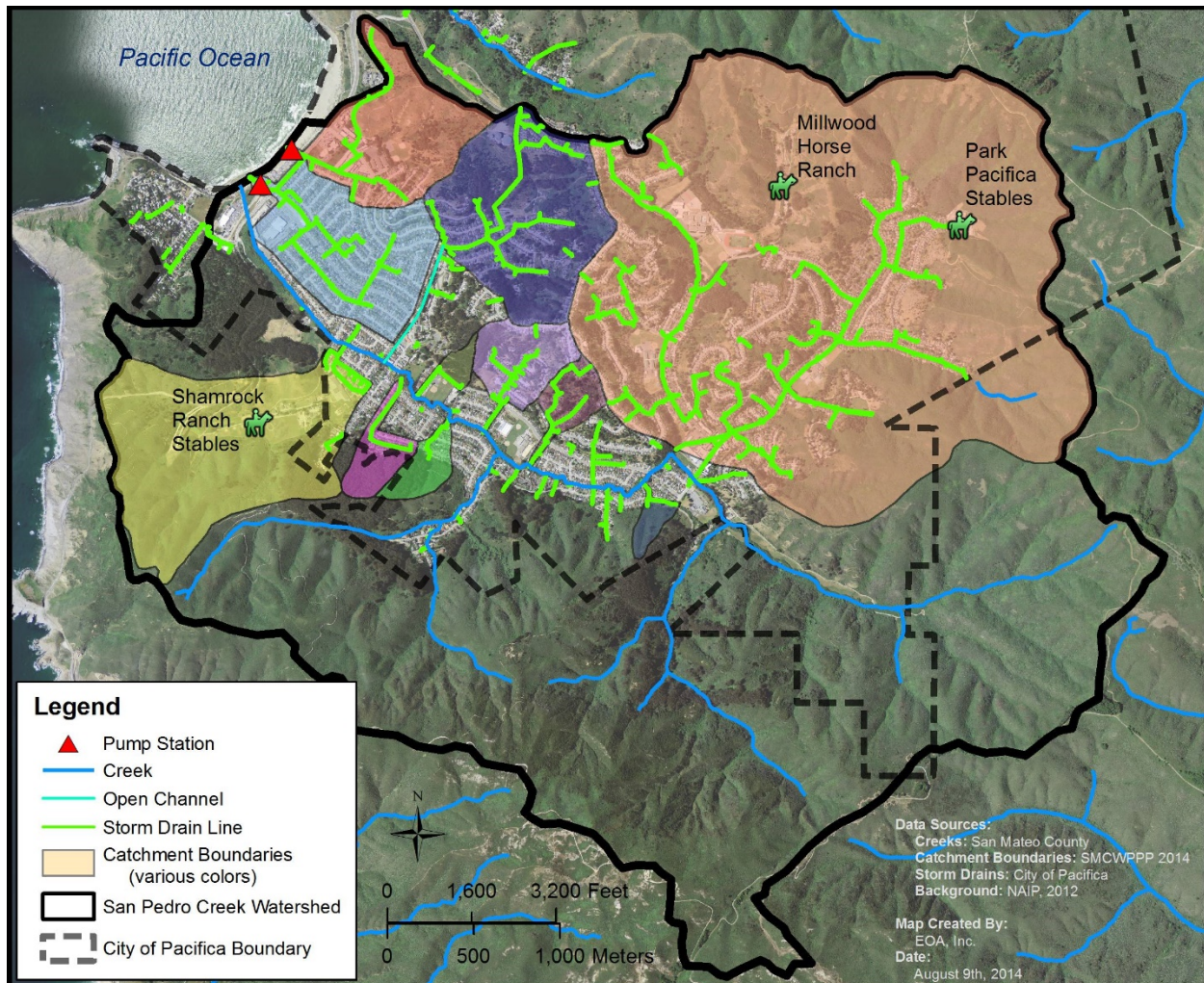


Figure 4. San Pedro Creek watershed, showing the storm drain network and pump stations.

Wasteload Allocation Attainment Assessment

As required by the MRP, a detailed assessment of wasteload allocation attainment progress is provided based on the compliance monitoring data summarized in each annual status report.

