SAN PEDRO CREEK AND PACIFICA STATE BEACH FECAL INDICATOR BACTERIA TMDL STATUS AND MONITORING REPORT WATER YEAR 2018

IN COMPLIANCE WITH PROVISION C.14 OF THE MUNICIPAL REGIONAL STORMWATER PERMIT

Submitted in Accordance with State Water Resources Control Board Resolution No. 2013-0007 (Approving Basin Plan Amendment for TMDL)

March 15, 2019

Prepared by the County of San Mateo and City of Pacifica



1. Introduction

This report provides the status of the County of San Mateo and the City of Pacifica's implementation of the Total Maximum Daily Load (TMDL) for Fecal Indicator Bacteria in San Pedro Creek and at Pacifica State Beach, as required by Provision C.14 of the Municipal Stormwater Permit (Order No. R2-2015-0049).

The TMDL for Bacteria in San Pedro Creek and at Pacifica State Beach was adopted by the San Francisco Bay Regional Water Quality Control Board (RWQCB) on November 14, 2012. An amendment to the San Francisco Bay Basin Water Quality Control Plan establishing the TMDL was approved by the State Water Resources Control Board and the U.S. Environmental Protection Agency on June 24, 2013 and August 1, 2013 respectively. The Basin Plan Amendment became effective on October 1, 2013.

As part of the TMDL, the RWQCB required the County of San Mateo and the City of Pacifica to develop a Best Management Practices (BMP) implementation plan and water quality monitoring plan. The BMP Implementation Plan and Monitoring Plan were developed in 2014 and identify best management practices to address sources of impairment and to achieve water quality objectives. The plan also describes a fecal indicator bacteria monitoring plan for compliance monitoring and characterization monitoring to identify bacteria sources and to measure wasteload allocations.

This report was prepared by the County of San Mateo and City of Pacifica and provides an update on BMP implementation and water quality monitoring in San Pedro Creek and at Pacifica State Beach in Water Year 2018 (October 1, 2017-September 30, 2018).

2. Control Measures to Achieve Indicator Bacteria Wasteload Allocations

The following section details control measures implemented by the County of San Mateo (County) and by the City of Pacifica (City). The City and County may modify and/or refocus control measure implementation efforts as appropriate, at a frequency of no less than every two years.

2.1 Control Measures Implemented by the County of San Mateo

The County of San Mateo has implemented the following measures as required in Provision C.14.a.ii:

2.1.1. Sanitary Sewer System Activities

The County of San Mateo operates two restroom facilities at the San Pedro Valley County Park that discharge to the Pacifica collection system within the San Pedro Creek watershed. County Parks Ranger staff continues to conduct an annual visual inspection of the manhole near the San Pedro Valley County Park restroom for root issues that could compromise sewer line integrity. No issues were found in Water Year (WY) 2018.

The County will ensure that routine sewer line scoping is conducted every seven years. The most recent scoping was in 2015; the next scoping will occur in 2022. At that time, the County will take actions to correct any issues found and will report on the findings of the scoping in the TMDL Status and Monitoring Report.

2.1.2. Bacteria Discharges from Horse and Dog Facilities

Shamrock Ranch Kennels and Stables is the only commercial horse facility and dog kennel facility in the unincorporated County areas of the San Pedro Creek Watershed. According to County records,

Shamrock Ranch has been a permitted horse facility since the early 1970's. Inspections for horse facilities in San Mateo County are normally conducted every three years as required by the San Mateo County Confined Animal Ordinance. However, in order to comply with Provision C.14.a.ii(2) of the MRP, Shamrock Ranch horse facility has been elevated to an annual inspection schedule. The San Mateo County Kennels/Catteries Ordinance requires inspections of dog kennel facilities annually.

The County Planning and Building Department and County Environmental Health have conducted joint annual site inspections and compliance reviews of Shamrock Ranch beginning in 2014. The TMDL Implementation Plan requires annual inspections and compliance reviews by June 30 but due to conflicting schedules between the County and Shamrock Ranch operators, the 2018 inspection and compliance review occurred two weeks past the due date on July 19, 2018.

Horse Facility: On July 19, 2018, County staff found the Shamrock Ranch horse facility to be in compliance with all standards of the County's Confined Animal Ordinance and the facility's Confined Animal Permit, PLN1999-00406, including for manure management, drainage, and facility management practices.

Dog Kennel Facility: On July 19, 2018, County staff found the Shamrock Ranch dog kennel facility to be in compliance with all standards of the County's Kennels/Catteries Ordinance (San Mateo County Ordinance, Chapter 6.20.) and the facility's Kennel Permit, PLN1999-00633, including for waste management, drainage, and facility management practices. During site inspection, staff observed that all of the pens and runs were free of standing water and were kept in a clean and sanitary manner.

2.2 Control Measures Implemented by the City of Pacifica

The City of Pacifica has implemented the following measures as required in C.14.a.ii:

2.2.1. Bacteria discharges from Horse Facilities

Two commercial horse facilities are located in the City of Pacifica, including Sweeney Ridge Equestrian and Millwood Ranch. As of July 30, 2018, City staff found Sweeny Ridge Equestrian facilities to be in compliance with the City's standards for Keeping Animals including for waste management, drainage, and facility management practices. As of August 8, 2018, City staff found Millwood Ranch facilities to be in compliance with the City's standards for Keeping Animals including waste management, but compliance with the City's standards for Keeping Animals including waste management, but compliance with a number of the City's policies and codes including those related to drainages and ponds have not yet been achieved. The City has an on-going Code Enforcement action against Millwood Ranch.

2.2.2 Dog Waste Installations

The City of Pacifica installed 10 new dog waste clean-up signs, waste bag dispensers and trash cans at high priority locations within the TMDL Project Area. The high priority sites were determined via visual inspections of popular dog walking areas and their potential to discharge improperly deposited pet waste to San Pedro Creek and Pacifica State Beach. The City is in the process of installing additional pet waste station along the Highway 1 trail at Linda Mar Boulevard and at locations where San Pedro Creek crosses Linda Mar Boulevard and Oddstad Boulevard. The locations are listed on Table 1 and shown on Figure 1.

	Table 1. San Pedro Creek and Pacifica State Beach Pet Waste Stations					
#	Station ID	Station Location	Latitude	Longitude		
1	Pet Waste Station 1	Pacifica State Beach Anza Pump Station	37°35'53.63"N	122°30'7.63"W		
2	Pet Waste Station 2	Pacifica State Beach North of Taco Bell	37°35'50.28"N	122°30'11.40"W		
3	Pet Waste Station 3	Pacifica State Beach South of Taco Bell	37°35'49.65"N	122°30'13.63"W		
4	Pet Waste Station 4	Pacifica State Beach Linda Mar Pump Station	37°35'47.49"N	122°30'16.41"W		
5	Pet Waste Station 5	Pacifica State Beach San Pedro Creek	37°35'45.00"N	122°30'20.22"W		
6	Pet Waste Station 6	Highway 1 and San Pedro Creek Trail Head	37°35'35.73"N	122°30'19.43"W		
7	Pet Waste Station 7	San Pedro Creek Trail Head and Linda Mar Covelescent Home	37°35'21.52"N	122°30'6.02"W		
8	Pet Waste Station 8	Peralta Bridge	37°35'18.36"N	122°29'58.15"W		
9	Pet Waste Station 9	Sanchez Arts Center Entrance	37°35'1.25"N	122°29'12.76"W		
10	Pet Waste Station 10	Sanchez Arts Center Parking Lot	37°34'57.79"N	122°29'13.98"W		
11	Pet Waste Station 11	Linda Mar Boulevard and Highway 1 (Scheduled)	37°35'44.41"N	122°30'13.93"W		
12	Pet Waste Station 12	Linda Mar Boulevard (Proposed)	37°34'54.69"N	122°28'41.57"W		
13	Pet Waste Station 13	Oddstad Boulevard (Proposed)	37°34'53.18"N	122°28'31.94"W		



Figure 1. San Pedro Creek and Pacifica State Beach Pet Waste Stations

2.2.3. Visual Inspections

In February 2017, the City of Pacifica developed and implemented a visual inspection and cleanup plan for high dog waste accumulation areas along San Pedro Creek and its tributaries. The locations of visual inspection and cleanup areas are listed on Table 2 and shown on Figure 2. Visual inspections completed in October 2018 and January 2019 found pet waste left on two (2) of the ten (10) walking pathways.

Visual inspection log is attached as Exhibit B.

	Table 2. San Pedro Creek and Pacifica State Beach Visual Monitoring					
#	Station ID	Station Location	Latitude	Longitude		
1	Visual Monitoring 1	Pacifica State Beach Anza Pump Station	37°35'53.63"N	122°30'7.63"W		
2	Visual Monitoring 2	Pacifica State Beach North of Taco Bell	37°35'50.28"N	122°30'11.40"W		
3	Visual Monitoring 3	Pacifica State Beach South of Taco Bell	37°35'49.65"N	122°30'13.63"W		
4	Visual Monitoring 4	Pacifica State Beach Linda Mar Pump Station	37°35'47.49"N	122°30'16.41"W		
5	Visual Monitoring 5	Pacifica State Beach San Pedro Creek	37°35'45.00"N	122°30'20.22"W		
6	Visual Monitoring 6	Highway 1 and San Pedro Creek Trail Head	37°35'35.73"N	122°30'19.43"W		
7	Visual Monitoring 7	San Pedro Creek Trail Head and Linda Mar Covelescent Home	37°35'21.52"N	122°30'6.02"W		
8	Visual Monitoring 8	Peralta Bridge	37°35'18.36"N	122°29'58.15"W		
9	Visual Monitoring 9	Sanchez Arts Center Entrance	37°35'1.25"N	122°29'12.76"W		
10	Visual Monitoring 10	Sanchez Arts Center Parking Lot	37°34'57.79"N	122°29'13.98"W		



Figure 2. San Pedro Creek and Pacifica State Beach Visual Monitoring

2.2.4. Pet Waste Outreach

The City has implemented an enhanced pet waste public outreach and education campaign that includes all of the following:

Stakeholder Group

The City continued to search for animal clubs, organizations and groups in the City with no success. Due to limited resources, the City did not explore the possibility of establishing a new public pet waste management stakeholder group for this water year. The pet waste informational brochures were distributed to various City Departments for community distribution.



Figure 3. Pet Waste Poster at the Pacifica Community Center and City Hall

Public Service Announcements

The City continues to request Pacifica Coast TV to broadcast public service announcements regarding pet waste management and associated impacts to the Creek and Beach and run public service advertisements in the Pacifica Tribune. The print ads ran monthly throughout the summer and weekly throughout the winter of 2018-19.

