City of Santa Barbara

Creeks Division

Fiscal Year 2019 Annual Water Quality Monitoring and Research Report

Report on data collected between July 1, 2017 and June 30, 2018, according to the FY 2018 Water Quality Research and Monitoring Plan

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Introduction

The following report describes sampling and results that were based on the Fiscal Year 2019 Research and Monitoring Plan (Research Plan; Appendix A). The Research Plan is organized around program elements and research questions that have been reviewed by the Creeks Advisory Committee (CAC). The Research and Monitoring Program is adaptive, and as questions are answered or modified, sampling strategies change as well. The program elements and research questions are provided below. Where possible, the report is organized around the research questions. ***The primary purpose of this report is to serve as an internal record of data collection and analysis.*** Please see the Creeks Division 2001-2006 report for a discussion of methods, information on water quality criteria, and a glossary of monitoring terms.

The **goals** of the monitoring program are to:

1. Quantify the levels (concentration, flux, or load) of microbial contamination and chemical pollution in watersheds throughout the city.
2. Evaluate impacts of pollution on beneficial uses of creeks and beaches, including recreation and habitat for aquatic organisms.
3. Evaluate the effectiveness of the City's restoration and water quality treatment projects, which includes collecting baseline data for future projects.
4. Identify sources of contaminants and pollution in creeks and storm drains.
5. Evaluate long-term trends in water quality.
6. Meet monitoring requirements for grants.
7. Meet General Permit monitoring requirements.
8. Investigate 303(d)-listed waterbody impairments.

The **underlying motivatio**n behind the monitoring program is to obtain information that the City can use to:

1. Develop strategies for water quality improvement, including prioritization of capital projects and outreach/education programs.
2. Communicate effectively with the public about water quality.

In support of the program goals, the Research Plan consists of six key elements and associated research questions:

1. Grant Project Requirements
2. General Permit Requirements
3. Watershed Assessment (including Creek Walks and Bioassessment
4. Storm Monitoring
5. Restoration and Water Quality Project Assessment
6. Source Tracking

Andrée Clark Bird Refuge

During FY 19 the Creeks Division continued to sample at the Andrée Clark Bird Refuge (Bird Refuge) in support of restoration project design and to understand odor events. Samples to investigate nutrient loading from subwatersheds of the Bird Refuge were collected during storm conditions. Dissolved oxygen monitoring showed that the Bird Refuge continued to experience periods of low dissolved oxygen, despite a lack of odor incidents. Breaching of the beach lagoon had short-term impacts on nutrient, indicator bacteria, and suspended sediment levels in the surf zone, but levels quickly returned to background conditions. Indicator bacteria results in the surf zone were similar to past breaching events studied at Arroyo Burro Lagoon. Baseline dry-weather sampling was conducted in the Bird Refuge, the beach lagoon, and the surf zone in order to compare pre-project water quality with post-project data when the restoration project is constructed.

Creek Restoration and Water Quality Improvement Projects

In addition to analyzing baseline data at the Bird Refuge, the Creeks Division also collected storm samples to assess nutrient, indicator bacteria, and suspended sediment reduction at the Upper Arroyo Burro at Barger Canyon and Arroyo Burro Open Space restoration projects. Samples for nutrients, indicator bacteria, oil and grease, metals, and pesticides were collected from the City's bioretention planters. At least two more years of samples

must be collected from these projects before there are enough data to draw statistical conclusions about performance.

Drought Recovery

Water year 2018-2019 had normal rainfall with several late storms. After prolonged dry conditions in many creek reaches, base flows returned and most creeks continued to flow through FY 19. Shallow groundwater levels also increased in FY 19. Creeks Division staff continue to investigate the connection between creek base flow, shallow and deep groundwater, groundwater pumping, and rainfall. Beach water quality improved during the drought, as measured by the number of beach warnings issued by the County of Santa Barbara and Heal the Bay's Beach Report Cards. Despite normal rainfall levels during two of the past three years, the number of warnings increased only for East Beach at Mission Creek. Based on observations, dry weather warnings at this location may be due to increased presence of seagulls on the beach.

General Permit Monitoring

The Creeks Division conducts monitoring and load reduction calculations to meet the NPDES General Permit Requirements. In FY 19 data was analyzed and the General Permit 5 Year Monitoring Report was prepared.

Andree Clark Bird Refuge

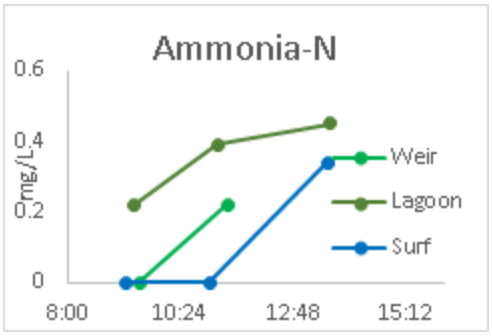
During FY 19 the Creeks Division continued to sample at the Andrée Clark Bird Refuge (Bird Refuge) in support of restoration project design and to understand odor events. Samples to investigate nutrient loading from subwatersheds of the Bird Refuge were collected during storm conditions. Dissolved oxygen monitoring showed that the Bird Refuge continued to experience periods of low dissolved oxygen, despite a lack of odor incidents. Breaching of the beach lagoon had short-term impacts on nutrient, indicator bacteria, and suspended sediment levels in the surf zone, but levels quickly returned to background conditions. Indicator bacteria results in the surf zone were similar to past breaching events studied at Arroyo Burro Lagoon. Baseline dry-weather sampling was conducted in the Bird Refuge, the beach lagoon, and the surf zone in order to compare pre-project water quality with

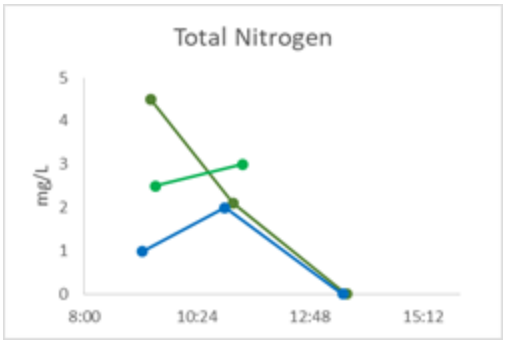
post-project data when the restoration project is constructed. Last, data were used to create a conceptual model in support of the restoration project design.