Compliance Monitoring

Beginning WY2016, Compliance Monitoring has occurred on a weekly basis at two monitoring stations. County Environmental Health performs weekly compliance monitoring on behalf of the City of Pacifica and the County at Pacifica State Beach (Linda Mar Station #5) and the mouth of San Pedro Creek (Creek Mouth). See Figure 5 for a map of sampling locations. Ocean water samples from Linda Mar beach were analyzed for total coliform, enterococci, and *E. coli* (in place of fecal coliform). Creek mouth samples were analyzed for *E. coli* and total coliform. Monitoring data from Linda Mar and the Creek Mouth is entered by County Environmental Health into the State Water Board's Beach Watch database on a weekly basis.

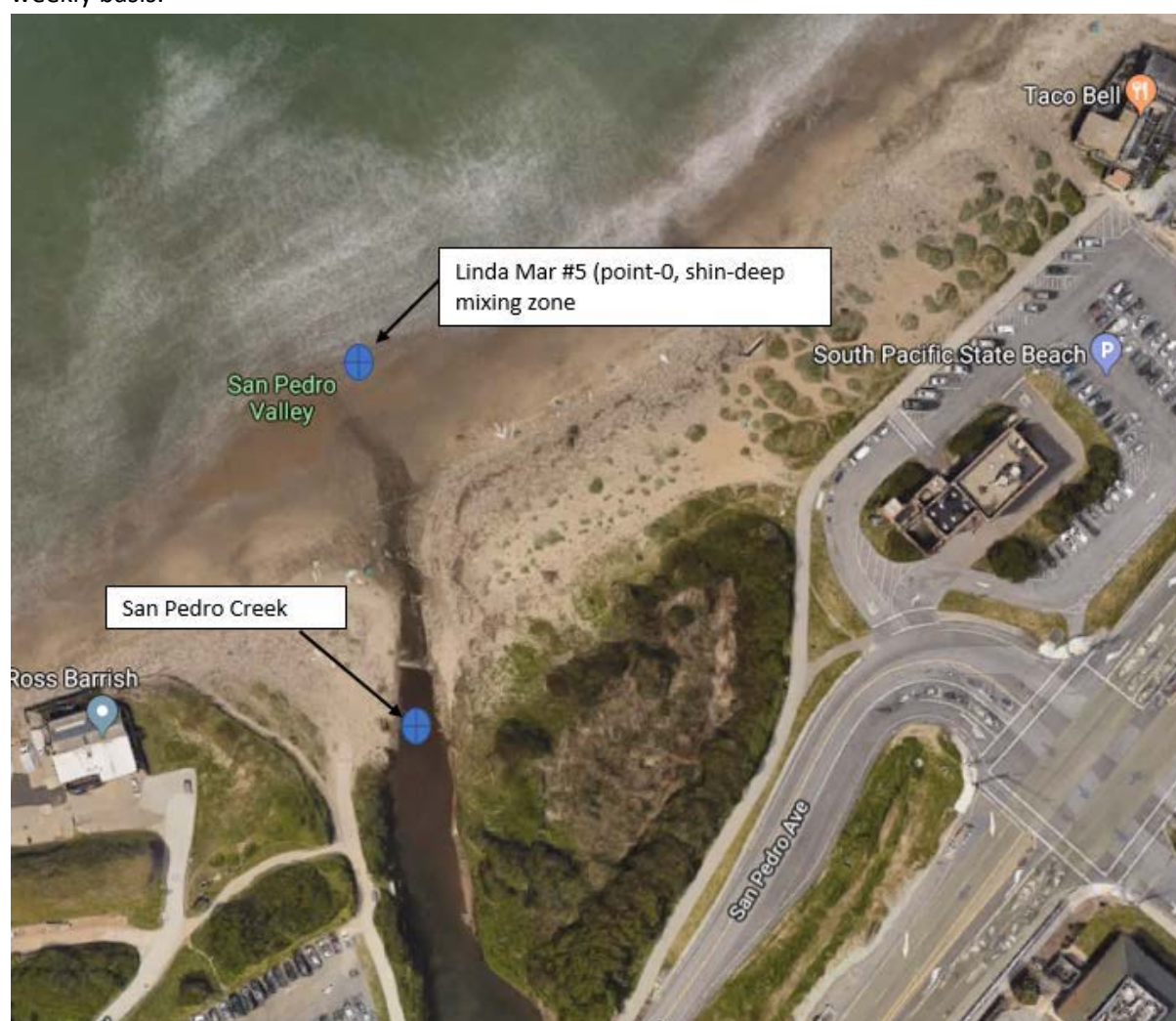


Figure 5. County Environmental Health Weekly Beach Sampling Locations

Pacifica State Beach Compliance Monitoring

As shown in the tables below, water quality samples continue to exceed water quality objectives with no trends indicating improvement of water quality at Pacifica State Beach. The October 1, 2021 deadline for attainment is unlikely to be met at this time.

