



Morro Bay National Estuary Program's
Implementation Effectiveness Program
For the Morro Bay Watershed

**Stormwater Monitoring Report
2014**

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Executive Summary

The Morro Bay National Estuary Program (Estuary Program) conducts monitoring in the Morro Bay estuary and watershed to gather data to track long-term ambient trends, to study project effectiveness, and to guide future implementation efforts. Program-collected data also supports the stormwater management efforts of local municipalities and agencies. As part of this report, data was compiled for *E. coli* and enterococcus for eight bay sites, for total coliform for one creek site, and for *E. coli* for two creek sites.

- Six bay sites had little to no indication of bacterial contamination compared to safe swimming levels: Coleman Beach, Tidelands Park, Windy Cove and State Park Marina in Morro Bay; and Cuesta Inlet and Sharks Inlet in Los Osos. When compared to the stricter standards for the protection of shellfish growing areas, all sites had some exceedances, varying from 5 to 29% of the total samples.
- Two sites continue to have elevated bacteria levels: Baywood Pier and Pasadena Point in Los Osos. Historical bacterial levels are in line with the current analysis, with approximately a quarter of the samples exceeding the regulatory standard for safe swimming at Baywood Pier and 16% exceeding at Pasadena Point.
- On Chorro Creek at Twin Bridges, only one sample of eight exceeded the safe swimming level for *E. coli*.
- On Los Osos Creek, none of the samples exceeded the safe swimming level for *E. coli* (of 12 samples) or enterococcus (of 10 samples).

Introduction

The Morro Bay National Estuary Program (Estuary Program) works to restore, understand and educate to help protect and preserve the Morro Bay estuary and its watershed. To that end, the program maintains a Monitoring Program which trains and coordinates staff and volunteers to conduct different types of monitoring in the estuary and the lands that drain into it.

The Estuary Program is a non-profit organization that is non-regulatory in nature. The monitoring data collected has three primary goals: to provide a long-term ambient data set; to provide data on the effectiveness of various implementation efforts; and to help identify potential problem areas that might be addressed by future projects.

Stormwater management is a regulatory area that is currently in flux. Local municipalities are working to effectively manage stormwater with limited budgets and resources. An area where the Estuary Program can contribute to this effort is through monitoring. Estuary Program data is collected monthly at sites throughout the bay and at the creek mouths. The city of Morro Bay collects data every other month from bay receiving waters. The county monitoring plan includes run-off from county-run facilities throughout the watershed. Estuary Program data, in combination with data from municipalities, provides a more well-rounded picture of water quality.

In addition to supporting local stormwater management efforts, Estuary Program data also supports the following efforts:

- Assessment of the Morro Bay Pathogen Total Maximum Daily Load (TMDL)
- Updating of the 303(d) list of impaired waterbodies
- Assessment of the TMDL Wasteload Allocation Attainment Plan for San Luis Obispo County
- Assessment of the TMDL Wasteload Allocation Attainment Plan for the City of Morro Bay
- Tracking of stormwater management efforts by the Los Osos Community Services District (LOCSO)
- Regulation of shellfish growing waters by the California Department of Public Health (CDPH)
- Assessment of safety of waters for swimming, by the County of San Luis Obispo Environmental Health Services

The Estuary Program conducts bacteria monitoring at additional sites throughout the watershed. Information on these additional sites was not included in this report since they are outside of the jurisdiction of the municipalities responsible for stormwater management. Details on these sites and results will be available in the Estuary Program’s *Data Summary Report 2014*, which will be issued in October 2014 and available on the Estuary Program website.

Monitoring Background

The Estuary Program’s Monitoring Program has been conducting regular on-going monitoring throughout the estuary and watershed for over ten years. Program volunteers conduct on-going monitoring of water quality in the bay and creeks. Bacteria monitoring in Morro Bay and the watershed has been a component of this effort. Program staff train volunteers to collect samples and process them for various bacterial indicators.

Analysis methods and detection limits for the various indicators are presented in the following table.