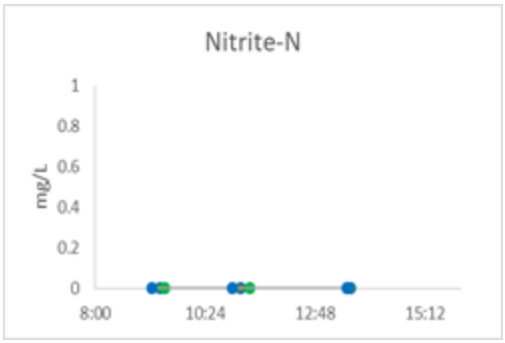
Storm monitoring

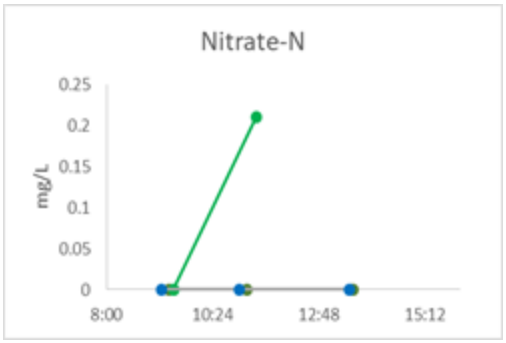
The The CreeksDivision sought test the impact of a breaching event on beach water quality in January, 2019. Samples were collected before, during, and after the breach event at the weir, the lagoon outlet, and in the surf zone. ·

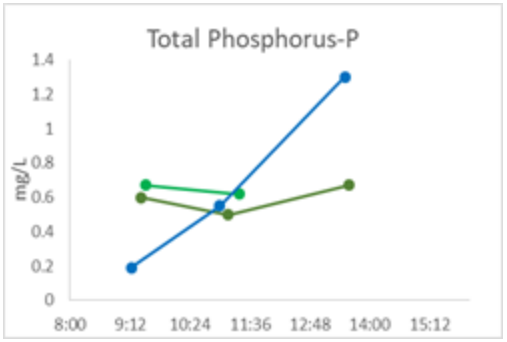
As shown in the figures below, the breach event showed increased nutrients, bacteria, and sediment over the short term, similar to what has been seen at other breach events from creeks in Santa Barbara.Toxicity tests of water discharging from the lagoon showed 100% survival of fathead minnow (96 hr) and 75% survival of ceriodaphnia (96-hr).

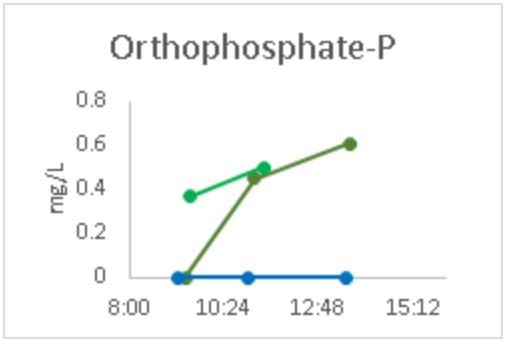


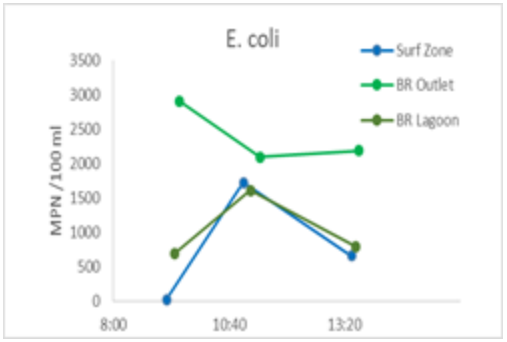


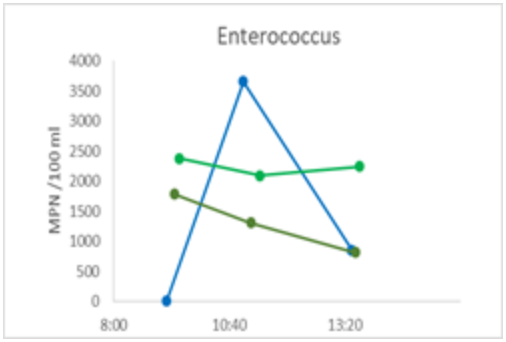


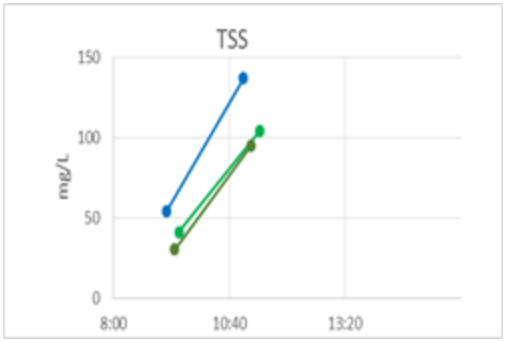




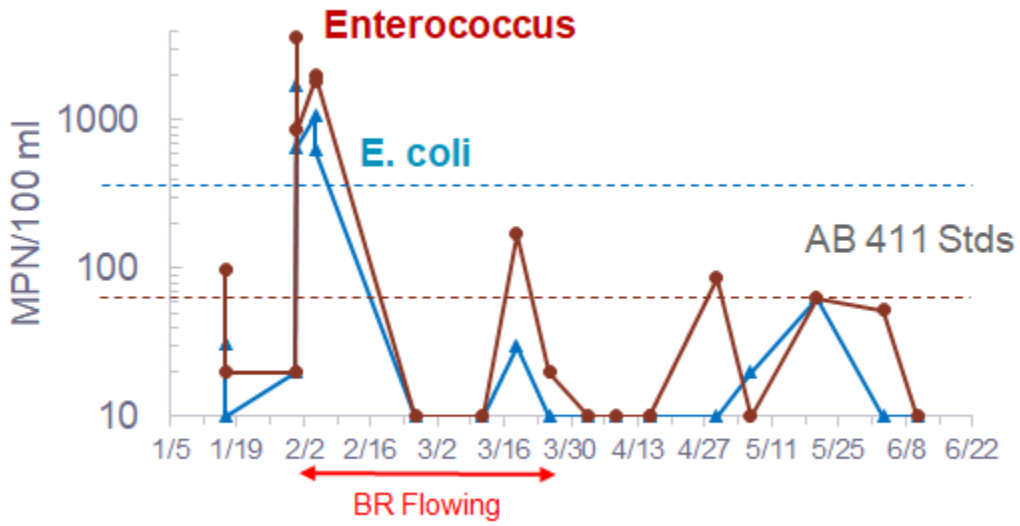








As shown in the figure blow, fecal indicator bacteria returned to baseline conditions several days after the breach, again similar to other creek outlets in Santa Barbara.