Table 3: Pacifica State Beach allowable exceedances vs actual exceedances for weekly sampling, WYs 2016-2019

WY	Summer Dry Weather		Winter Dry Weather		Wet Weather	
	Allowed	Actual	Allowed	Actual	Allowed	Actual
2016	0	6	1	8	5	7
2017	0	9	1	0	5	11
2018	0	10	1	12	5	6
2019	0	10	1	5	5	7

Table 4: Pacifica State Beach percent exceedances, WYs 2016-2019

WY	% of Samples Exceeded (total samples in parenthesis)		
	Summer Dry Weather	Winter Dry Weather	Wet Weather
2016	21% (28)	57% (14)	70% (10)
2017	33% (27)	0% (9)	79% (14)
2018	36% (28)	75% (16)	86% (7)
2019	32% (31)	83% (6)	64% (11)

On average, between WY2016 and WY2019, 31% of summer dry weather samples exceeded water quality objectives, 54% of winter dry weather samples exceeded water quality objectives and 75% of wet weather samples exceed water quality objectives. The attainment goals of 0 exceedances during summer dry weather, 1 exceedance during winter dry weather and 5 exceedances during wet weather remain far below water quality sampling results.

San Pedro Creek Compliance Monitoring

Exceedances at the San Pedro Creek monitoring station also continue to be well above allowable exceedances in both wet and dry weather conditions (see table below). The attainment deadline for San Pedro Creek is October 1, 2028 which still allows time to adjust implementation of BMPs to achieve water quality objectives.

Table 5: San Pedro Creek allowable vs actual exceedances for weekly sampling, WYs 2016-2019

WY	Dry Weather		Wet Weather	
	Allowed	Actual	Allowed	Actual
2016	1	32	4	9
2017	1	26	4	12
2018	1	33	4	5
2019	1	28	4	9

Table 6: San Pedro Creek percent exceedances, WYs 2016-2019

	% of Samples Exceeded (total samples in parenthesis)	
WY	Dry Weather	Wet Weather
2016	76% (42)	90% (10)
2017	72% (36)	86% (14)
2018	73% (45)	83% (6)
2019	76% (37)	75% (12)

On average, between WY2016 and WY2019, 74% of dry weather samples exceeded water quality objectives and 84% of wet weather samples exceeded water quality objectives. The percentage of wet weather exceedances has consistently trended downward since WY2016, moving from 90% of samples exceeding water quality objectives down to 75% of samples in exceedance. While this indicates some progress, the attainment goals of 1 exceedance during dry weather and 4 exceedances during wet weather remain far below water quality sampling results.

Characterization Monitoring

Characterizing monitoring has been conducted by the San Mateo County Resource Conservation District since 2016 and has alternately focused on characterization during the wet season or dry season of each year (see table below). Characterization monitoring has been helpful in evaluating effectiveness of specific BMPs and allowing for prioritization of existing or new BMPs. Recent characterization monitoring results suggest that wildlife continues to be a prominent source of bacteria in the watershed but remains largely uncontrollable. Results also suggest a relationship between increased *E Coli*. levels and urban land use. Despite the high levels of wildlife prevalent in the watershed, controllable sources identified as human, horse, and dog waste have been detected with reasonable confidence at most monitoring locations, especially during the wet season.

Assessment Recommendations

Based on the results of compliance and characterization monitoring conducted from WY2016 to present, it is evident that BMPs currently in place are not sufficient in addressing bacterial sources and should be adjusted and/or increased in order to improve water quality. Changes based on feedback from Water Board staff and resulting from Characterization Monitoring analysis are suggested in the next section.

The responsible parties are concerned that the compliance monitoring locations (see figure X above) are located in close proximity to each other near the mouth of San Pedro Creek and, while conservative in respect to health concerns, may not accurately represent water quality at Pacifica State Beach. An alternative sampling site may allow for better mixing with ocean water and demonstrate fewer exceedances of water quality objectives. Alternatively, given the high levels of background bacteria from uncontrollable sources such as wildlife, it may also be beneficial to review waste load allocation attainment timelines or the feasibility of achieving water quality objectives at all given the number of terrestrial, marine and avian wildlife present in the watershed. A Source/Stressor Identification Study, similar to what was conducted recently for Pillar Point Harbor, may provide updated information on sources of bacteria in the watershed by using new methods and techniques to identify specific sources and locations of bacteria.