A video copy of the TV PSA is available in the enclosed CD. Print ads are attached as Exhibit C.

Mailer

The City developed an informational brochure describing proper pet waste management, the linkage of the watershed to the Creek and Beach and the adverse impact on those water bodies and those recreating in them from improper pet waste management. In November 2018, the City mailed the brochure to approximately 4,987 addresses in the San Pedro Creek and Pacifica State Beach neighborhoods. The next round of mailers is scheduled for Fall of 2019.

Informational brochure is attached as Exhibit D.

Web Page

The City added a website with information on the TMDL and the water quality monitoring and BMP implementation activities, as well as information about proper pet waste management and the impact of improperly deposited waste on water quality of the Creek and Beach and public health. The web site has been active since December 2015. In May of 2018, we added the Scoop the Poop Pledge to the City's pet waste web page and have received many requests for the free Dog Bag Dispensers.

Photos of the City of Pacifica Dog Bag Dispensers are attached as Exhibit E.

Email Alert

The City implemented a pre-rain pet waste cleanup social media alert on Nextdoor, reminding residents to cleanup accumulated pet waste in their yards that could otherwise get washed into the Creek and Beach. Nextdoor is a social networking service for neighborhoods and allows users to connect with people who live in their own and nearby neighborhoods. Alerts were posted on March 13, 2018, April 4, 2018, May 25, 2018, September 28, 2018, November 20, 2018, January 4, 2019 and January 29, 2019. As of February 2019, there were approximately 6,500 subscribers and 10 neighborhoods in the San Pedro Creek and Pacifica State Beach Nextdoor groups. Discussions related to this topic have occurred in these groups and over 50 residents have thanked the City for the alerts.

Nextdoor can send urgent alerts and can target individual neighborhoods. Nextdoor members in those neighborhoods receive alerts via text messages, app notifications or email. Nextdoor has thousands of readily available members in the affected neighborhood(s). Screenshot of the Nextdoor post is attached as Exhibit F.

Events and Festivals

The City has participated in several annual local events and festivals such as Pacifica Eco Fest and Fog Fest since 2015 and distributed pet waste management materials such as educational fliers, dog waste bags, etc.

Eco Fest/Earth Day was held on Saturday April 21, 2018 and as always was well attended and includes a Citywide cleanup prior to the celebration. Many locations throughout the City are cleaned. The City of Pacifica distributed Pet Waste materials as well as doggy bags and dispensers.



Figure 4. City of Pacifica Booth at the 2018 Eco Fest

The Fog Fest was held on Saturday and Sunday September 29 and 30, 2018 and again was very well attended by people from all over the Bay Area. Many people want various brochures and information, and this triggers interesting discussions about how to better protect the creek, ocean and our environment. Over the weekend hundreds upon hundreds of people participate in the City's interactive storm drainage booth. The City of Pacifica distributed Pet Waste materials as well as doggy bags and dispensers.



Figure 5. City of Pacifica Table at the 2018 Fog Fest

3. Water Quality Monitoring

3.1 Requirements

Provision C.14.b of the MRP requires water quality monitoring to assess attainment of wasteload allocations. Provision C.14.c of the MRP requires water quality monitoring to characterize sources of bacteria and assess BMP effectiveness.

Compliance Monitoring

Wasteload allocation assessment monitoring (i.e., "compliance monitoring") must be conducted by the City and County at two stations (Pacifica State Beach and the mouth of San Pedro Creek) year-round on a weekly basis for fecal indicator bacteria. Samples collected at the beach (Linda Mar #5) must be monitored for enterococci, fecal coliform, and total coliform. Samples collected at the creek mouth must be analyzed for *E. coli* and total coliform. Annual reporting requirements include comparison of monitoring results from Linda Mar #5 and the creek mouth to the TMDL wasteload allocations, including a trends analysis and consideration of local rainfall data. See Section 3.2 for monitoring results and analysis.

Characterization Monitoring

Characterization/BMP effectiveness monitoring must be conducted by the City and County every other year on a water year basis (i.e., October 1 through September 30) beginning in WY 2016. All samples must be analyzed for *E. coli* and a subset of samples must be analyzed for human-, horse-, and dog-specific genetic markers. Characterization monitoring occurred in WY16 but only *E. coli* data was collected, so monitoring for *E. coli* and genetic markers took place in WY17. Due to the compressed timeline of sampling in WY17, the next round of Characterization Monitoring was set for the dry season of WY18 and the wet season of WY19, as approved by the RWQCB. The final round of Characterization

Monitoring will occur in WY20 as planned. Annual reports must evaluate characterization monitoring results focusing on geographic and genetic sources of bacteria in the San Pedro Creek Watershed. Characterization Monitoring Report for Water Year 2018 (Dry Season) is attached as Appendix A.

3.2 Compliance Monitoring

This report includes an analysis of compliance monitoring conducted in WY 2018. County Environmental Health performed weekly compliance monitoring on behalf of the City and the County at Pacifica State Beach (Linda Mar Station #5) and the mouth of San Pedro Creek (Creek Mouth). See Figure 6 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 6: Compliance monitoring sampling sites

51 total samples at each location were collected and analyzed in WY 2018. On February 28, 2018, a sample was taken at the beach but not the creek. On June 4, 2018, a sample was taken at the creek but not the beach. Samples were not taken on December 25, 2017 during the Christmas holiday.

For the purposes of data analysis, we assumed any samples under the lower detection limit of 10 MPN/100mL for *E. coli* and enterococci were 10 MPN/100mL. Samples never hit the lower detection limit for total coliform. We assumed any samples above the upper detection limit of 24196 MPN/100mL for total coliform were 24196 MPN/100mL. Samples never hit the upper detection limit for enterococci or *E. coli*.

To determine whether the weekly attainment monitoring sampling events occurred during dry weather or wet weather, rainfall data was gathered from the Half Moon Bay airport station (KHAF) from wunderground.com. KHAF is 11 miles south of Pacifica State Beach and the closest active station to the sampling locations. This rainfall data may not fully represent precipitation received at the attainment monitoring sampling sites in Pacifica. The station received 9.08 inches of rainfall in WY 2018.

Measured constituents were compared to water quality objectives, or thresholds, set in the TMDL Staff Report, as shown in Table 3. The water quality objective for fecal coliform was used for *E. coli* at Pacifica State Beach, since *E. coli* is sampled in place of fecal coliform.

Table 3: Water quality objectives for single samples (Table 6.1 of TMDL Staff Report)

E. coli (Pacifica State Beach)	E. coli (San Pedro Creek)	Total coliform	Enterococci
400 MPN/100 mL	235 MPN/100 mL	10,000 MPN/100 mL	104 MPN/100 mL

The number of actual exceedances were compared to the number of allowable exceedances for weekly sampling, set in the TMDL Staff Report, as shown in Table 4. An exceedance indicates an exceedance of any one of the three indicator bacteria. Thus, not all three indicators would need to be exceeded in a sample to constitute an exceedance. Reversely, if a sample exceeds water quality objectives for multiple indicators, it would still count as a single exceedance, not multiple.

Table 4: Allowable exceedances of single-sample objectives for weekly sampling (Table 6.2 of TMDL StaffReport)

	San Pedro Creek		Pacifica State Beach		
	Dry Weather	Wet Weather	Summer Dry Weather	Winter Dry Weather	Wet Weather
Allowable Exceedances	1	4	0	1	5

3.2.1 Pacifica State Beach

As explained in the footnote of Table 6.2 from the TMDL Staff Report, wet weather is defined as any day with 0.1 inches of rain or more and the following 3 days. As defined in Table 6.2 from the TMDL Staff Report, summer is April 1 through October 31, and winter is November 1 through March 31. Wet weather includes samples collected during wet weather in summer and winter months.

The sampling location at Pacifica State Beach, Linda Mar #5, is conservatively collected at shin depth in the ocean water at point zero (coincident with San Pedro Creek outfall), which is the mixing zone of ocean water and San Pedro Creek. Thus, the sample has a higher percentage of creek water than if samples were collected further north or south on the beach. This configuration is recognized by the State Water Resources Control Board (SWRCB) Ocean Unit as being more protective of public health for beach water monitoring programs.

Overall, out of 51 samples taken in WY 2018, 28 samples exceeded water quality objectives. 21% of exceedances occurred during wet weather (six out of 28 total exceedances). See Table 5, Table 6, Table 7, and Figure 7 for more information and for a comparison to previous water years.

Table 5: Pacifica	state Beach tot	al exceedances	for weekly	samplina	WYs 2016-2018
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WY	Total	Total Samples	% of Exceedances that Occurred
	Exceedances		During Wet Weather
2016	21	52	33%
2017	20	50	55%
2018	28	51	21%

Table 6: Pacifica State Beach allowable exceedances vs actual exceedances for weekly sampling,WYs 2016-2018

	Summer Dry Weather		Winter Dry W	Winter Dry Weather		Wet Weather	
WY	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	

Table 7: Pacifica	State Beach	percent	exceedances.	WYs 2016	5-2018
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	% of Samples Exceeded (total samples in parenthesis)				
WY	Summer Dry	Summer Dry Winter Dry			
	Weather	Weather			
2016	21% (28)	57% (14)	70% (10)		
2017	33% (27)	0% (9)	79% (14)		
2018	36% (28)	75% (16)	86% (7)		



Figure 7: Pacifica State Beach E. coli, WY 2016

Three of the five highest *E. coli* concentrations occurred during winter wet weather. The lowest *E. coli* concentrations all occurred during dry weather.

Overall, trends throughout WY 2018 show that the beach has exceeded water quality thresholds in both summer and winter and dry and wet weather. The data also show that background *E. coli* concentrations at the beach throughout the dry, summer period is below water quality objectives, though there were two exceedances of the *E. coli* threshold during that time period.

There were two reported Sanitary Sewer Overflows (SSOs) on 1/8/18 and 4/7/18 that flowed to the ocean entry point to the north of Linda Mar #5 (at the sewer pump station). After each SSO, Pacifica posts the beach as closed and collects samples at point of entry, 300 feet south of entry point, and 300 feet north of entry point. The 300 feet south sample is very near the Linda Mar #5 location. The beach is not reopened until County Environmental Health determines the water is no longer "sewage dominated". Both SSOs were storm related (stormwater overwhelming the sanitary sewer system). In both cases, the residual impact to the ocean was likely a combination of stormwater and storm/sewage mixture.

Overall, TMDL wasteload allocations were not attained at Pacifica State Beach in WY 2018. The attainment date to achieve the wasteload allocations at the beach is August 1, 2021.