Dry weather monitoring will be presented in the following annual report.

Conceptual Modeling

Through extensive studies and monitoring efforts, the City has developed a broad understanding of existing conditions and key obstacles to ecosystem function at the Bird Refuge. Despite the small geographic scale of the project, a myriad of physical constraints shape water quality and habitat conditions. In turn, the ecology of the lagoon is impacted at every trophic level. Following guidance of CALFED (2000), a conceptual model is presented to articulate not only the City's understanding of the lagoon ecosystem, but also the expected qualitative outcomes of the proposed restoration project. Fischenich (2008) notes that there is no specific form for conceptual restoration models. Because of the critical spatial component of the proposed project, a mapped conceptual model for existing conditions and expected post-project conditions is presented; this approach follows the example of PWA (2003) for tidal restoration by the National Park Service. Figure 1 shows the conceptual model of existing conditions at the Bird Refuge. The primary physical drivers of compromised ecology are the lack of hydrologic connection among the ocean, lower lagoon, and upper lagoon, preventing movement of biota, and the lack of nutrient removal by any means. The continual input of nutrients without removal leads to the key habitat compromise: extremely severe eutrophication and anoxic or hypoxic conditions throughout the water column for days to weeks at time. Entire trophic levels (BMI, fish) are nearly nonexistent from the upper lagoon due to hypoxia. In turn, prey for fish, reptiles, and birds is scarce. Figure 2 shows the conceptual model of the Bird Refuge after the restoration project is complete, using the site plan diagram to map the expected impact of design elements on the physical, habitat, and ecosystem outcomes. The conceptual model can be used to guide monitoring and adaptive management throughout the life of the project (DiGennaro et al. 2012).

References:

CALFED 2000. Strategic plan for ecosystem restoration. CALFED Bay-Delta program. Sacramento, CA

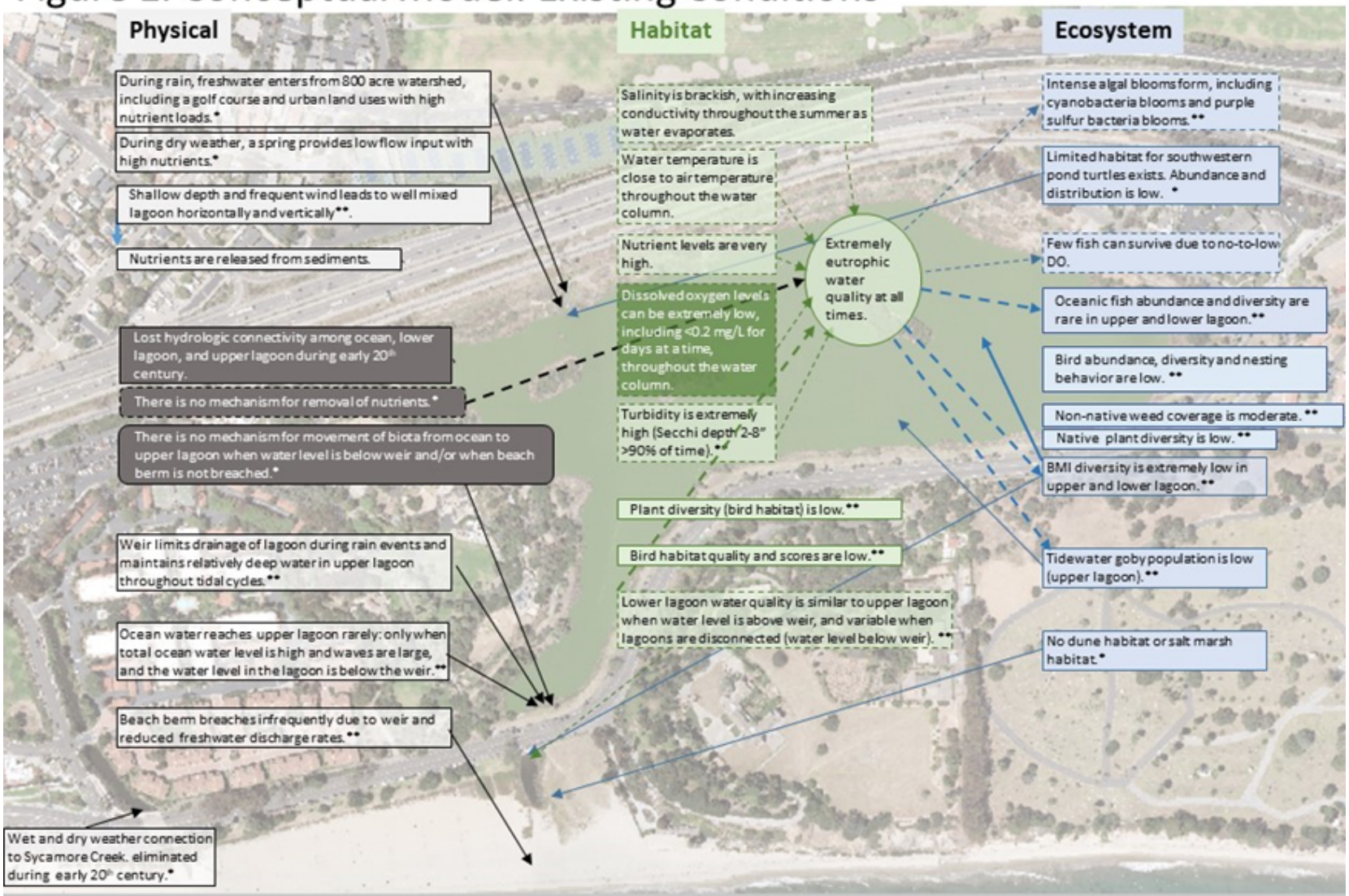
DiGennaro B, Reed D, Swanson C, Hastings L, Hymanson Z, Healey M, Siegel S, Cantrell S, Herbold B. 2012. Using conceptual models in ecosystem restoration decision making: an

example from the Sacramento–San Joaquin River Delta, California. San Franc Estuary Watershed Sci

Fischenich, C. 2008. The application of conceptual models to ecosystem restoration. ERDC/EBA TN-08-1. Vicksburg, MS: US Army Engineer Research and Development Center.