Revised Implementation Tasks

Given the lack of progress towards attainment of wasteload allocations, responsible TMDL parties propose the following updates to the BMP Implementation Plan:

Sanitary Sewer Mapping Effort

Map the age of the sanitary sewer infrastructure and understand operations and maintenance activities, including planned upgrades and integrity testing. Opportunities for improved coordination, O&M, and additional investigations will be explored. An updated map will be submitted with the TMDL Status Report by March 15, 2022.

Storm Drain Infrastructure Mapping Effort

To the extent that data are available, City will map the age of the storm drain infrastructure systems. Results of the mapping will be used to identify opportunity for additional investigations. An updated map will be submitted with the TMDL Status Report by March 15, 2022.

Video Inspection of Storm Drain System

City to video inspect the storm drain infrastructure systems. Results of the inspections will be used to identify opportunity for additional measures. Results will be submitted with the TMDL Status Report by March 15, 2021.

Homeless Encampment Clean-Up and Prevention

The City will include a description of the actions currently being done to address clean-up of homeless encampments. The issue of homelessness is complex and politically sensitive. Potential solutions are generally resource intensive and beyond the scope of stormwater programs. Clean-up activities can be dangerous to personnel due to encounters with individuals/dogs and the presence of hazardous materials. However, the City will identify opportunities to improve homeless encampment clean-up and/or prevention actions. These may include:

- coordination with other municipal departments, NGOs, and non-profits;
- Development of flyers and signage specifically targeting the homeless population

A summary of current and planned actions will be submitted with the TMDL Status Report by March 15, 2021.

Outreach to Recreational Vehicles (RVs)

The City will conduct outreach on proper disposal of greywater where RVs and trucks stay overnight. Another consideration will be development of a voucher program for the RV population for disposal of black water. A summary of current and planned actions will be submitted with the TMDL Status Report by March 15, 2021.

Pet Waste Stakeholder Group

The City will explore the possibility of establishing a new Public Pet Waste Management Stakeholder Group. Evaluation of feasibility of public workgroup will be completed by March 15, 2021

Annual Horse Facility Compliance Inspections

As described in the initial BMP Implementation Plan, the City of Pacifica will formalize an agreement with the County for annual horse facility compliance review and inspection services.

Crespi Canal Fence Repairs

City will evaluate and repair fences and gates along Crespi Canal. Repairs will be completed by March 15, 2021.

Summary Table

The table below summarizes Implementation tasks and provides a status update of existing tasks and incorporates additional proposed tasks. Changes are highlighted in red.

San Pedro Creek and Pacifica State Beach Bacteria TMDL Monitoring and BMP Implementation Plan UPDATED tasks and schedule.

Category	Implementation Task	Location	Responsible Party	Enforcement Entity	Schedule
BMP Implementation Plan (Section 2.0)					
Sanitary Sewer System	Comply with: <ul style="list-style-type: none"> RWB Cease and Desist Order No. R2-2011-0031 for the Pacifica WWTP and Collection System; and SWB Order No. 2006-0003-DWQ Statewide General Waste Discharge Requirements for Sanitary Sewer Systems 	City-wide	City	Regional Water Board	Combined SSMP Audit/SSO Report and CDO Section VIII. 23 Compliance Report submitted to RWB March 15 each year beginning 2012
	Private Sewer Lateral Ordinance Enforcement – Requires Individual Building Lateral Condition Assessment and Potential Replacement to Obtain City Approvals	City-Wide	City	City	At property transfer, significant structural remodel, addition of drain or fixture, or change in water service
	Map the age of the sanitary sewer infrastructure and understand operations and maintenance activities, including planned upgrades and integrity testing. Opportunities for improved coordination, O&M, and additional investigations will be explored.	Watershed	City	City	Updated map will be submitted with TMDL Status Report by March 15, 2022.
Storm Drainage System	To the extent that data are available, City will map the age of the storm drain infrastructure systems. Results of the mapping will be used to identify opportunity for additional investigations.	Watershed	City	City	Updated map will be submitted with TMDL Status Report by March 15, 2022.
	City to video inspect the storm drain infrastructure systems. Results of the inspections will be used to identify opportunity for additional measures.	Watershed	City	City	Results will be submitted with TMDL Status Report by March 15, 2021.