Table 1. Bacteria Indicators and Frequency of Monitoring for Estuary Program Effort

Analyte	Type of Water	Frequency	Organization Conducting Analysis	Analytical Method	Detection Limit for Reporting	Sample Hold Times
Total coliform	Freshwater (creeks)	Monthly	MBNEP volunteers	IDEXX, Colilert-18	2 MPN/100 mL	8 hours preferred, 24 hours is acceptable
<i>E. coli</i>	Freshwater (creeks)	Monthly	MBNEP volunteers	IDEXX, Colilert-	2 MPN/100	8 hours preferred,

Analyte	Type of Water	Frequency	Organization Conducting Analysis	Analytical Method	Detection Limit for Reporting	Sample Hold Times
				18	mL	24 hours is acceptable
	Marine water (bay and tidally-influenced creeks)	Monthly	MBNEP volunteers	IDEXX, Colilert-18	2 MPN/100 mL	8 hours preferred, 24 hours is acceptable
Enterococcus	Marine water (bay and tidally-influenced creeks)	Monthly	MBNEP volunteers	IDEXX, Enterolert	2 MPN/100 mL	8 hours preferred, 24 hours is acceptable
Fecal coliform	Freshwater (creeks)	Monthly	SLO County Public Health Laboratory	Standard Method 9221 E.2.A-1	2 MPN/100 mL	24 hours
	Freshwater (creeks) during storm flows	When feasible	SLO County Public Health Laboratory	Standard Method 9221 E.2.A-1	2 MPN/100 mL	24 hours
	Marine water (bay)	Quarterly	SLO County Public Health Laboratory	Standard Method 9221 E.2.A-1	2 MPN/100 mL	24 hours

The majority of monitoring is conducted by Estuary Program volunteers. These volunteers typically have a background in science or laboratory work, although some do not. Volunteers are trained and coordinated by program staff. Volunteers undergo extensive training in sterile technique, sample collection technique, lab analysis methods, and sample result interpretation. Program staff oversee the operation of the lab space, which is housed in the Morro Bay Wastewater Treatment Plant laboratory. WWTP staff support the program by running the autoclave to provide sterile glassware and water for the analysis.

Protocols describing sample collection, analysis and interpretation are contained in the program's Quality Assurance Project Plan (QAPP). This plan follows the 24-section Surface Water Ambient Monitoring Program (SWAMP) format for QAPPs. It is updated on an annual basis and reviewed by the EPA's Office of Quality Assurance, as well as the QA Officer for the Central Coast Regional Water Quality Control Board (CCRWQCB). For full details of the monitoring protocols, please refer to the most recent version of the Morro Bay National Estuary Program's QAPP.

Monitoring Sites

When selecting bacteria monitoring sites, several factors were taken into account:

- Locations of historical monitoring
- Locations of implementation projects
- Landowner permission
- Safe access
- Areas with recreational use such as swimming, wading and boating

The monitoring sites are illustrated on the following map.



The sites, analytes, monitoring frequency and entities making use of the data are summarized in the following table.

Table 2. Monitoring Site Details for Estuary Program Monitoring Effort

Site Code	Site Description	Analytes	Frequency of Monitoring	Stormwater Regulatory Jurisdiction	Entity Using Data
COL	Coleman Beach	<i>E. coli</i> , enterococcus	Monthly	City of Morro Bay	CDPH, city of Morro Bay, SLO County Public Works, SLO County Public Health Dept
TID	Tidelands Park	<i>E. coli</i> , enterococcus	Monthly	City of Morro Bay	CDPH, city of Morro Bay, SLO County Public Health Dept
		Fecal coliform	Quarterly	City of Morro Bay	CDPH
WIN	Windy Cove	<i>E. coli</i> , enterococcus	Monthly	City of Morro Bay	CDPH, city of Morro Bay, SLO County Public Health Dept
SPM	State Park Marina	<i>E. coli</i> , enterococcus	Monthly	City of Morro Bay	CDPH, city of Morro Bay, SLO County Public Health Dept
		Fecal coliform	Quarterly	City of Morro Bay	CDPH
PAS	Pasadena Point	<i>E. coli</i> , enterococcus	Monthly	County of SLO, LOCSD	CDPH, SLO County Public Works, SLO County Public Health Dept, LOCSD
		Fecal coliform	Quarterly	County of SLO, LOCSD	CDPH
BAY	Baywood Pier	<i>E. coli</i> , enterococcus	Monthly	County of SLO, LOCSD	CDPH, SLO County Public Works, SLO County Public Health Dept, LOCSD
CIN	Cuesta Inlet	<i>E. coli</i> , enterococcus	Monthly	County of SLO, LOCSD	SLO County Public Works, SLO County Public Health Dept, LOCSD
SIN	Sharks Inlet	<i>E. coli</i> , enterococcus	Monthly	State Parks	SLO County Public Works, SLO County Public Health Dept
TWB	Chorro Creek	<i>E. coli</i> , Total coliform	Monthly	State Parks	CDPH, city of Morro Bay, SLO County Public Works, SLO County Public Health Dept
		Fecal coliform	Monthly	State Parks	CDPH