3.2.2 San Pedro Creek

As explained in the footnote of Table 6.2 from the TMDL Staff Report, wet weather is defined as any day with 0.1 inches of rain or more and the following 3 days.

Overall, out of 51 samples collected in WY 2018, 38 exceeded water quality objectives. 13% of exceedances occurred during wet weather (5 out of 38 total exceedances). See Table 8, Table 9 and Figure 8 for more information.

	Dry W	eather	Wet W	eather
WY	Allowed	Actual	Allowed	Actual
2016	1	32	4	9
2017	1	26	4	12
2018	1	33	4	5

Table 8: San Pedro Creek allowable vs actual exceedances for weekly sampling, WYs 2016-2018

Table 9: San	Pedro Creek	percent exceedances.	WYs 2016-2018
rubic 5. Sun	r curo creek	percent execcuances,	101520102010

	% 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)		



Figure 8: San Pedro Creek E. coli, WY 2018

E. coli concentrations exceeded water quality objectives throughout the year. The lowest *E. coli* concentrations occurred during dry weather. Half of the top six highest concentrations of *E. coli* occurred during wet weather, the other half occurred during dry weather.

Overall, TMDL wasteload allocations were not attained in San Pedro Creek in WY 2018. The attainment date to achieve the wasteload allocations in the creek is August 1, 2028.

3.2.3 Trend Analysis

The weather station used to gather rainfall data, KHAF, received 8.88 inches of rainfall in WY 2016, 22.48 inches of rainfall in WY 2017, and 9.08 inches of rainfall in WY 2018. These drastic differences in rainfall may have an influence on water quality monitoring results. Enhanced rainfall can cause stormwater runoff to transport pollutants that are deposited on land between storms into surface waters which could lead to greater pollutant levels, though more rain can also increase the amount of water in the system which could dilute pollutant levels. Despite the varying amounts of rainfall, as explained below, the number of exceedances did not vary greatly between water years.

Pacifica State Beach

Overall, the total number of exceedances did not vary greatly over the past three years, nor did the number of summer dry weather or wet weather exceedances. The major difference was that in WY 2017, none of the samples taken during dry winter weather exceeded water quality objectives, whereas in WYs 2016 and 2018 there were several winter dry weather exceedances. See Table 10 and Table 11 for more information.

	Summer Dry Weather	Winter Dry Weather	Wet Weather	TOTAL
WY 2016 Exceedances	6	8	7	21
WY 2017 Exceedances	9	0	11	20
WY 2018 Exceedances	10	12	6	28

Table 10: Comparison of Pacifica State Beach # of exceedances

Table 11: Comparison of Pacifica State Beach % exceedances Note: 21% means 21% of all summer dry weather samples exceeded water quality objectives.

	Summer Dry Weather	Winter Dry Weather	Wet Weather
WY 2016 Exceedances	21%	57%	70%
WY 2017 Exceedances	33%	0%	79%
WY 2018 Exceedances	36%	75%	86%

San Pedro Creek

Overall, the total number of exceedances did not vary greatly over the past three years. See Table 12 and Table 13 for more information.

Table 12: Comparison of San Pedro Creek # of exceedances

	Dry Weather	Wet Weather	TOTAL
WY 2016 Exceedances	32	9	41
WY 2017 Exceedances	26	12	38
WY 2018 Exceedances	33	5	38

Table 13: Comparison of San Pedro Creek % exceedances Note: 76% means 76% of all dry weather samples exceeded water quality objectives.

	Dry Weather	Wet Weather
WY 2016 Exceedances	76%	90%
WY 2017 Exceedances	72%	86%
WY 2018 Exceedances	73%	83%

Appendix A

Characterization Monitoring Report Water Year 2018 (Dry Season)

San Pedro Creek and Pacifica State Beach Bacteria TMDL

Characterization Monitoring Report Water Year 2018 (Dry Season)

Prepared for:

City of Pacifica 155 Milagra Drive Pacifica, CA 94044

County of San Mateo 455 County Center Redwood City, CA 94063

Prepared by:

San Mateo Resource Conservation District 80 Stone Pine Road #100 Half Moon Bay, California 94019







March 15th 2019

IN COMPLIANCE WITH PROVISION C.14 OF THE SAN FRANCISCO BAY REGION MUNICIPAL REGIONAL STORMWATER NPDES PERMIT (Order No. R2-2015-0049)

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Appendix 1: Multi-Year Characterization Monitoring Summary

I. <u>Data Tables</u>



Site ID	Sample Site Name	Latitude and Longitude	Parameters Assessed
NFWM	North Fork West Mason Street	37.5963, -122.4794	E.coli
NFWT	North Fork West Terra Nova Blvd	37.5954, -122.4777	E.coli
NFWB	North Fork West Bus Stop	37.5921, -122.4755	E.col, Bacteroidales (human, horse, dog)
NFWC	North Fork West Corner at Everglades	37.5914, -122.4754	E.coli
NFWL	North Fork West Lerida Street	37.5889, -122.4776	E.coli
NFWE	North Fork West	37.5855, -122.4770	E.coli
NFEC	North Fork East Cape Breton	37.5951, -122.4624	E.coli
NFEO	North Fork East Oddstad	37.5946, -122.4640	E.coli
NFES	North Fork East Sweeney	37.5931, -122.4634	E.coli, Bacteroidales (human, horse, dog)
NFEA	North Fork East	37.5841, -122.4731	E.coli
SPMS	San Pedro Middle/South Fork	37.5817, -122.4757	E.coli
LMMS	Linda Mar Bridge Mainstem	37.5816, -122.4785	E.coli
ADMS	Adobe Drive Mainstem	37.5869, -122.4953	E.coli
CLMD	Crespi/La Mirada Drainage	37.5939, -122.4894	E.coli
CCLM^	Crespi Canal Drainage	37.5896, -122.4941	E.col, Bacteroidales (human, horse, dog)
HADD	Higgins/Adobe Drive Drainage	37.5845, -122.4996	E.coli
SHAM	Shamrock Watershed Drainage	37.5876, -122.4990	E.coli, Bacteroidales (human, horse, dog)
PRLT	Peralta Bridge Mainstem	37.5885, -122.4994	E.coli
SPCM	San Pedro Creek Mouth	37.5960, -122.5055	E.coli

Green indicates sample site is a storm drain and blue indicates sample site is an open channel. ^ *indicates channel is concrete-lined*

Sample Date	Site ID	Water Year 2018 (Dry Season) Characterization Monitoring results. Exceedances of <i>E.coli</i> WQO (235 MPN/100 mL) and all detections of <i>Bacteroidales</i> markers highlighted					
		<i>E.coli</i> (MPN/100 mL)	Human Bacteroidales (gc/mL)	Dog Bacteroidales (gc/mL)	Horse Bacteroidales (gc/mL)		
	NFWM	<10	NA	NA	NA		
	NFWT	NW	NA	NA	NA		
	NFWB	NS	NA	NA	NA		
	NFWC	NW	NA	NA	NA		
	NFWL	NS	NA	NA	NA		
	NFWE	504	NA	NA	NA		
	NFEC	10	NA	NA	NA		
	NFEO	NW	NA	NA	NA		
	NFES	10	NA	NA	NA		
6/19/2018	NFEA	41	NA	NA	NA		
	SPMS	20	NA	NA	NA		
	LMMS	529	NA	NA	NA		
	ADMS	209	NA	NA	NA		
	CLMD	<10	NA	NA	NA		
	CCLM	<10	NA	NA	NA		
	HADD	NW	NA	NA	NA		
	SHAM	12,997	NA	NA	NA		
	PRLT	238	NA	NA	NA		
	SPCM	NS	NA	NA	NA		
	NFWM	3,654 NA		NA	NA		
	NFWT	NW	NA	NA	NA		
	NFWB	41	0	116	2,654		
	NFWC	107	NA	NA	NA		
	NFWL	85	NA	NA	NA		
	NFWE	63	NA	NA	NA		
	NFEC	146	NA	NA	NA		
7/17/2018	NFEO	NW	NA	NA	NA		
11112010	NFES	<10	0	13	196		
	NFEA	41	NA	NA	NA		
	SPMS	98	NA	NA	NA		
	LMMS	75	NA	NA	NA		
	ADMS	96	NA	NA	NA		
	CLMD	<10	NA	NA	NA		
	CCLM	452	0	3*	16*		
	HADD	NW	NA	NA	NA		

	SHAM	450	0	17	53*
	PRLT	243	NA	NA	NA
	SPCM	179	NA	NA	NA
	NFWM	171	NA	NA	NA
	NFWT	NW	NA	NA	NA
	NFWB	<10	NA	NA	NA
	NFWC	121	NA	NA	NA
	NFWL	1,553	NA	NA	NA
	NFWE	1,723	NA	NA	NA
	NFEC	NA	NA	NA	NA
	NFEO	NA	NA	NA	NA
	NFES	NA	NA	NA	NA
8/6/2018	NFEA	NA	NA	NA	NA
	SPMS	NA	NA	NA	NA
	LMMS	NA	NA	NA	NA
	ADMS	NA	NA	NA	NA
	CLMD	NA	NA	NA	NA
	CCLM	NA	NA	NA	NA
	HADD	NA	NA	NA	NA
	SHAM	NA	NA	NA	NA
	PRLT	NA	NA	NA	NA
	SPCM	2,014	NA	NA	NA
	NFWM	31	NA	NA	NA
	NFWT	NW	NA	NA	NA
	NFWB	<10	NA	NA	NA
	NFWC	41	NA	NA	NA
	NFWL	134	NA	NA	NA
	NFWE	132	NA	NA	NA
	NFEC	20	NA	NA	NA
	NFEO	NW	NA	NA	NA
	NFES	17,329	NA	NA	NA
8/20/2018	NFEA	345	NA	NA	NA
	SPMS	10	NA	NA	NA
	LMMS	199	NA	NA	NA
	ADMS	155	NA	NA	NA
	CLMD	120	NA	NA	NA
	CCLM	10	NA	NA	NA
	HADD	NW	NA	NA	NA
	SHAM	>24,196	NA	NA	NA
	PRLT	443	NA	NA	NA
	SPCM	556	NA	NA	NA
9/12/2018	NFWM	NW	NA	NA	NA
7/12/2010	NFWT	NW	NA	NA	NA

NF	FWB	10	0	0	126
NF	FWC	20	NA	NA	NA
NF	FWL	NS	NA	NA	NA
NF	FWE	41	NA	NA	NA
NF	FEC	NW	NA	NA	NA
NF	FEO	NW	NA	NA	NA
NF	FES	10	0	0	294
NF	FEA	183	NA	NA	NA
SP	PMS	195	NA	NA	NA
LN	MMS	148	NA	NA	NA
AI	DMS	256	NA	NA	NA
CL	LMD	20	NA	NA	NA
CC	CLM	41	5*	0	147
HA	ADD	NW	NA	NA	NA
SH	IAM	>24,196	0	0	0
PR	RLT	759	NA	NA	NA
SP	РСМ	1,187	NA	NA	NA

*Concentration of sample below the Method Detection Limit (MDL). NA=Not Applicable NW= No Water or not enough water to sample. NS=No Sample taken due to error or lack of access

II. <u>Background</u>

San Pedro Creek and Pacifica State Beach are located in San Mateo County, California and are on the Clean Water Act's 303(d) list for impairment of fecal indicator bacteria (ex: *E.coli, Enterococcus*). This suggests fecal contamination from warm-blooded animals such as human, horses, dogs and wildlife. Fecal bacteria from these sources can indicate the presence of pathogens which can pose health risks to humans through water contact or ingestion.