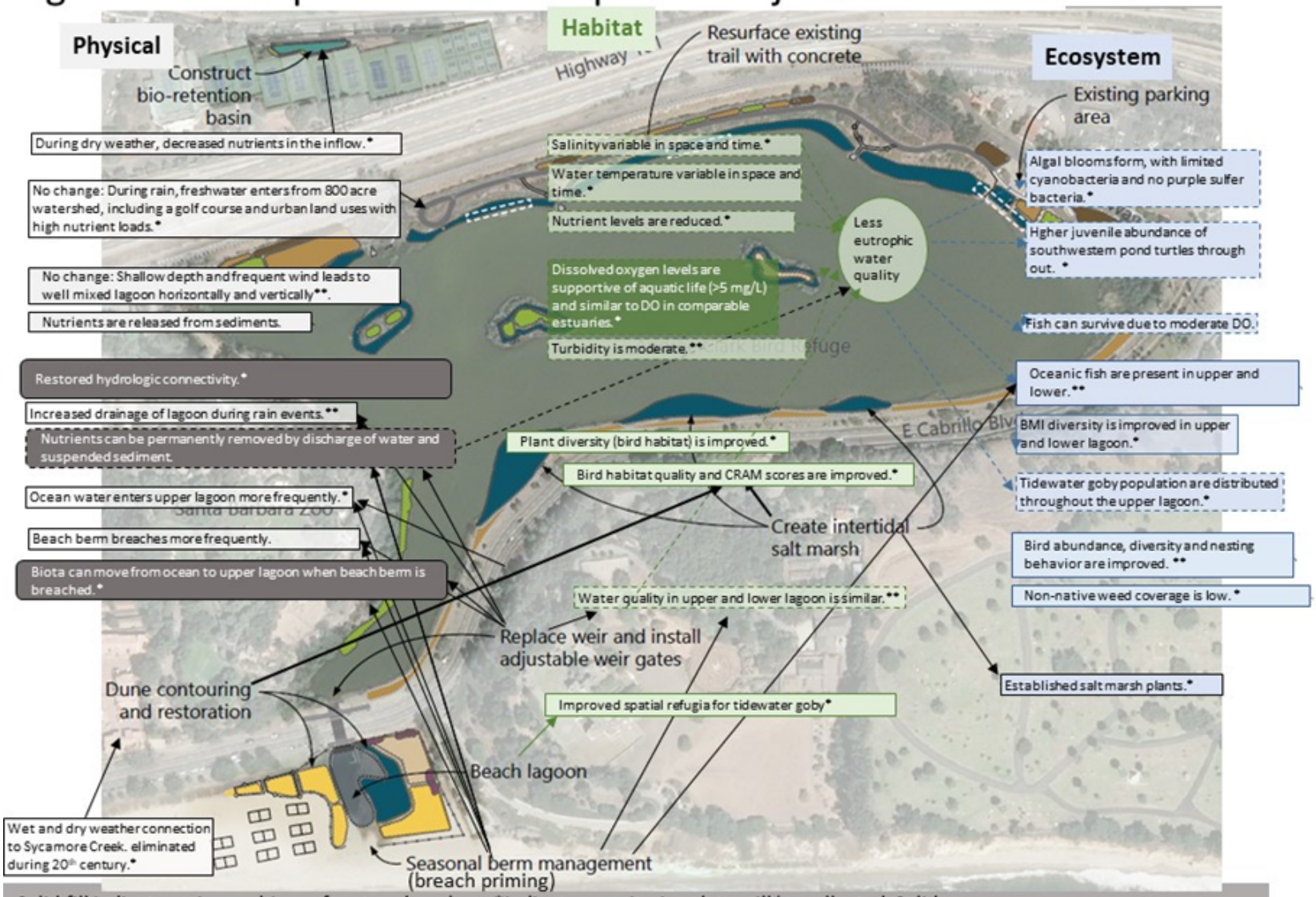
Phillip Williams and Associated (PWA). 2003. Big Lagoon Wetland and Creek Restoration Project, Muir Beach, CA. Part I. Site Analysis Report. Prepared with assistance from Stillwater Science for the National Park

Figure 1. Conceptual Model: Existing Conditions



Solid fill indicates primary driver of compromised ecology. *indicates supporting data exists; ** indicates substantial supporting data exists. Solid arrows indicate a specific location; dashed lines indicate direct connections to or impacts from poor water quality due to eutrophic conditions.

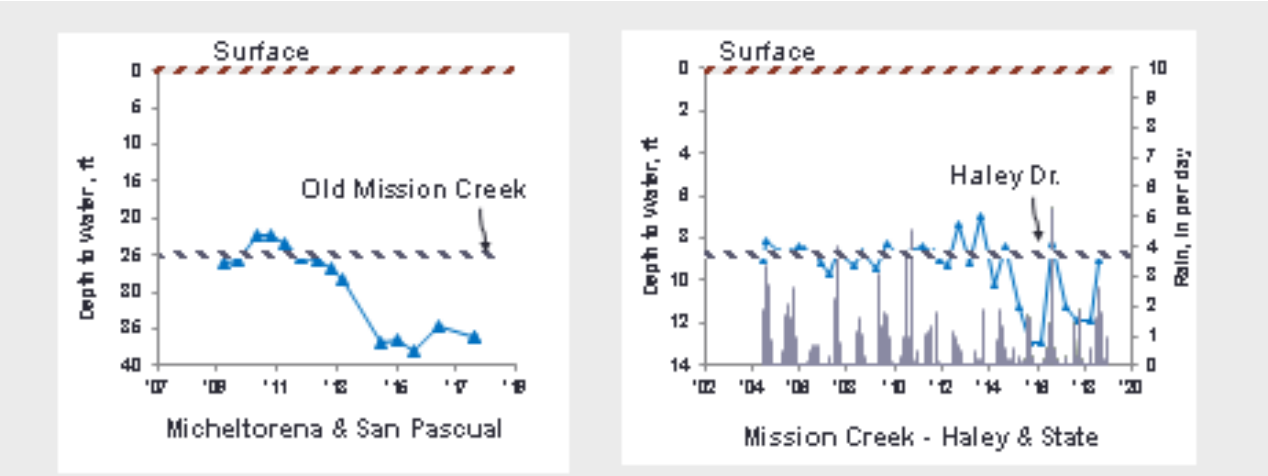
Figure 2. Conceptual Model: Proposed Project Conditions