Site Code	Site Description	Analytes	Frequency of Monitoring	Stormwater Regulatory Jurisdiction	Entity Using Data
	Chorro Creek during storm flows	Fecal coliform	As needed	State Parks	CDPH
SYB	Los Osos Creek	<i>E. coli</i>	Monthly	State Parks	CDPH, SLO County Public Works, SLO County Public Health Dept
GS1	Los Osos Creek	Fecal coliform	Monthly	State Parks	CDPH
	Los Osos Creek during storm flows	Fecal coliform	As needed	State Parks	CDPH

GS1 is located immediately downstream from SYB. The analysis and results for GS1 will be included in the *Data Summary Report 2014*, to be issued in October 2014.

Data Analysis

The data was compiled and compared to various applicable standards for receiving waters from sources including the CCRWQCB's Basin Plan, EPA guidance documents, and CDPH regulations for shellfish growing waters.

Bay Data for *E. coli* and Enterococcus

Analysis was conducted for bay bacteria data for *E. coli* and enterococcus from July 2013 through June 2014. In this analysis, the data was compared to the following criteria:

- For *E. coli*, standards do not exist for marine waters. In previous analyses conducted with Estuary Program data, the results were compared to the REC-1 standard from the EPA's Ambient Water Quality Criteria for Bacteria Guidance, 1986. The current analysis uses EPA's 2012 Recreational Water Quality Criteria and its Recommendation 1 standard of 410 MPN/100 mL to determine how many samples exceeded this value. This is a freshwater criterion that has been adapted for marine waters, upon the advice of the CCRWQCB.
- For enterococcus, the results are compared to a value of 130 MPN/100 mL to determine how many samples exceeded this value. Again, this criterion is from EPA's 2012 Recreational Water Quality Criteria for freshwater.