The San Francisco Bay Regional Water Quality Control Board (RWQCB) adopted the San Pedro Creek and Pacifica State Beach Bacteria Total Maximum Daily Load (TMDL) to address these impairments. The TMDL establishes wasteload allocations, or an amount of permitted exceedances of water quality objectives (WQOs) that are designed to protect the water contact recreation beneficial use. Fecal indicator bacteria WQOs in the TMDL include a single sample maximum of 235 MPN/100mL *E.coli* in freshwater. The amount of permitted exceedances of this WQO at the mouth of San Pedro Creek is one sample during the dry season and 4 samples during wet season, assuming weekly sampling. The TMDL requires that wasteload allocations for San Pedro Creek be attained by August 1, 2028.

The TMDL includes requirements for a monitoring plan for the San Pedro Creek watershed to "1) better characterize bacteria contributions; and 2) assess compliance with wasteload allocations." The City of Pacifica (City), the County of San Mateo (County), and Eisenberg Olivieri and Associates Inc. developed the San Pedro Creek and Pacifica State Beach Bacteria Monitoring Plan (MP) to achieve the requirements set forth in the TMDL. The County and City partnered with the San Mateo Resource Conservation District (RCD) to implement the

Characterization Monitoring component of this plan which aims to better characterize bacteria contributions by addressing the following questions:

- 1. Which land uses and/or sources contribute most to bacteria impairments in San Pedro Creek?
- 2. Are controllable sources of fecal contamination (e.g., human, horses, and dogs) present in the San Pedro Creek watershed?
- 3. What are the multi-year indicator bacteria density trends in San Pedro Creek (i.e., are BMPs showing any effect)?

Characterization Monitoring involves collecting water samples at various locations in the San Pedro Creek watershed and testing samples for *E.coli*, in addition to conducting microbial sources tracking using host-specific *Bacteroidales* markers. The City collected samples for *E.coli* at 11 locations in Water Year 2016 (WY16), and the RCD collected samples for *E.coli* and *Bacteroidales* (human, horse, and dog markers) at 10 locations in WY17. Due to a compressed timeline, samples were not collected in the wet season of WY18, but were collected in the dry season of WY18 and will be collected in the wet season of WY19. This report therefore includes results from the WY18 dry season, while results from the WY19 wet season will be reported by March 15th 2020. Characterization Monitoring also involves collecting samples in WY20 and reporting results by March 15th 2021.For additional information about the Characterization Monitoring Program see Section 3.0 of the MP and the RCD's Bacteria TMDL Monitoring Services Plan.

III. <u>Environmental Setting</u>

San Pedro Creek is a perennial stream that flows from the Santa Cruz Mountains through San Pedro Valley and the City of Pacifica to its mouth at Pacifica State Beach. Precipitation varies from the headwaters to the mouth with approximately 38 inches per year in higher elevations and 23 inches per year in the lowest elevations. The creek drains approximately 8 square miles of residential, commercial, and open space areas. The mainstem of the creek is 2.5 miles long and about 36% of the creek is modified. About 33% of the watershed is developed and 15% of the watershed consists of impervious surface (STOPPP 2001 and 2002).

The San Pedro Creek watershed is comprised of the mainstem of the creek, numerous catchments with perennial and intermittent tributaries, and spring water within the stormwater network (Fig 1). The Middle Fork, the South Fork, and the Sanchez Fork are open channel, perennial streams with vegetated banks. The Northeast and Northwest Forks consist of several perennial and intermittent tributaries that are conveyed into the stormwater system before discharging to the mainstem. The Shamrock catchment is comprised of intermittent open channel tributaries routed through ponds before being routed into the stormwater system and discharging to the mainstem. The Crespi catchment consists of perennial spring water within the stormwater system that is routed to an open concrete-lined channel that discharges to the mainstem. Anza and Linda Mar catchments do not drain to San Pedro Creek but rather to pump stations where stormwater is conveyed to a water recycling plant or to Pacifica State Beach. The small remaining catchments in the watershed convey wet weather flows through the stormwater network to the mainstem of the creek.



Figure 1. San Pedro Creek watershed catchments, stormwater system, and WY18/19 sample sites.

IV. <u>Previous Studies</u>

San Pedro Creek has been monitored for fecal indictor bacteria at numerous locations and by a variety of organizations over the last two decades. Overall, results show that fecal bacteria can exceed WQOs for water contact recreation in both the wet and dry season, and in urban and non-urban areas.

A study conducted in 2001 found that fecal bacteria levels in the North Fork and mainstem of San Pedro Creek had some of the highest bacteria levels (STOPPP 2001). An *E.coli* and microbial source tracking study conducted in 2006 found correlations between wet weather runoff and high *E.coli*, particularly at the downstream end of the mainstem (Davis and Chan 2008). During the dry season, this study found considerable variability in *E.coli* among sample sites, especially in the upper watershed such as the North Forks, where *E.coli* could be higher than at downstream sites. Microbial source tracking information from this study indicated that ~75% of the detected markers were by definition uncontrollable, such as birds, which had the highest detection frequency. A more recent microbial source tracking study found similar results with no detections of human and horse markers, indicating more natural or background sources of bacteria within the watershed (Sassoubre et al. 2011). In the 2006 study, the potentially controllable sources were defined as canine (14% detection frequency), human (8%), and horse (3%). Note detection frequencies do not indicate the amount of feces or bacteria loading from

each species but instead the percentage of source matches out of *E.coli* isolates analyzed. Of the controllable sources, canine and human detections were associated with both wet and dry season samples, while the horse detections were more abundant during the wet season.

Based on these efforts, the RWQCB has identified controllable sources of bacteria in the San Pedro watershed as the sanitary sewer system, horse facilities, municipal stormwater runoff, and dry weather flows (RWQCB 2012). Wildlife (birds, raccoons, rodents deer etc) are also identified as sources but are considered to be uncontrollable. The TMDL can be referenced for more information on previous monitoring efforts and microbial source assessments.

V. <u>Results</u>

The Characterization Monitoring plan for the WY18 dry/WY19 wet season includes 19 sample sites along the mainstem of the creek, within storm drains, and in open channels. In the dry season of WY18, three sample sites (NFWT, NFEO, HADD) were not flowing or did not have enough water to sample. A total of 63 *E.coli* samples were collected at 16 sample sites during five dry weather sampling events in WY18. Note only four sampling events were planned for in the monitoring plan but the Northwest Fork was resampled (8/6/18) due to lack of access during previous sampling events.

A total of 24 *Bacteroidales* samples (human, horse, and dog markers) were collected during two of these dry events (7/17/18 and 9/12/18) at sample sites in the Northwest Fork (NFWB), the Northeast Fork (NFES), the Crespi Drainage (CCLM), and the Shamrock Drainage (SHAM). Several additional samples were also tested for *E.coli* and processed at a local laboratory (not certified) at various sites to provide more information about certain areas. These will be discussed in the discussion section along with previous Characterization Monitoring data from the dry seasons of WY16 and WY17.

In the dry season of WY18, flow rates on the mainstem of the creek were estimated around 350 gallons/min (~0.75 cfs) earlier in the dry season and around 100 gallons/min (~0.25 cfs) later in the dry season. It appeared that the majority of water at the mouth of the creek originated from the Middle, South, and Sanchez Forks followed by the North Forks. Flow rates in the North Forks ranged from <1 gallon/min to ~ 15 gallons/min depending on the sampling event and sample site. Flows in the Crespi and Shamrock catchments were the lowest and estimated at ~1-5 gallons/min.

The *E.coli* WQO of 235 MPN/100 mL was exceeded in 36% of the samples in the WY18 dry season. Most exceedances of the WQO occurred at the three sample sites furthest downstream (SHAM, PRLT, SPCM). Some of the highest concentrations of *E.coli* were seen at the SHAM sample site which had a median *E.coli* level of 6,724 MPN/100 mL. There were five sample sites (NFWB, NFWC, NFEC, SPMS, CLMD) where the WQO was never exceeded (Fig 2). There was an upstream/downstream trend of higher *E.coli* along the mainstem of the creek between each sample site except between LMMS and ADMS (Fig 3). Note, if the recently adopted *E.coli* WQO of 320 MPN/100 mL is used to assess the WY18 dry season data, there would be three less exceedances of the WQO (at PRLT and ADMS).



Figure 2. *E.coli* by sample date in the dry season of WY18. Note the figure does not include data from 8/6/18 sampling event in the Northwest Fork in order to better visualize trends.



Figure 3. Box and whisker plot of *E.coli* in the dry season of WY18.

Bacteroidales results were analyzed based on detection of the markers (non-zero data), as there is currently no threshold for what constitutes a 'positive' sample (Table 1). The horse marker was detected in 87.5% of samples, followed by the dog marker at 50%, and the human marker at 12.5%. The human marker was detected once at one site (CCLM), but it was below the Method Limit of Detection (MDL), or below the linear range of qPCR detection. Further, a field duplicate was taken at CCLM during this sampling event and the human marker was not detected. The dog marker was detected at all sample sites tested in the WY18 dry season, but at CCLM it was below the MDL. The horse marker was also detected at all sample sites, but at SHAM it was below the MDL.

Sample Site/ <i>Bacteroidales</i> Markers	WY18 Dry Season Detection Rate				
NFWB					
Human	0/2				
Dog	1/2				
Horse	2/2				
NFES					
Human	0/2				
Dog	1/2				
Horse	2/2				
CCLM					
Human	1/2*				
Dog	1/2*				
Horse	2/2*				
SHAM					
Human	0/2				
Dog	1/2				
Horse	1/2*				
*Concentration of one sample b	pelow Method Detection Limit (MDL)				

Table 1. Detection rate of *Bacteroidales* markers at several sample sites in the WY18 dry season.