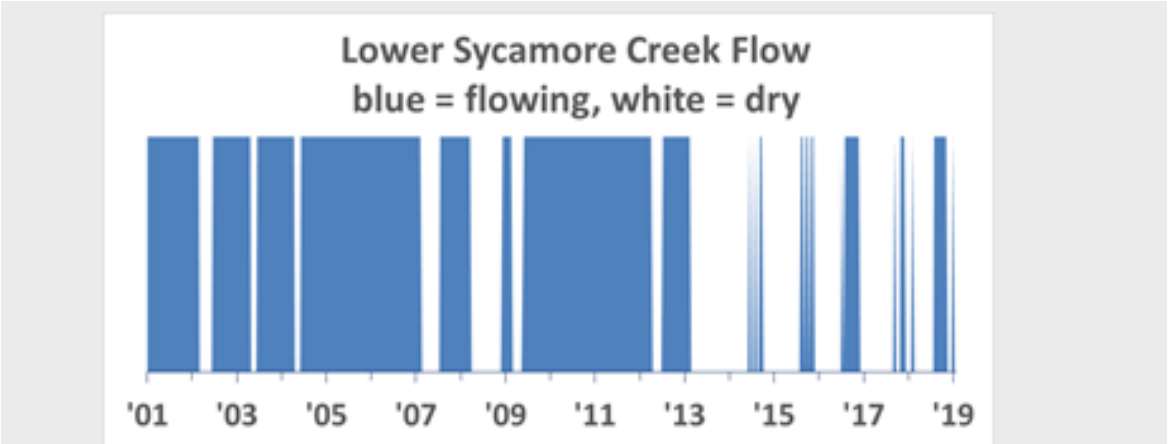


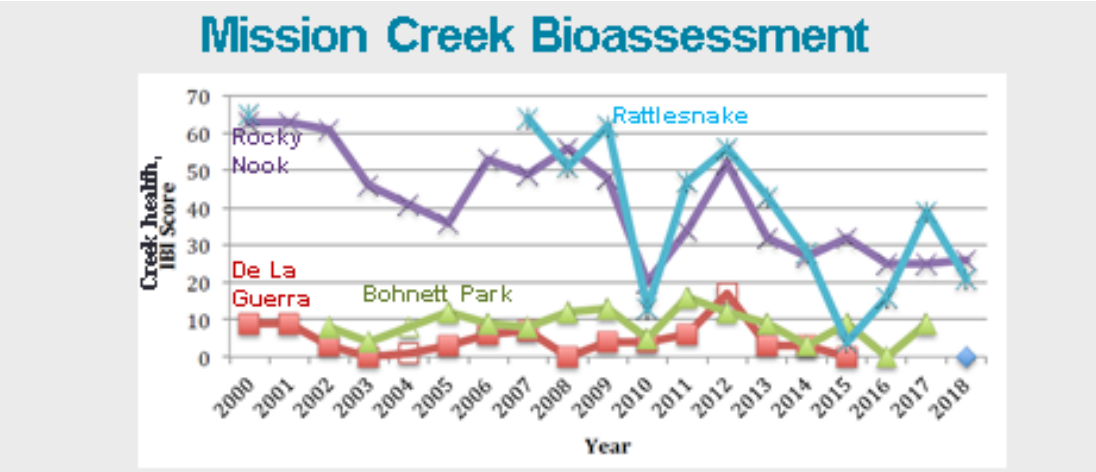
Solid fill indicates primary driver of restored ecology. *indicates monitoring data will be collected. Solid arrows indicate a specific location; dashed lines indicate direct connections to or impacts from improved water quality.

Drought Recovery & Beach Water Quality

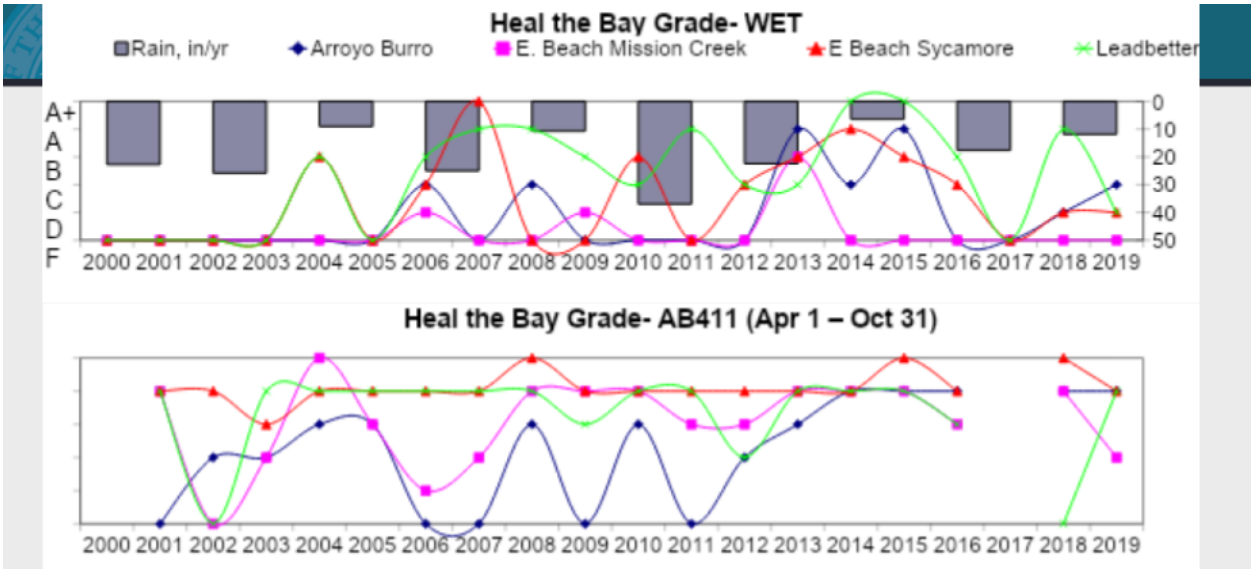
After normal rainfall two of the past three years, the drought officially ended. However, effects continue. Short-term replenishment of shallow groundwater (shown in the figure below) has not persisted and the water table is still below the creeks in many areas. Many creeks sites have been dry for extended periods, as shown in the figure below for Sycamore Creek. Bioassessment scores show rapid recovery from fire and scouring events, but drought recovery is a lengthier process (see figure below).