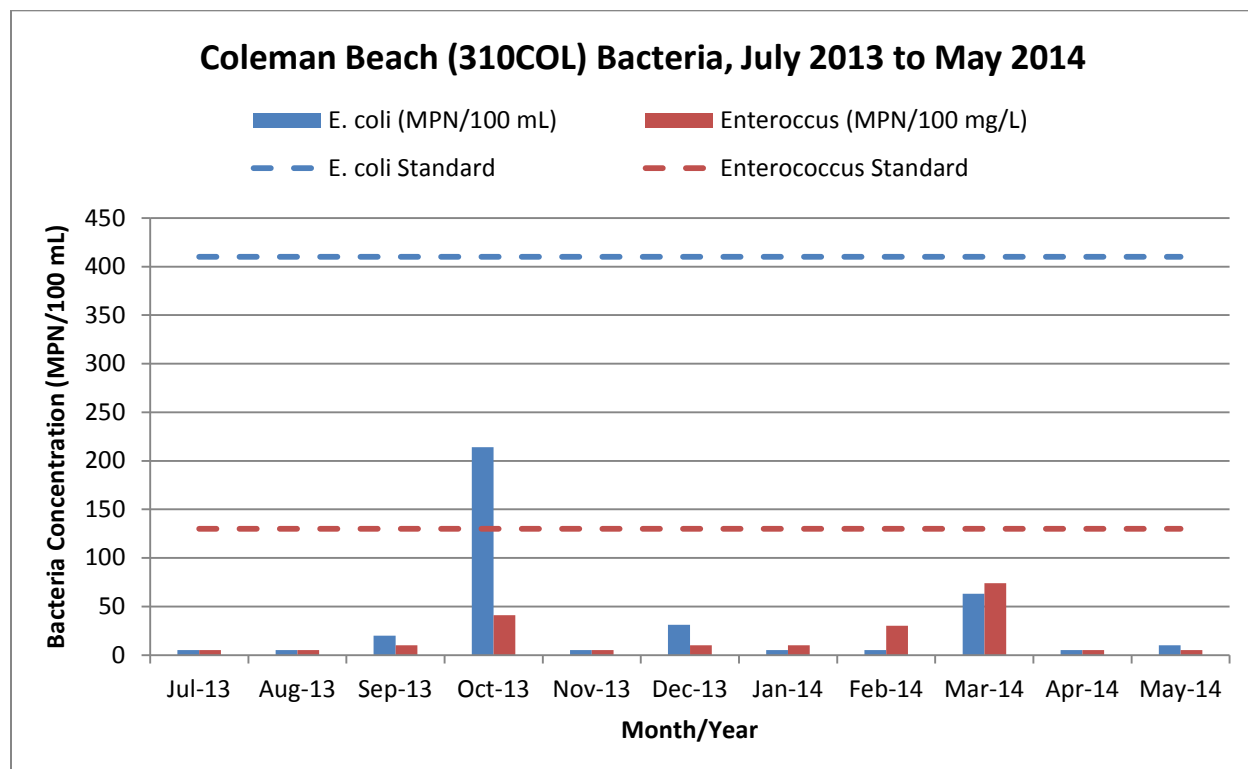
The percent of samples exceeding each of these criteria are presented in the following table.

Table 3. Geomean and Percent of Samples Exceeding Standards for *E. coli* and Enterococcus for July 2013 to June 2014

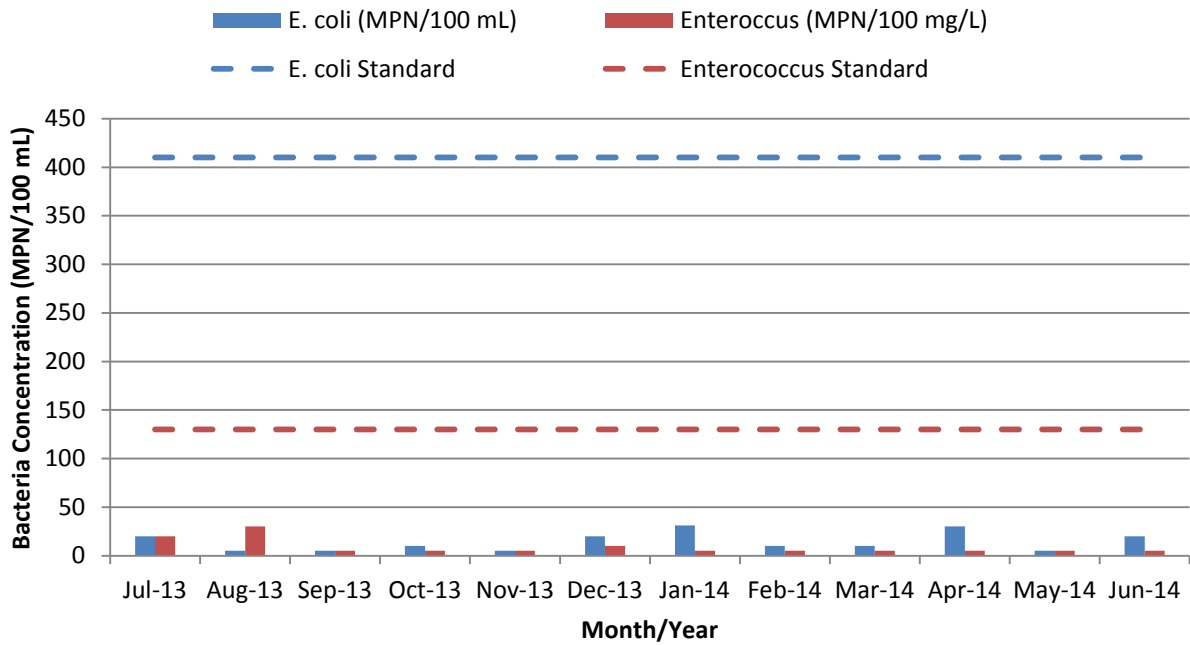
Site	<i>E. coli</i> Geomean (MPN/100 mL)	% <i>E. coli</i> samples > 410 MPN/100 mL	Enterococcus Geomean (MPN/100 mL)	% Enterococcus samples > 130 MPN/100 mL
310COL	12.6	0.0%	11.0	0.0%
310TID	11.4	0.0%	6.9	0.0%
310WIN	33.9	8.3%	18.7	8.3%
310SPM	13.9	0.0%	9.6	0.0%
310PAS	35.0	8.3%	35.3	16.7%
310BAY	39.4	0.0%	28.1	25.0%
310CIN	14.3	0.0%	9.8	8.3%
310SIN	8.3	0.0%	11.5	0.0%