All field and lab blanks for *E.coli* were <10 MPN/100 mL. *E.coli* field duplicates were similar to the original samples except during one sampling event where *E.coli* differed by 1,167 MPN/100 mL at the mouth of the creek (SPCM). Lab duplicates for *E.coli* were also similar except for a difference of 116 MPN/100 mL *E.coli* during one sample event at NFWE.

All field blanks for *Bacteroidales* (Universal) were 0 gc/mL. Field duplicates for *Bacteroidales* (human, horse, dog marker) were collected at CCLM during one sampling event. Results for the dog marker were the same (0 gc/mL), while the horse marker differed by 34 gc/mL, and the human marker differed by 5 gc/mL.

VI. <u>Discussion</u>

Data Quality (QA/QC)

There were no QA/QC issues with field blanks or lab blanks for *E.coli* or *Bacteroidales*. Field duplicates for *Bacteroidales* markers indicate that the number of gene copies can vary slightly, particularly for the horse marker. This lends credence to the current standard of analyzing *Bacteroidales* data based on detection rather than by concentration.

Field and lab duplicates for *E.coli* indicated some variability which could be the result of an error in the field or lab, or true heterogeneity within the creek water sampled. Many studies have shown that *E.coli* can be highly variable both spatially and temporally within a stream channel (EPA 2010). Field duplicates were taken by collecting sample water in a stainless steel bucket, swirling the water in the bucket, and distributing the sample water into two sample bottles. The bucket was cleaned with distilled water then rinsed three times with sample water before sample collection. In the future, the bucket will be rinsed with isopropyl alcohol to further ensure disinfection of the sampling container. As an additional QA/QC check, we compared data taken at the mouth of the creek with data collected on the same day by the County through their weekly creek monitoring program. There were differences higher than the WQO between County and RCD samples but samples were not collected at the exact same time (Table 2).

Data		RCD Samples	County Samples		
Date	Time	E.coli (MPN/100 mL)	Time	<i>E.coli</i> (MPN/100 mL)	
08/06/18	8:09 am	2,014	8:50 am	1,565	
08/20/18	9:10 am	556	9:05 am	862	

Table 2. Results for San Pedro Creek mouth (SPCM) when samples were collected on same day

Mainstem

The mainstem of the creek starts near sample site SPMS and spans to the mouth of the creek at sample site SPCM. SPMS is just downstream of where the Middle and South Forks come together and is upstream of the North Forks, Sanchez Fork, and the Shamrock and Crespi catchments. The Middle Fork and South Forks are perennial systems and together these catchments drain ~ 3 square miles, most of which is open space. Within these catchments and draining to sample site SPMS, there is also San Pedro Valley Park (allows horses, not dogs), a church, and stormwater runoff from Oddstad Blvd.

In the dry season of WY18, SPMS (Middle and South Forks combined) never exceeded the WQO. Previous data collected from the South Fork also indicate low *E.coli* levels (Davis and Chan 2008). In WY16 and WY17, samples were collected along just the Middle Fork (MFCP) and the WQO was exceeded periodically but not as often as other tributaries or the mainstem (Appendix 1). Therefore, the Middle and South Forks are not currently considered to be major contributors of *E.coli*; however, *E.coli* can still exist and may be related to natural sources such as wildlife.

The next sample site downstream is LMMS, which is just downstream of where the Northeast and Northwest Forks join the mainstem. Therefore, LMMS is comprised of Middle and South Forks, as well as the North Forks which include large residential areas, horse facilities, schools, and commercial areas. In the dry season of WY18, the WQO was exceeded during one sampling event at LMMS. So the North Forks may impact *E.coli* levels on the mainstem of the creek in the dry season. Note that the North Forks join together and discharge at a large outfall to the creek where litter, trash bags, raccoon prints and erosion have been observed (Fig 4).



Figure 4. Outfall transporting water from the North Forks to the mainstem of the creek.

At the next sample site downstream (ADMS) there was one exceedance of the WQO in the dry season of WY18. The dry season medians at ADMS and LMMS were similar and lower than the WQO so there do not appear to be substantial sources of *E.coli* along this section of the mainstem in the dry season. This section of the creek flows through residential and commercial areas, and includes the Sanchez Fork which drains ~0.9 square miles of open space, low density residential areas, and trails that allow horses and dogs.

The next site sampled along the mainstem was at Peralta Bridge (PRLT). In the WY18 dry season, the *E.coli* WQO was exceeded during every sampling event at PRLT. The dry season *E.coli* median at the upstream site (ADMS) is 182 MPN/100 mL and it is 400 MPN/100 mL at PRLT. This section of the creek (ADMS to PRLT) includes the Crespi and Shamrock catchment outfalls to the creek and private residences that line the banks of the creek. Activities such as dog walking, car washing and power washing into storm drains has been observed on numerous occasions in this area (Bower, Dell and Standish Roads). Dog waste has been observed on the sidewalks once near ADMS and once near PRLT. There is pet waste signage near ADMS and there is a pet waste station near PRLT.

In WY16 and W17, a site (USSH) was sampled between ADMS and PRLT that is downstream of the Crespi catchment and upstream of the Shamrock catchment. The dry season median at USSH is 632 MPN/100 mL, where just upstream at ADMS it is 182 MPN/100 mL. The section of creek between ADMS and USSH is only about 300 feet long but it includes the Crespi outfall to the creek and erosion in this area has been noted. This section of the creek is not easily accessed as it is surrounded by private property, but the RCD plans to walk the creek between ADMS and USSH in the summer of 2019 to see if additional information can be gathered about dry season sources of bacteria.

Downstream of PRLT is the mouth of the creek (SPCM). In the WY18 dry season, the *E.coli* WQO was exceeded during three of the four sampling events. The dry season *E.coli* median at SPCM is 449 MPN/100 mL, which is fairly similar to the upstream site PRLT (400 MPN/100 ml). Based on this data, there may not be substantial sources of *E.coli* in this section of the creek in the dry season. However, there are known homeless encampments in this area (~10 individuals on the eastside of Hwy 1) and dog waste, horse waste and trash have been observed between these two sites.

Northwest Fork

The Northwest Fork is comprised of perennial and intermittent springs that are conveyed to and infiltrate into the stormwater system. The Northwest Fork is highly developed and includes residences, schools, churches, Millwood Ranch and the Golden Gate National Recreation Area's (GGNRA) Sweeney Ridge trails that allow horses and dogs. The largest source of water in the Northwest Fork appears to originate from the Millwood Ranch area (~150 acres). In this area, perennial springs are routed through different conveyance systems (ponds, pipes, open etc) before the water is routed under the Terra Nova High School and into the stormwater system on Terra Nova Blvd (NFWB). There is also intermittent spring water in the stormwater system on Mason Drive (NFWM) and on Everglades Drive (NFWC). All three of these systems come together into a single system within the stormwater network that runs parallel to Terra Nova Blvd (NFWL and NFWE).

There were a total of three exceedances of the WQO in the Northwest Fork in the WY18 dry season. These occurred at the most upstream site (NFWM) during one event and at the two sites furthest downstream (NFWL and NFWE) during a different sampling event. Data from WY16 and WY17 dry seasons also show exceedances of the WQO in the Northwest Fork at sample site NFWE.

Sample site NFWM appears to be comprised of spring water within the stormwater system due to infiltration, as well as overland runoff into the top of stormwater system. This overland water originates from drainage holes in the curbs in front of residences and is presumed to be spring water. An extra sample was collected of this overland runoff on Mason Drive in May 2018 and *E.coli* was 4,884 MPN/100 mL. So exceedances of the WQO at NFWM could be due to this overland runoff and/or existing water within the stormwater system.

The exceedance at NFWE was likely related to the exceedance just upstream at NFWL. Water at NFWL is mainly comprised of the three spring-fed systems described above. There is also some localized spring water infiltration into the stormwater system on Poplar Ave and Lerida Way. Since the upstream sites did not exceed the WQO during this event, it appears that there is a dry season source of *E.coli* between Everglades Drive and Lerida Way (between NFWC and NFWL).

In the dry season of WY18, the *E.coli* WQO was never exceeded at sample site NFWC or at NFWB where the largest spring-fed system running through Millwood Ranch enters the stormwater network. Note that sample site NFWB is a storm drain that is always completely full of water, even in the dry season. It appears that once the spring water running through Millwood

Ranch enters the stormwater system on Terra Nova Blvd, the system is not able to handle the water capacity or drain the water properly. This could result in dilution of *E.coli* at this sample site. However, low *E.coli* in the spring water running through the Millwood Ranch area is confirmed by data from WY16 (NMHR-C) and two extra samples taken at this site in the WY18 dry season.

Bacteroidales markers were also tested in the dry season of WY18 in the Northwest Fork, at sample site NFWB. The dog marker was detected once above the MDL, the horse marker was detected twice above the MDL, and the human marker was not detected. Therefore, it appears that there is dog and horse fecal matter within the spring water system running through the Millwood Ranch area, but this does not necessarily result in high *E.coli* levels. There are horses and dogs at Millwood Ranch and GGNRA trails further up in the catchment. *Bacteroidales* markers were also tested in WY17 at sample site NFWE, downstream of NFWB. In the dry season, the horse marker was detected once above the MDL and the human marker was detected twice above the MDL. This indicates that there may be a dry season source of human feces between NFWB and NFWE. Note that the *E.coli* data indicate that there may be a dry season source of *E.coli* between these two sites, specifically between NFWC and NFWL.

No homeless encampments or dumping has been observed in this area and the City noted that RV activity in the watershed is minimal. Stormwater lines and the City's sewer lines are close to each other at these sample sites but not between these sample sites (Fig 5). The City's sewer system in the Northwest Fork is ~60-70 years old and is therefore reaching the end of its lifespan (Fig 6). Most sewer pipes and laterals in this area are made of clay and are therefore outdated and likely deteriorated (RMC 2011). Exfiltration of sewer water into surrounding soil, groundwater and potentially the stormwater system is possible. The stormwater system was built around the same time as the sewer system, and the condition (cracks, fractures, holes etc) is unclear as it has not been assessed.

The Sewer System Collection Master Plan (RMC 2011) indicates that there is a major structural defect along Terra Nova Blvd near the intersection with Everglades Drive (near NFWC) that is considered a high priority for repairs. It also indicates that increased pipe sizes are needed along Terra Nova Blvd from Lerida Way to Oddstad Blvd (near NFWL and NFWE). The City began upsizing these pipes on Terra Nova Blvd in January 2019 and indicated that this should address issues identified upstream such as the defect at Everglades Drive.