Category	Implementation Task	Location	Responsible Party	Enforcement Entity	Schedule
Homeless Encampment Clean-up/Prevention	<p>The City will include a description of the actions currently being done to address clean-up of homeless encampments. The issue of homelessness is complex and politically sensitive. Potential solutions are generally resource intensive and beyond the scope of stormwater programs. Clean-up activities can be dangerous to personnel due to encounters with individuals/dogs and the presence of hazardous materials. However, the City will identify opportunities to improve homeless encampment clean-up and/or prevention actions. These may include:</p> <ul style="list-style-type: none"> • coordination with other municipal departments, NGOs, and non-profits; • development of flyers and signage specifically targeting the homeless population 	City-Wide	City	City	Submit current and planned actions with TMDL Status Report by March 15, 2021.
Outreach to RV's	The City will conduct outreach on proper disposal of greywater where RVs and trucks stay overnight. Another consideration will be development of a voucher program for the RV population for disposal of black water.	City-Wide	City	City	Submit current and planned actions with TMDL Status Report by March 15, 2021.
Horse Facilities	Obtain coverage under and comply with Water Board's updated General Waste Discharge Requirements for Confined Animal Facilities, when Order is reissued/or the existing version, if an update to the Order is not made within two years of the effective date of the TMDL)	Millwood Ranch, Sweeney Ridge Stable, Shamrock Ranch	Existing and future horse facility owners or operators	Regional Water Board	No later than two years after the TMDL effective date (by October 1, 2015)
	Comply with the CAO for Millwood Ranch	City	Millwood Ranch Owners	Regional Water Board	As required by the CAO
	Review compliance with Pacifica's Administrative Policy on "Standards for Keeping Animals"	City	City	City	June 30, 2015
	Review compliance with Pacifica's Municipal Code on "Animal Excreta"	City	City	City	June 30, 2015
	Finalize agreement with County for annual horse facility compliance review and inspection services	City	City and County	City	March 15, 2021

Category	Implementation Task	Location	Responsible Party	Enforcement Entity	Schedule
	Annual compliance review and inspection	City	City and County	City	Annually by June 30 beginning in 2015
Horse Facilities	San Mateo County's Ordinance for Confined Animals Compliance a) Site inspection for zoning compliance by June 30 each year b) Compliance review of current manure, stormwater, and drainage management plans by June 30 each year c) Review of County Confined Animal Ordinance by April 20, 2105 d) Site inspection by June 30 each year	County	a), b), and c) County Planning and Building Department, d) County Env. Health Division	County	a) Annual inspection on-going from FY 2013-14 b) Annual review on-going from FY 2013-14 c) Reporting on Ordinance review by Sept. 15, 2015 d) Annual inspection on-going from FY 2013-14
	Elevate compliance review of Shamrock Ranch to annual schedule. a) Site inspection for zoning compliance by June 30 each year b) Compliance review of current waste, stormwater, and drainage management plans by June 30 each year c) Annual compliance review and inspection by June 30	County	a) and b) County Planning and Building Department c) County Env. Health Division	County	a) Annual inspection on-going from FY 2013-14 b) Annual review on-going from FY 2013-14 c) Annual inspection on-going from FY 2013-14
	Ensure existing and future dog kennel facilities have current operations on file with County. a) Site inspection for zoning compliance by June 30 each year b) Compliance review of current manure, stormwater, and drainage management plans by June 30 each year c) Annual compliance review and inspection by June 30 d) Update Dog Kennel/Cattery Permit Application	County	a), b), and d) County Planning and Building Department c) County Env. Health Division	County	a) Annual inspection on-going from FY 2013-14 b) Annual review on-going from FY 2013-14 c) Annual inspection on-going from FY 2013-14 d) October 31, 2014
MRP	C.3 New Development and Redevelopment. The City will continue to comply with standard C.3 requirements as qualifying projects occur.	City	City	City	On-going