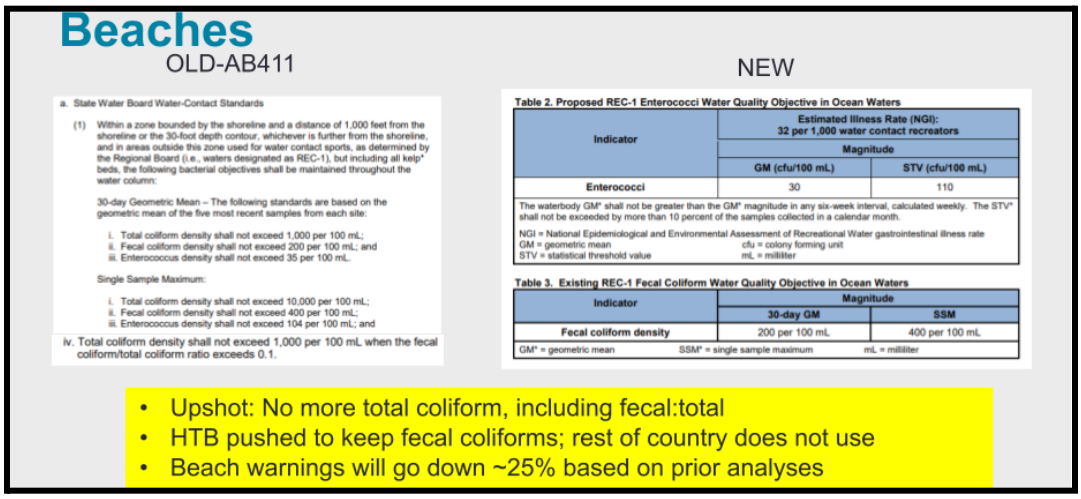


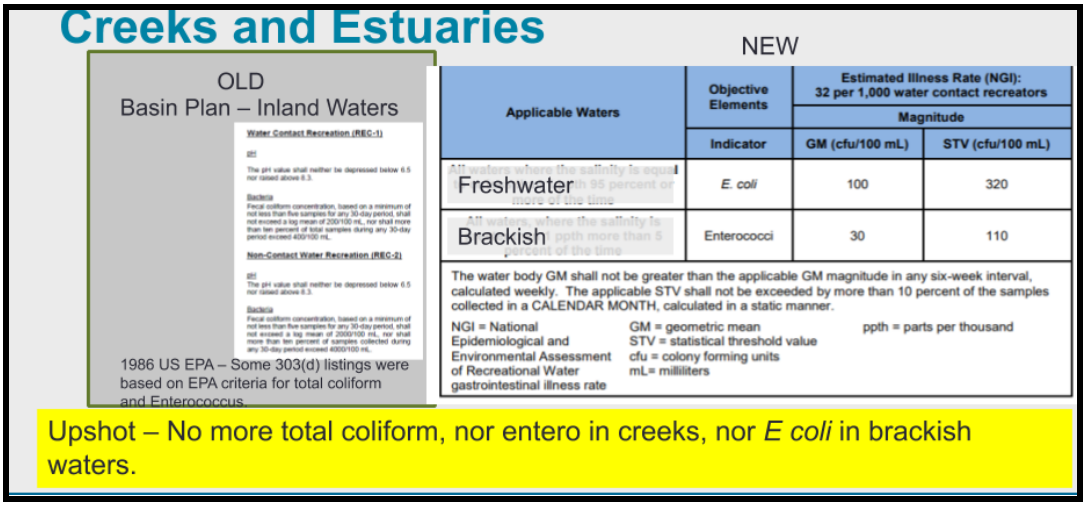
Beach water quality, as shown by fecal indicator bacteria levels and grades from Heal the Bay, showed improvement during the drought due to the lack of flowing creeks and drains. Grades have recently fallen due to normal rainfall levels and creek flow, as shown in the figure below.



Regulatory Update - Statewide Bacteria Provisions

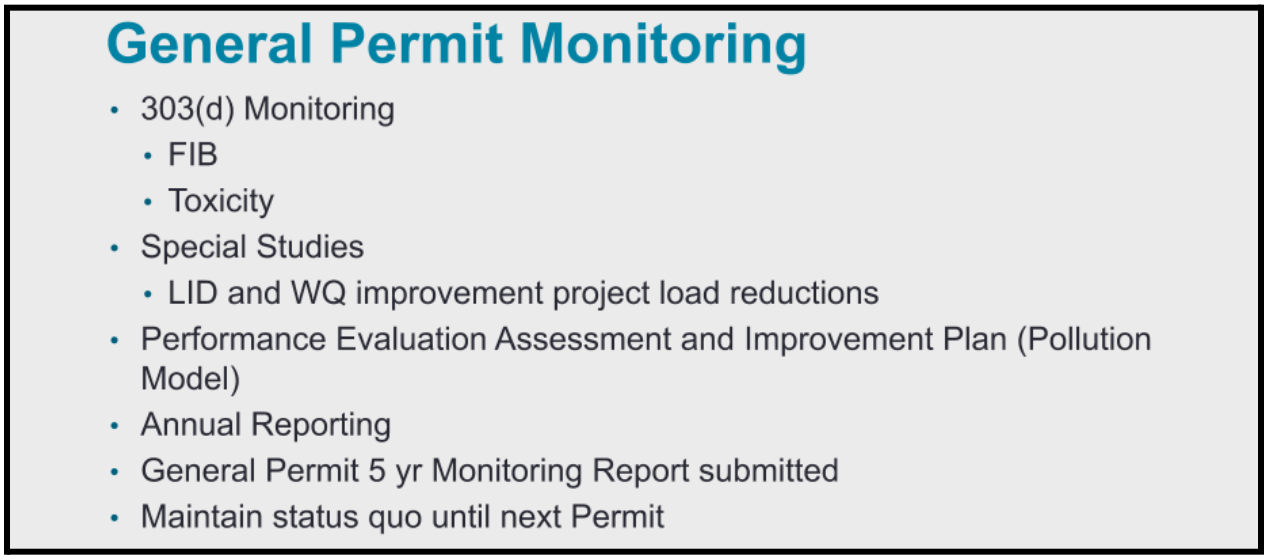
Beach monitoring criteria have changed recently due to the new Statewide Bacteria Provisions, shown in the figures below.. In 2012 the US EPA updated bacteria objectives and in 2018 the California Water Board drafted Statewide Bacteria Provisions, In 2019 the provisions were approved by the US EPA. It is not clear when Basin Plans, 303(d) lists, AB411 Beach Warnings and Heal the Bay report cards will be based on the new criteria.