Northeast Fork

The Northeast Fork is also comprised of perennial and intermittent springs that are conveyed to and infiltrate into the stormwater system. The Northeast Fork includes dense residential areas, a park, a commercial area, Sweeney Ridge Equestrian Center, and trails at GGNRA's Sweeney Ridge. There are perennial spring-fed systems along Cape Breton Ave and St. Lawrence Ave, while there is an intermittent spring water system along Oddstad Blvd. These systems combine at sample site NFES. An additional source of spring water enters the stormwater system along Park Pacific Ave and joins the main system at sample site NFEA.



Figure 5. Stormwater lines and City sewer lines in the San Pedro Creek watershed



Figure 6. City sewer system age (RMC 2011)

In the dry season of WY18, there were two exceedances of the WQO in the Northeast Fork. These occurred at NFES and the sample site downstream (NFEA), while there were no exceedances at the most upstream site NFEC. In the WY16 and WY17 dry seasons, there were also periodic exceedances of the WQO at NFES and NFEA.

In the dry season, the water at NFES can originate from the spring-fed systems along Cape Breton, St. Lawrence and/or Oddsadd Blvd. It is not always clear where the water inside this manhole is coming from as the amount of water can often be higher than the pipes conveying the water. During every sampling event in the dry season of WY18, *E.coli* at NFES was only 10 MPN/100 mL except for the August event when *E.coli* was 17,329 MPN/100mL. During this event, the flow at NFES appeared to come from all three spring-fed drainages. However, at the upstream sample site on Oddstad Blvd (NFEO) there was no water and at the upstream sample site along Cape Breton (NFEC) there was only 20 MPN/100 mL *E.coli*. So there appears to be a dry season source of *E.coli* downstream of NFEO and NFEC, but upstream of NFES. However, it should be noted that NFEC was tested in May 2018 when trying to determine sample sites and *E.coli* here was 5,172 MPN/100 mL. These data indicate that *E.coli* can be high periodically in the upper Northeast Fork in the dry season. In this small area of the Northeast Fork (above NFES) there are residences, Sweeney Ridge Equestrian, and GGNRA trails that allow horses and dogs.

The exceedance of the WQO at sample site NFEA in WY18 was likely a result of the exceedance upstream at NFES. Dry season medians at these two sites are fairly similar with 10 MPN/100 mL at NFES and 58 MPN/100 mL at NFEA. Although, in the WY17 dry season there was an increase of ~15,000 MPN/100 mL *E.coli* between NFES and NFEA indicating a dry season source of bacteria between these two sites. Between NFES and NFEA there are residences, several businesses, a park, and additions of spring water into the stormwater system from Park Pacific Ave and potentially other locations.

Bacteroidales markers were also tested in the dry season of WY18 in the Northeast Fork, at sample site NFES. The dog marker was detected once above the MDL, the horse marker was detected twice above the MDL, and the human marker was not detected. Therefore, it appears that there is dog and horse fecal matter within the stormwater system as far upstream as NFES, but this was not correlated with high *E.coli* levels. *E.coli* at NFES during both *Bacteroidales* sampling events was 10 MPN/100 mL. *Bacteroidales* markers were also tested in WY17 at sample site NFEA, downstream of NFES. In the dry season of WY17, the dog marker was not detected, the horse marker was detected once above the MDL and once below, and the human marker was detected once below the MDL. Results from both sampling years indicate presence of the horse marker and the dog marker in the dry season in the Northeast Fork. Because the human marker has not been detected above the MDL in the dry season, specifics of the sewer system in the Northeast Fork will not be discussed at this time.

Crespi Catchment

The Crespi catchment includes ~ 0.4 square miles of residential land use and open space The catchment includes a stormwater network that is routed to a ~ 0.5 mile open concrete-lined canal that discharges to the mainstem of the creek. The canal itself is gated and locked on each end and

is lined with fences and private properties on each side. There are also numerous stormwater outfalls draining residential areas that discharge to the canal.

In the dry season of WY18, samples taken upstream of the canal within the stormwater network at sample site CLMD did not exceed the *E.coli* WQO. Samples collected downstream in the canal at sample site CCLM exceeded the WQO during one sampling event. Previous data collected in the dry seasons of WY16 and WY17 at CCLM were similar with one exceedance of the WQO. The dry season water in the Crespi canal originates almost entirely from the stormwater network upstream, as the outfalls in the canal only trickle sometimes in the dry season. The dry season flows in the stormwater network are presumed to be coming from spring water infiltrating into the stormwater system. Since there were no exceedances at the upstream site (CLMD), there appears to be a dry season source of *E.coli* downstream of this site within the stormwater system or within the canal itself.

Bacteroidales markers were also tested in the dry season of WY18 within the Crespi canal at CCLM. The dog and human markers were detected once below the MDL, while the horse marker was detected once below the MDL and once above it. Duplicate samples were taken during one of these sampling events and the human and dog markers were not detected, while the horse marker was detected above the MDL.

During sampling events and reconnaissance surveys, horse waste was never observed at or near CCLM and there does not appear to be any horses in the entire catchment. The MDL for horse is 60 gc/mL and the highest concentration at CCLM was 181 gc/mL. According to the laboratory, it is possible that these were false positives or that the horse marker was picking up other species such as ruminants. Although the Crespi canal is largely fenced off, there is a small section of the canal that is not fenced off (~25 ft). It is clear that wildlife access the canal as evident by large amounts of scat from deer, rabbits, and raccoon. Even though the dog marker was not detected during the WY18 dry sampling events, dog waste is observed frequently along the banks of the canal. This waste appears to be coming from dogs at residences lining the canal where there are holes in some of the private fences. Dog waste bags have also been observed inside the storm drain on Crespi Drive right above the canal. Further over the course of the dry season, trash accumulates inside and along the canal (Fig 7). Cleaning up trash and animal waste along the canal would likely be beneficial in improving the overall health of the creek.



Figure 7. Crespi canal in the dry season.

Shamrock Catchment

The Shamrock catchment drains ~0.5 square mile area including Shamrock Ranch Equestrian and Dog Boarding Facility, a school, and small residential and open space areas. The upstream end of the catchment is comprised of several open channel tributaries that are generally routed to Caltrans habitat mitigation ponds which are also supplemented with City water in the dry season. The ponds are located on Shamrock Ranch property and downstream of the ponds, the tributaries join into a single open channel tributary that exits the property and is routed underground into the stormwater system at Shamrock Ranch Road. In the dry season, the tributaries are dry in some locations and wet in others due to spring water influence. But at the point where the tributary is routed underground there is often low flow or a trickle in the dry season. This tributary travels under the school and Rosita and Bower Roads before discharging to the mainstem of the creek. The SHAM sample site is located in a storm drain on Bower Road.

All samples collected at SHAM during the WY18 dry season exceeded the WQO and this site had some of the highest *E.coli* levels. This also occurred in the dry season of WY17, while in WY16 there was often not enough water to sample. During the dry season, the amount of water at this sample site can range from stagnant, to trickle, to low flow. And the amount of water appears to impact *E.coli* levels, as sampling events with slightly more water had lower *E.coli* levels (7/17/18). Still, this sample site consistently has higher *E.coli* levels in the dry season than other sampling locations as evident by the dry season median (6,131 MPN/100 mL).

Dry season flows at SHAM appear to be coming from groundwater infiltration into the stormwater system and potentially from the open channel tributary flowing through Shamrock Ranch. It is unclear if and how much water from this tributary makes its way underground to SHAM in the dry season. But water at SHAM can still exist when the tributary is dry. During a reconnaissance survey and extra sampling event late in the dry season (November 2018), the tributary was dry and *E.coli* levels at SHAM were >24,196 MPN/100 mL. During this event, a sample was also taken where the water from SHAM outfalls to the creek and *E.coli* here was 4,374 MPN/100 mL. This indicates that the very high *E.coli* levels at SHAM may be a result of a localized issue in the stormwater system or the nature of the flow at this site since *E.coli* was lower where the water daylights. The water from the outfall also travels through an earthen channel and largely soaks into the ground before reaching the mainstem of the creek. This indicates that *E.coli* detected at the SHAM sample site may have little impact on the mainstem of the creek itself in the dry season. Still, it may be worthwhile to further investigate the stormwater line above SHAM in the dry season to better understand where dry season flows and *E.coli* at this site may be coming from.

Bacteroidales markers were also tested in the WY18 dry season at SHAM. The human marker was not detected, while the horse marker was detected below the MDL, and the dog marker was detected above the MDL. Dog waste was not observed at or near SHAM in the WY18 dry season. It is possible that the dog marker picked up raccoon feces as they are known to cross-react, but dogs are also present in the upper catchment at Shamrock Ranch.

VII. <u>BMP Effectiveness</u>

Since the TMDL was adopted in 2012, various Best Management Practices (BMPs) have been implemented to address controllable sources of bacteria (human, horse, dog waste). These will be discussed generally below but Characterization Monitoring is not designed to directly assess the effectiveness of individual BMPs. Characterization Monitoring focuses on identifying bacteria hot spots, potential sources, and documenting bacteria levels throughout the watershed over time as BMPs are implemented.

Measures to address human waste include implementation actions listed in the TMDL, in addition to attempting to address homeless encampments and failing septic systems. There is one known remaining septic system within the watershed, at Millwood Ranch. The City has required that it be decommissioned and has issued numerous citations but compliance has not yet been achieved. The City is currently in legal proceedings with the property owner. The City has also worked with the police department to try to address the issue of homeless encampments in the lower watershed. In the past, police have handed out resources to individuals and physically removed camps and trash. However, the areas quickly become repopulated.

Sewer system implementation actions in the TMDL include the City complying with the Waste Discharge Requirement for sanitary sewer systems (No. 2006-0003), the Cease and Desist Order (No. R2-2011-0031) and ensuring compliance with their Private Sewer Laterals Ordinance. Many of the required tasks have been completed and documentation can be found on the City's website. Continued compliance with these requirements is assumed and efforts appear to be effective. For example, since 2009 the number of SSOs reported to the State Water Resources Control Board for the San Pedro Creek watershed has declined substantially (Table 3).