Category	Implementation Task	Location	Responsible Party	Enforcement Entity	Schedule
MRP	C.10 Trash Load Reduction. Required enhanced street sweeping and additional full trash capture device installation could provide some incidental removal of large solid pieces of dog waste that reach the side of the road.	City	City	City	Being Implemented Per February 2014 Long-Term Trash Plan
TMDL-Specific BMPs	Complete Pacifica Dog Park with Engineered Bioretention Treatment Facility and Bioswales and three years of post-project upstream and downstream monitoring	City	City	City	Operational March 2012
	Install dog waste clean-up sign at Peralta Road and San Pedro Terrace Road	City	City	City	Installed Spring 2014
	Install five additional dog waste clean-up signs along San Pedro Creek	City	City	City	Complete by June 30, 2015
	Install dog waste bag dispensers and trash cans at Peralta and Pacifica Beach signs	City	City	City	Complete by June 30, 2015
	City will coordinate with civic groups to conduct quarterly visual inspections and clean-ups in high dog waste accumulation areas along San Pedro Creek	City	City	City	Complete by June 30, 2015
	City will evaluate and repair fences along Crespi Canal	City	City	N/A	Complete repairs by March 15, 2021
	City will coordinate with County to develop enhanced pet waste public outreach and education efforts. Updated efforts will focus on attempting to establish new public pet waste support group	City	City	City	Evaluate feasibility of public workgroup by March 15, 2021
	City will add a new page to the City website with information on the San Pedro Creek TMDL, WQ monitoring, and BMP implementation. City will provide similar information to local media sites.	City	City	City	Complete by June 30, 2015
	City will continue to participate in local events such as Fog Fest and Earth Day and distribute pet waste management materials	City	City	City	On-going since mid-2014
BMP Reporting	Review all measures and submit BMP Implementation Status Report	NA	City and County	--	Annually with TMDL Monitoring Results each March 15

Category	Implementation Task	Location	Responsible Party	Enforcement Entity	Schedule
	Adjust BMPs based on results of Characterization Monitoring	NA	City and County	NA	Annually with TMDL Monitoring Results each March 15
Monitoring Plan (Section 3.0)					
Compliance Monitoring	Conduct routine monitoring at compliance stations (Creek Mouth for <i>E. coli</i> , total coliform and enterococci and Linda Mar #5 for enterococci, fecal coliform, and total coliform). Monitoring conducted/coordinated weekly by County Environmental Health Department.	Watershed	City and County	NA	On-going, weekly, year-round sampling began prior to WY2015
Characterization Monitoring	In WY2016, sample 12 characterization stations for <i>E. coli</i> 10 times (Nov, Dec, Jan, Feb, Mar, May, Jun, Jul, Aug, Sep) with a focus on storm events during wet weather events (0.1" and following 3 days); sample 4 stations for Bacteroidales 4 times (2 wet season, 2 dry season). WY2018 and WY2020 monitoring details based on prior results but WY2016 represents maximum level-of-effort.	Sub-watershed-level investigations	City and County	NA	Biennial monitoring to implemented in WY2016, WY2018 and WY2020.
Monitoring Reporting	Submit on-going compliance and biennial characterization monitoring results with annual BMP Implementation Status Report. Review monitoring results for compliance, trends, and source identification. Revise characterization monitoring details and BMP Implementation Plan as needed.	NA	City and County	NA	Annually with BMP Implementation Status Report each March 15
MRP Wasteload Allocation Assessment					

Category	Implementation Task	Location	Responsible Party	Enforcement Entity	Schedule
MRP Wasteload Allocation Assessment	If wasteload allocations are not achieved by the end of a permit term, submit a plan acceptable to the Executive Officer, which describes additional BMPs or increased levels of existing BMPs that will be implemented to prevent or reduce discharges of bacteria to storm drain systems to attain wasteload allocations. The plan shall include implementation methods, and implementation schedule, and proposed milestones.	NA	City and County	Regional Water Board	<p>Formal wasteload allocation attainment evaluation and submission of formal BMP plan 180 days prior to MRP expiration date.</p> <p>Informal assessments of wasteload allocation attainment and BMP effectiveness with each March 15 report.</p>

Revised Monitoring Plan

As mentioned in the Wasteload Allocation Attainment Assessment, Compliance Monitoring and Characterization Monitoring have continued since 2016 with small adjustments made to the methodology based on feedback from Water Board staff and extenuating circumstances (weather conditions, staff availability, etc).

County Environmental Health continues to sample Compliance Monitoring stations on a weekly basis. At this time, the only change to be considered for Compliance Monitoring would be a change in the monitoring station for Pacifica State Beach to move the station further away from the creek mouth. This possibility still needs to be reviewed by County Environmental Health for feasibility as it relates to cost and volunteer time. Change in the monitoring station location will also need to be approved by Water Board staff.

Characterization Monitoring has been largely helpful in the past to help prioritize BMPs and evaluate sources of bacteria. A Source Stressor Identification Study (SSID) was suggested as a possibility in the Wasteload Allocation Attainment Assessment and would be pursued in lieu of annual Characterization Monitoring if considered helpful by Water Board staff. New identification methods and techniques in the SSID may provide a better analysis of bacterial sources. Any methodology would need to be approved by Water Board staff.

The responsible parties look to the Water Board for guidance on any additional changes to the Monitoring Plan

Appendices

April 2015 BMP Implementation Plan and Monitoring Plan