General Permit Monitoring

General Permit Monitoring includes the requirements shown in the following figure:



The City conducted all of the required monitoring provided the following information to the Water Board:

Introduction

During Permit Year 6, the City carried out monitoring for Special Studies and 303(d) Monitoring under Regional-Board Approved Monitoring Plan/QAPPs. The City also carried out extensive monitoring and research under the Creeks Advisory Committee-approved Water Quality Research and Monitoring Plan (not included here).

Special Studies Monitoring

Special Studies Monitoring was carried out according to the approved Monitoring Plan/QAPP with the following exceptions: the Haley Drain was not sampled due to lack of flow during dry weather. The Hope Drain and Westside Drain were not sampled due to lack of operation. As discussed in previous reports, the City added asecond LID project, the Streets, Sidewalks and Alleys Project, to load reduction estimates.

In Permit Year 5, the City completed and made available a 5-year report that included a comparison of data collection to baseline data and discussion of monitoring program results. In the current Year 6 report, the format returns to that used during Years 1-4.

303(d) Monitoring

303(d) Monitoring was carried out according to the approved Monitoring Plan/QAPP with the following exceptions:

Sycamore Creek was not sampled on 17 sample dates due to non-existent flow in the creek. Mission Creek was not sampled on five samples dates, and Arroyo Burro was not sampled on three sample dates due to holiday closures of City offices, storm sampling, and staff illness. Fecal indicator bacteria results are shown in Figure 1. Project Action Limits are shown for visual comparison; however additional calculations are required to demonstrate exeedances. Table 1 shows the samples which exceed Project Action Limits; note, however, that the water quality objectives underlying the Project Action Limits were developed mostly for beach environments and are not typically applied to freshwater. For comparison purposes, beach water quality exceedances are summarized in Table 2 (these data were acquired from the County of Santa Barbara and were not sampled by the City).

Toxicity testing was completed during Permit Year 5.

There is no separate or specific report required by the Permit for this Project. Recent fecal indicator bacteria data generated under this project have not been uploaded and checked by the Regional Data Center for upload to California Environmental Data Exchange Network (CEDEN) because the Regional Data Center does not have staff available to check uploads.

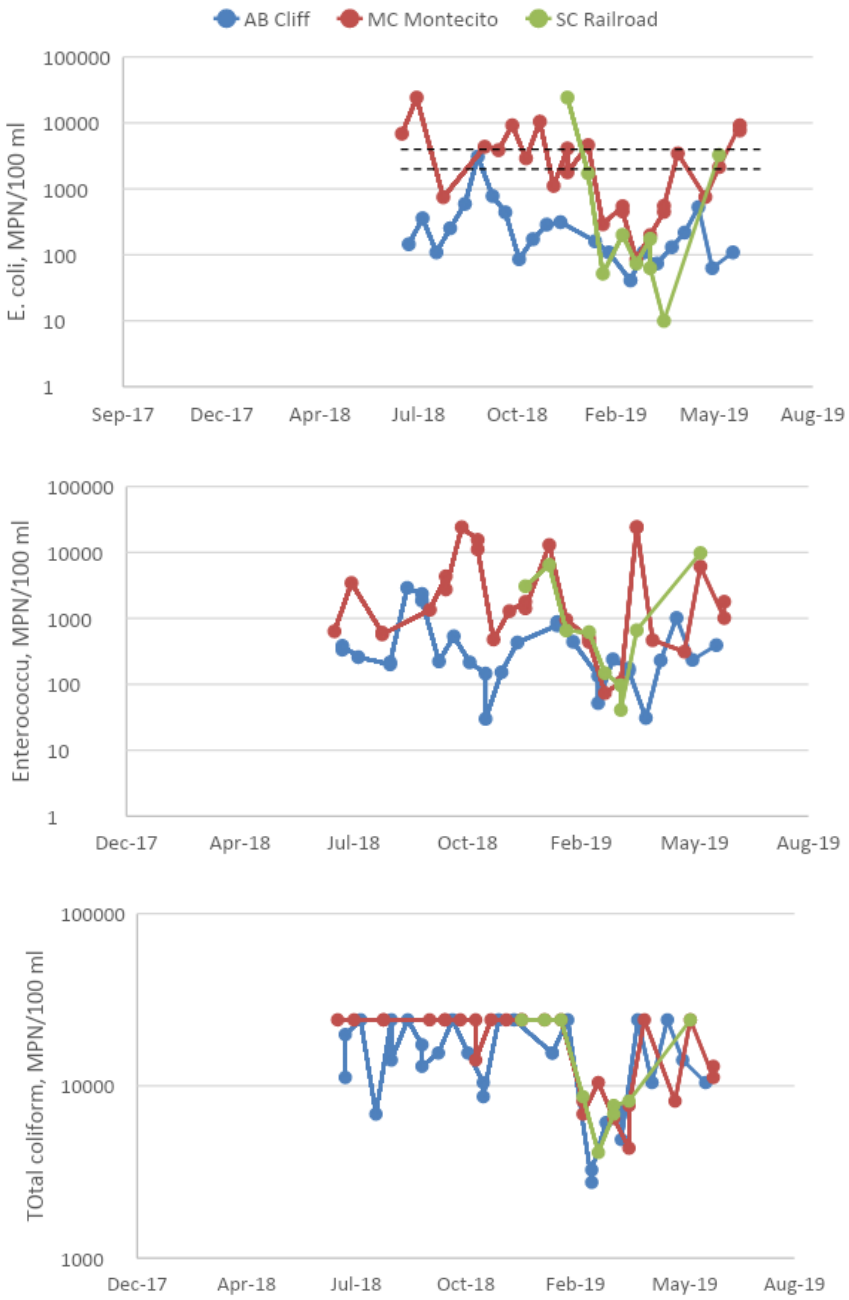


Figure 1. Fecal indicator bacteria results during Permit Year 6. Missing data points represent dates when creek was not flowing due to drought. Horizontal lines represent or partially represent Project Action Limits as follows: fecal coliform/E. coli, 10% of samples should not exceed 4,000 MPN/100 ml (upper line) during any 30 day period and 5-sample/30 day geomean should not exceed 2,000 MPN/100 ml (lower line); note that due to only two samples collected per 30-day period, the upper limit functions as a single sample maximum for these samples and note that geomeans were not calculated due to sampling frequency < 5 samples/30 days. Enterococcus: no Project Action Limit. Total coliform: Samples should not exceed 1,000 MPN/100 ml when the ratio of fecal coliform/total coliform>0.1.