As of 2014, all sewer gravity and force main lines have been cleaned and inspected. The City also has a comprehensive asset management system containing information on sewer infrastructure and a modeling system to prioritize improvements. Since 2012, the City has made substantial repairs to the sewer system particularly in the lower San Pedro Creek watershed near sample sites CCLM, USSH, PRLT, and SPCM. In 2018, the City replaced approximately 16,000 feet of damaged sewer mainlines and completed three major improvement projects in the lower watershed (Crespi Drive, Highway 1, and Linda Mar Blvd).

Calendar Year	Number of SSOs
2009	22
2010	20
2011	14
2012	5
2013	7
2014	4
2015	0
2016	4
2017	3
2018	2

Table 3. Number of SSOs in the San Pedro Creek watershed.

Sewer lines are also currently being upsized in the lower Northwest Fork (Terra Nova Blvd) and near the upper mainstem of the creek (Oddstad Blvd). In 2019, the City also plans to complete the wet weather equalization basin which will help further mitigate SSOs by temporarily storing sewer water diluted with stormwater during large precipitation events. There will be other sewer line replacements and repairs in 2019 but the City is still prioritizing these projects. It is recommended that information from Characterization Monitoring reports and presence of the human marker in the North Forks be considered as repairs are further prioritized and implemented.

In addition to sewer system repairs and upgrades, the City has a Sewer Lateral Replacement Grant Program to incentivize compliance with the City's Private Sewer Laterals Ordinance. This ordinance indicates that property owners are responsible for the condition and operation of sewer laterals and requires a sewer lateral compliance certificate for real estate transactions and major remodels. So far 2,121 compliance certificates have been issued and 300 grants have been awarded. It is estimated that there are approximately 3,500 private sewer laterals in the San Pedro Creek watershed (RWQCB 2012). Since many of the laterals in the City are known to be Orangeburg pipe or clay pipe (RMC 2011) it will be important to continue to incentivize replacement of laterals. The Sewer Lateral Replacement Grant Program is funded through June 2019 and is expected to continue in the future.

Implementation actions listed in the TMDL to address horse waste are related to meeting local and state requirements for confined animal facilities. Shamrock Ranch is in the County's jurisdiction and is therefore subject to the County's Confined Animal Facility Ordinance. During the annual inspection in 2018, compliance was confirmed. Sweeney Ridge Equestrian and Millwood Ranch are in the City's jurisdiction and are therefore subject to the City's Standards for Keeping Animals. During the 2018 inspection, compliance at Sweeney Ridge Equestrian was confirmed but not at Millwood Ranch. Millwood Ranch was only in compliance in regards to waste management and not in regards to drainage or facility management. To address this, the City has an on-going code enforcement action against the property owner. A Cleanup and Abatement Order (No. R2-2009-0045) was also issued by the RWQCB to Millwood Ranch in 2009 and it is assumed that this has not been resolved.

In addition to the City and County regulations, each of these horse facilities must comply with the RWQCB's Waste Discharge Requirement (WDR) for Confined Animal Facilities Order (No. R2-2016-0031). The WDR requires water quality monitoring, development and implementation of a Ranch Water Quality Plan (RWQP), and annual reporting. Based on current understanding, Shamrock Ranch and Sweeney Ridge Equestrian have met requirements and are completing RWQPs (an extension was granted). The status of Millwood Ranch and WDR requirements is unclear. Overall, progress has been made to ensure that the horse facilities are in compliance with numerous policies designed to effectively manage confined animal facilities. More specific management measures to protect water quality may also be implemented as a result of the WDR.

Over the past few years, the issue of dog waste has been addressed by various agencies and mechanisms including dog waste signs and stations, visual inspections, clean-ups, mailers, informational brochures, TV public service announcements, newspaper ads, wet weather alerts, webpages, dog bag giveaways, and outreach events. In 2018, the City continued implementing

all of these efforts, except for adding new pet waste stations and signs. In addition to the City's efforts, the RCD sent out wet weather alerts that included the County's Scoop the Poop Pledge and also added the pledge to the RCD's Water Quality webpage. The RCD and the County also participate in a local group called Coastside One Water and in 2018 various pet waste outreach materials were distributed during the Half Moon Bay Pumpkin Festival, Dream Machines, and the World Dog Surfing Championships at Pacifica State Beach. Lastly, the RCD included pet waste messaging in several presentations to the community and at local schools.

Pet waste education and outreach efforts are multi-faceted and are carried out by numerous agencies and organizations (the City, the County, RCD, Coastside DOG, Pacifica Beach Coalition, San Pedro Watershed Coalition, Surfrider Foundation, Coastside One Water) that share information, exchange materials, and further distribution. This allows a wide variety of audiences to be reached through various formats. This strategy appears to be effective in reaching tens of thousands of people including both residents and tourists. It is recommended that these efforts continue, especially to highlight the importance of picking up pet waste even on trails and in backyards.

Pet waste stations and signage also appear to be an effective measure for reducing dog waste in the watershed. Stations receive routine maintenance by the City, but additional maintenance is needed at the Peralta Bridge station, as it is often overflowing or out of supplies. The City plans to install three new pet waste stations along the Highway 1 trail, near the bridge at Linda Mar Blvd, and at the intersection of Linda Mar and Oddstad Blvd. It is recommended that the City add a few visual monitoring locations in the North Forks, and that the City and the RCD consolidate visual observations to get a better sense of hot spots and potential future locations for stations and/or signage.

VIII. Conclusion

In summary, fecal bacteria (*E.coli*) can exist in levels higher than the WQO in the dry season throughout the San Pedro Creek watershed, particularly in the North Forks, the Shamrock catchment, and the lower mainstem of the creek. There may be a relationship between higher *E.coli* and urban land use as the Middle and South Forks have generally exhibited lower *E.coli* levels and are largely characterized by open space. However, *E.coli* can still exceed the WQO in these areas, so there appears to be background sources such as wildlife waste. Observations and previous studies have shown that wildlife are prevalent in both open space and urban areas, so wildlife are considered a prominent source of bacteria in the watershed but are considered uncontrollable.

Controllable sources of fecal bacteria in the San Pedro Creek watershed have been identified as human, horse, and dog waste. All three of these species have been detected with reasonable confidence (above the MDL) in the Northeast Fork, the Northwest Fork and at the mouth of the creek during Characterization Monitoring efforts. So far, the human marker has not been detected above the MDL in any other areas of the watershed. Although the human marker has been detected less frequently than the horse and dog markers, addressing human waste has been prioritized as it is linked to higher human health risks.

The City has made significant repairs to sewer infrastructure and continues to implement projects in priority areas including the lower mainstem of the creek and the Northwest Fork. The horse facilities have largely come into compliance with confined animal facility requirements and it is likely that additional BMPs will be implemented to address water quality issues. Pet waste stations continue to be installed where needed and pet waste education/outreach efforts are widespread, diverse and continue to grow. Overall, BMPs have increased substantially over the past few years and appear to be effective measures that with additional time should help reduce fecal bacteria to San Pedro Creek and Pacifica State Beach.

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Multi-Year Characterization Monitoring Summary

Sample Site Map WY16-WY18



Bacteroidales	Samula Data				Sample	Site ID			
(gc/mL)	Sample Date	NFWB	NFWE	NFES	NFEA	SFPD	CCLM^	SHAM	SPCM
	1/10/2017	NA	8	NA	23	0	NA	NA	42
	2/21/2017	NA	26	NA	21	0	NA	NA	73
Human	6/28/2017	NA	31	NA	3*	0	NA	NA	9
numan	8/2/2017	NA	7	NA	0	3*	NA	NA	121
	7/17/2018	0	NA	0	NA	NA	0	0	NA
	9/12/2018	0	NA	0	NA	NA	5*	0	NA
	1/10/2017	NA	32	NA	632	19	NA	NA	163
	2/21/2017	NA	26	NA	0	0	NA	NA	2*
Dag	6/28/2017	NA	0	NA	0	0	NA	NA	16
Dog	8/2/2017	NA	0	NA	0	0	NA	NA	57
	7/17/2018	116	NA	13	NA	NA	3*	17	NA
	9/12/2018	0	NA	0	NA	NA	0	0	NA
	1/10/2017	NA	659	NA	2409	1038	NA	NA	133
	2/21/2017	NA	10*	NA	0	0	NA	NA	420
Hama	6/28/2017	NA	61	NA	40*	25*	NA	NA	3*
norse	8/2/2017	NA	352	NA	339	0	NA	NA	65
	7/17/2018	2654	NA	196	NA	NA	16*	53*	NA
	9/12/2018	126	NA	294	NA	NA	147	0	NA

Bacteroidales Results WY17 & WY18

Tan indicates dry season event and purple indicates wet season event. Green indicates sample site is a storm drain and blue indicates sample site is an open channel.*Concentration of one sample below Method Detection Limit (MDL).

Site ID	WY17+WY18 Dry
/Bacteroidales	Season Detection Rate
NFWB	
Human	0/2
Dog	1/2
Horse	2/2
NFWE	
Human	4/4
Dog	2/4
Horse	4/4*
NFES	
Human	0/2
Dog	1/2
Horse	2/2
NFEA	
Human	3/4*
Dog	1/4
Horse	3/4*
SFPD	
Human	1/4*
Dog	1/4
Horse	2/4*
CCLM	
Human	1/2*
Dog	1/2*
Horse	2/2*
SHAM	
Human	0/2
Dog	1/2
Horse	1/2*
SPCM	
Human	4/4
Dog	4/4*
Horse	4/4*

*Concentration of one sample below MDL.