Table 1. 303(d) Fecal Indicator Bacteria Monitoring Results, Permit Year 6. Shading represents exceedances. See Figure 1 heading for standards.

StationID	Date		E. coli		Enterooccus		Total Coliform	Ratio
AB Cliff	7/23/2018		359		259		24192	0.015
AB Cliff	8/6/2018		109		201		6867	0.016
AB Cliff	8/20/2018		253		216		24192	0.010
AB Cliff	9/4/2018		594		2359	>	24192	0.025
AB Cliff	9/17/2018		3076		1872		17329	0.178
AB Cliff	10/2/2018		780		537		15531	0.050
AB Cliff	10/15/2018		441		216	>	24192	0.018
AB Cliff	10/29/2018		86		146		15531	0.006
AB Cliff	11/12/2018		173		30		10462	0.017
AB Cliff	11/26/2018		288		153	>	24192	0.012
AB Cliff	12/10/2018		313		432	>	24192	0.013
AB Cliff	1/14/2019		161		785		15531	0.010
AB Cliff	1/28/2019		109		443	>	24192	0.005
AB Cliff	2/19/2019		41		134		2755	0.015
AB Cliff	3/4/2019		108		240		6131	0.018
AB Cliff	3/18/2019		74		175		7270	0.010
AB Cliff	4/2/2019		131		31	>	24192	0.005
AB Cliff	4/15/2019		218		231		10462	0.021
AB Cliff	4/29/2019		529		1017		24192	0.022
AB Cliff	5/13/2019		63		235		14136	0.004
AB Cliff	6/3/2019		109		393		10462	0.010
MC Monteci	7/2/2018		6867		638	>	24192	0.284
MC Monteci	7/17/2018	>	24192		3448	>	24192	1.000
MC Monteci	8/13/2018		749		609	>	24192	0.031
MC Monteci	9/24/2018		4352		1354	>	24192	0.180
MC Monteci	10/8/2018		3873		4352	>	24192	0.160
MC Monteci	10/22/2018		9208	>	24192	>	24192	0.381
MC Monteci	11/5/2018		2909		15531	>	24192	0.120
MC Monteci	11/19/2018		10462		480		24192	0.432
MC Monteci	12/3/2018		1112		1291	>	24192	0.046
MC Monteci	12/17/2018		4106		1785	>	24192	0.170
MC Monteci	1/7/2019		4611		12997	>	24192	0.191
MC Monteci	1/22/2019		291		959	>	24192	0.012
MC Monteci	2/11/2019		546		504		8164	0.067
MC Monteci	2/25/2019		85		74		10462	0.008
MC Monteci	3/11/2019		199		108		6488	0.031
MC Monteci	3/25/2019		448		24192		4352	0.103
MC Monteci	4/8/2019		3448		468	>	24192	0.143
MC Monteci	5/6/2019		754		313		8164	0.092
MC Monteci	5/20/2019		2142		6131	>	24192	0.089
MC Monteci	6/10/2019		9208		1014		11199	0.822

SC Railroa	12/17/2018	>	24192		3076	>	24192	1.000
SC Railroa	1/7/2019		1723		6488	>	24192	0.071
SC Railroa	1/22/2019		52		657		24192	0.002
SC Railroa	2/11/2019		201		620		8664	0.023
SC Railroa	2/25/2019		74		148		4106	0.018
SC Railroa	3/11/2019		175		97		6867	0.025
SC Railroa	3/25/2019	<	10		663		8164	0.001
SC Railroa	5/20/2019		3255		9804	>	24192	0.135
EXCEEDANCES			9				15	

Table 2. Santa Barbara County Beach Water Quality Results during Permit Year 6 for Beaches Impacted by 303(d) impaired water sampled here. Warning means one or more of the AB 411 criteria were exceeded, and n.s. represents no sample was collected, typically on days where resamples were collected for some beaches but not others. Blank cells represents that the sample was collected and the results were within compliance with the standards.

Date	**Arroyo Burro**	Mission Creek at East Beach	**Sycamore Creek at East Beach**
7/2/2018			
7/9/2018			
07/16/18			
07/23/18			
07/30/18		Warning	
08/01/18	#N/A	Warning	#N/A
08/06/18			
08/13/18		Warning	
08/20/18			
08/22/18	#N/A	#N/A	#N/A
08/27/18			
09/03/18			
09/10/18			
09/17/18			
09/24/18			
10/01/18			
10/08/18			
10/15/18			
10/22/18	Warning	Warning	
10/29/2018			
11/5/2018			
11/13/2018			
11/19/2018			
11/26/2018			
12/3/2019		Warning	
12/5/2019	#N/A	Warning	#N/A
12/10/2019			
12/17/2019			
12/19/2019	#N/A	#N/A	#N/A
12/31/2019			
1/7/2019	Warning	Warning	Warning
1/9/2019	Warning	Warning	Warning
1/14/2019		Warning	
1/16/2019	#N/A	Warning	#N/A
1/21/2019			
1/28/2019			
2/4/2019	Warning	Warning	Warning
2/6/2019		Warning	
2/11/2019	Warning	Warning	Warning
2/18/2019			
2/25/2019			
3/4/2019		Warning	
3/6/2019	#N/A	Warning	#N/A
3/11/2019			
3/18/2019		Warning	
3/25/2019	Warning	Warning	
3/27/2019	#N/A	Warning	#N/A
4/1/2019			
4/8/2019		Warning	
4/15/2019			
4/22/2019			
5/6/2019			

5/20/2019			
5/27/2019		Warning	
6/3/2019			
6/10/2019			
6/24/2019			