E.coli Results WY16-WY18

Parameter/	Sample Date	Sample Site ID																						
WQO		NFWM	NMHR	NMHR-C	NFWB	NFWC	NFWL	NFWE	NFEC	NFES	NFEA	MFCP	SPMS	LMMS	SFPD	ADMS	CLMD	CCLM	USSH	SHAM	PRLT	SPCM	LMPS	AZPS
	11/25/2015	NA	NA	1076	NA	NA	NA	4352	NA	NA	12997	24196	NA	NA	9804	NA	NA	24196	14136	12997	15531	NA	4884	4611
	12/29/2015	NA	NA	20	NA	NA	NA	10	NA	NA	31	327	NA	NA	158	NA	NA	41	336	158	432	NA	1725	749
	1/28/2016	NA	NA	31	NA	NA	NA	63	NA	NA	206	10	NA	NA	231	NA	NA	31	156	203	122	NA	183	1989
	2/29/2016	NA	NA	85	NA	NA	NA	31	NA	NA	185	10	NA	NA	185	NA	NA	145	214	110	109	NA	NA	NA
	3/28/2016	NA	NA	10	NA	NA	NA	20	NA	NA	31	10	NA	NA	253	NA	NA	85	262	84	121	NA	414	384
	3/31/2016	NA	NA	20	NA	NA	NA	NA	NA	NA	30	20	NA	NA	97	NA	NA	146	98	20	135	NA	NA	NA
	4/28/2016	NA	NA	31	NA	NA	NA	31	NA	NA	10	341	NA	NA	NA	NA	NA	10	279	259	275	NA	4884	809
	7/28/2016	NA	NA	10	NA	NA	NA	1086	NA	NA	546	119	NA	NA	341	NA	NA	10	279	20	426	NA	NA	NA
	8/30/2016	NA	NA	10	NA	NA	NA	10	NA	NA	10	173	NA	NA	355	NA	NA	148	933	NW	959	NA	NA	NA
	9/28/2016	NA	NA	10	NA	NA	NA	5475	NA	NA	74	237	NA	NA	292	NA	NA	10	3448	NW	373	NA	414	384
	10/26/2016	NA	NA	20	NA	NA	NA	209	NA	NA	110	20	NA	NA	109	NA	NA	24196	1250	794	1515	NA	4884	809
	11/30/2016	NA	NA	187	NA	NA	NA	120	NA	NA	609	20	NA	NA	359	NA	NA	512	1178	14136	1450	NA	262	2247
E.coli <235	1/10/2017	NA	2723	NA	NA	NA	NA	2755	NA	2489	2187	10	NA	NA	122	NA	NA	4611	1050	3076	1374	2603	NA	NA
	1/23/2017	NA	51	NA	NA	NA	NA	5794	NA	471	272	10	NA	NA	638	NA	NA	318	208	110	206	NA	NA	NA
	2/7/2017	NA	169	NA	NA	NA	NA	1112	NA	379	480	41	NA	NA	288	NA	NA	1153	988	657	1455	NA	NA	NA
	2/21/2017	NA	6488	NA	NA	NA	NA	10462	NA	231	620	10	NA	NA	41	NA	NA	631	1119	1421	2282	399	NA	NA
	3/23/2017	NA	789	NA	NA	NA	NA	1401	NA	1309	1291	10	NA	NA	170	NA	NA	9208	1694	2402	9208	NA	NA	NA
	6/28/2017	NA	NW	NA	NA	NA	NA	52	NA	10	41	41	NA	NA	75	NA	NA	110	148	801	203	187	NA	NA
	7/12/2017	NA	NW	NA	NA	NA	NA	63	NA	20	63	171	NA	NA	368	NA	NA	63	331	441	146	NA	NA	NA
	8/2/2017	NA	NW	NA	NA	NA	NA	31	NA	10	52	10	NA	NA	20	NA	NA	20	20	6131	228	341	NA	NA
	8/23/2017	NA	NW	NA	NA	NA	NA	238	NA	586	15531	1119	NA	NA	1722	NA	NA	285	1187	24196	563	NA	NA	NA
	9/11/2017	NA	NW	NA	NA	NA	NA	10	NA	10	20	31	NA	NA	884	NA	NA	20	959	NW	1296	NA	NA	NA
	6/19/2018	10	NA	NA	NS	NW	NS	504	10	10	41	NA	20	529	NA	209	10	10	NA	12997	238	NS	NA	NA
	7/17/2018	3654	NA	NA	41	107	85	63	146	10	41	NA	98	75	NA	96	10	452	NA	450	243	179	NA	NA
	8/6/2018	171	NA	NA	10	121	1553	1723	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2014	NA	NA
	8/20/2018	31	NA	NA	10	41	134	132	20	17329	345	NA	10	199	NA	155	120	10	NA	24196	443	556	NA	NA
	9/12/2018	NW	NA	NA	10	20	NS	41	NW	10	183	NA	195	148	NA	256	20	41	NA	24196	759	1187	NA	NA
								20.4																
Dry Median		101	NA	10	10	/4	134	63	20	10	58	145	59	1/4	548	182	15	51	632	6131	400	449	414	584
Wet Median		NA	789	31	NA	NA	NA	165	NA	471	239	15	NA	NA	185	NA	NA	415	662	458	903	1501	1725	809
Overall Median		101	789	20	10	74	134	126	20	126	147	26	59	174	253	182	15	128	635	794	429	478	1070	809

Red indicates an exceedance of the WQO. Tan indicates dry season event and purple indicates wet season event. Green indicates sample site is a storm drain, blue indicates sample site is an open channel; grey indicates sample site is at pump station outfall. NA=Not Applicable. NW=No Water or not enough water to sample and NS= No sample taken due to error or lack of access.

Appendix B

#	Station ID	Station Location	Latitude	Longitude	1/18/2018	10/2/2018	12/27/2018
1	Visual Monitoring 1	Pacifica State Beach Anza Pump Station	37°35'53.63"N	122°30'7.63"W	None	None	None
2	Visual Monitoring 2	Pacifica State Beach North of Taco Bell	37°35'50.28''N	122°30'11.40'W	None	None	None
3	Visual Monitoring 3	Pacifica State Beach South of Taco Bell	37°35'49.65"N	122°30'13.63'W	None	None	None
4	Visual Monitoring 4	Pacifica State Beach Linda Mar Pump Station	37°35'47.49'N	122°30'16.41"W	Evidence of Pet Waste	Evidence of Pet Waste	Evidence of Pet Waste
5	Visual Monitoring 5	Pacifica State Beach San Pedro Creek	37°35'45.00"N	122°30'20.22'W	Evidence of Pet Waste	None	Evidence of Pet Waste
6	Visual Monitoring 6	Highway 1 and San Pedro Creek Trail Head	37°35'35.73''N	122°30'19.43"W	None	Evidence of Pet Waste	None
7	Visual Monitoring 7	San Pedro Creek Trail Head and Linda Mar Covelescent Home	37°35'21.52'N	122°30'6.02"W	None	None	None
8	Visual Monitoring 8	Peralta Bridge	37°35'18.36"N	122°29'58.15"W	Evidence of Pet Waste	None	None
9	Visual Monitoring 9	Sanchez Arts Center Entrance	37°35'1.25'N	122°29'12.76"W	None	None	None
10	Visual Monitoring 10	Sanchez Arts Center Parking Lot	37°34'57.79'N	122°29'13.98'W	None	None	None

San Pedro Creek and Pacifica State Beach Visual Monitoring Log

Appendix C



July 18, 2018

Pacifica Tribune Pet Waste Public Service Advertisements



August 8, 2018



January 9, 2019

Appendix D

Pet Waste Mailers

Facts About Pet Waste

Every time it rains, the potential exists for thousands of pounds of pet waste to wash down storm drains and into streams, creeks and ocean. If not disposed of properly, pet waste flows directly into nearby streams and creeks without being treated at wastewater treatment facilities.



Pet waste can contain bacteria that threaten the peeth of animals and people, expectably children Pet waste also contains mutiretis that encourage excess weed and algae growth. This water then becomes cloudy and green — unaftractive for awimming, boating and fishing. Excess nutrients are a major cause of water quality decline.

When pet waste is washed into streams and creeks, the waste decays, using up oxygen and sometimes releasing ammonia. Low oxygen levels and ammonia combined with warm temperatures can kill fish and other aquate life.

When pet waste is disposed of improperly, water quality isn't the only thing that suffers — your health may be at risk, too.

Pets, children playing outside, and adults gardening are most at risk for infection from some of the bacteria and parasites found in pet waste. Diseases that can be transmitted from pet waste include the following:

Salmonellosis: the most common bacterial infection transmitted to humans by other animals. Symptoms include fever, muscle aches, headache, vomiting and diarrhea.

Toxocariasis: roundworms usually transmitted from dogs to humans, often without noticeable symptoms, but may cause vision loss, a rash,

fever or cough.

Toxoplasmode: a parasite carried by cafe that can cause birth defects if a woman becomes infected during pregnancy, and can also be a problem for people with depresed immune systems. What's the Problem? What Can You Do?

Pet waste should never enter storm drains and surface water. Many local communities require pet owners to pick up after pets when away from their property, and to pick up waste from their property if it attracts files and can pose a health risk.

Fortunately, there are actions pet owners can take to help keep our water clean:

Pick up pet waste from your yard. It is not a fertilizer.

Carry disposable bags while walking your dog to pick up and dispose of waste properly. If you dispose of pet waste in the trash, wrap it carefully to avoid spillage during collection.

 Bury pet waste in your yard, at least 12 inches deep and cover with at least eight inches of soil to let it decompose slowly. Bury the waste in several different locations and keep it away from vecatable cardenes.

The City of Pacifica provides pet waste disposal bags at selected local parks, trails and in public places where people frequently walk their dogs.

dogs.

San Pedro Creek and Pacifica State Beach

San Pedro Creek and a portion of Pacifica State Beach do not meet state water quality bacteria standards for recreational use. Pet waste is one of the components of non-point source pollution that contributes to our water quality problems, and is one that each of us can help orrect.

The Regional Water Board San Pedro Creek and Pacifica State Beach Total Maximum Daily Load showed that bacteria associated with pet waste were a source of the bacteria in samples collected from local waterways. What is a Watershed?

A watershed is an area of land that drains to a common point, such as a nearby creek, stream, river or ocean. Every small watershed drains to a larger watershed that eventually flows to the ocean.

Watersheds support a wide variety of plants and wildlife and provide many outdoor recreation opportunities.

By protecting the health of our watersheds we can preserve and enhance the quality of life for Pacifica residents.



What is Stormwater Runoff?

Stormwater is water from rain. It flows from rooftops, over paved streets, sidewalks and parking lots, across bare soil, and through lawns and storm drains. As it flows, runoff cellects and transports soil, pet waste, pesticides, fertilizer, oil and grease, litter and other pollutants. This water drains directly into nearby creeks, streams and rivers, without receiving treatment at sewage plants. Polluted stormwater contaminates streams, rivers and lakes. It can kill or damage plants, fish and wildlife, while degrading the quality of our water.

For more information, please visit our website: http://www.cityofpacifica.org/depts/pw/pet_waste.asp

This information is provided by the City of Pacitica and is applicable to properties within the limits of the City. If you reside in a jurisdiction other than the City of Pacifica, contact your regulatory authority for information. If you alevery our cestlevel this notech error, or if you no longer own the property, presese contact the City of Pacifica Department of Paulic Works at (050) 738-3700 or via U.S. Mail and the following addresses:

> City of Pacifica Department of Public V 170 Santa Maria Ave



LOCAL POSTAL CUSTOMER



PICK UP AFTER YOUR PET



Help Prevent Contamination of Creeks, Streams, Watersheds and the Ocean

Appendix E

Pet Waste Bags and Dispensers



Appendix F

Nextdoor Posts