Note: Generally, each site is monitored every month. However, due to logistics of scheduling and site access, some sites were not monitored for a given month and/or some sites were monitored twice for a given month. Please refer to the graphs below for the specific monitoring frequency for each site.

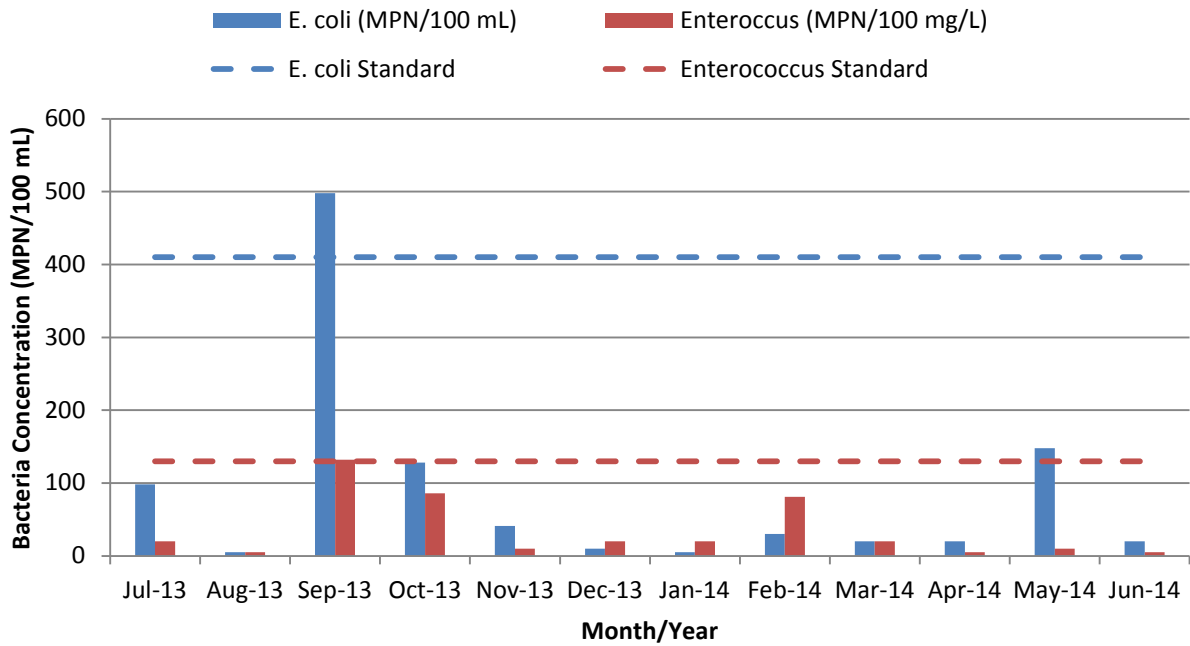
The graphs of *E. coli* and enterococcus for each site are as follows. Please note that the y-axes on the graphs are not standardized because the maximums varied greatly from site to site. Each graph contains a dotted blue line indicating the regulatory standard of interest for *E. coli* and a dotted red line indicating the regulatory standard of interest for enterococcus.



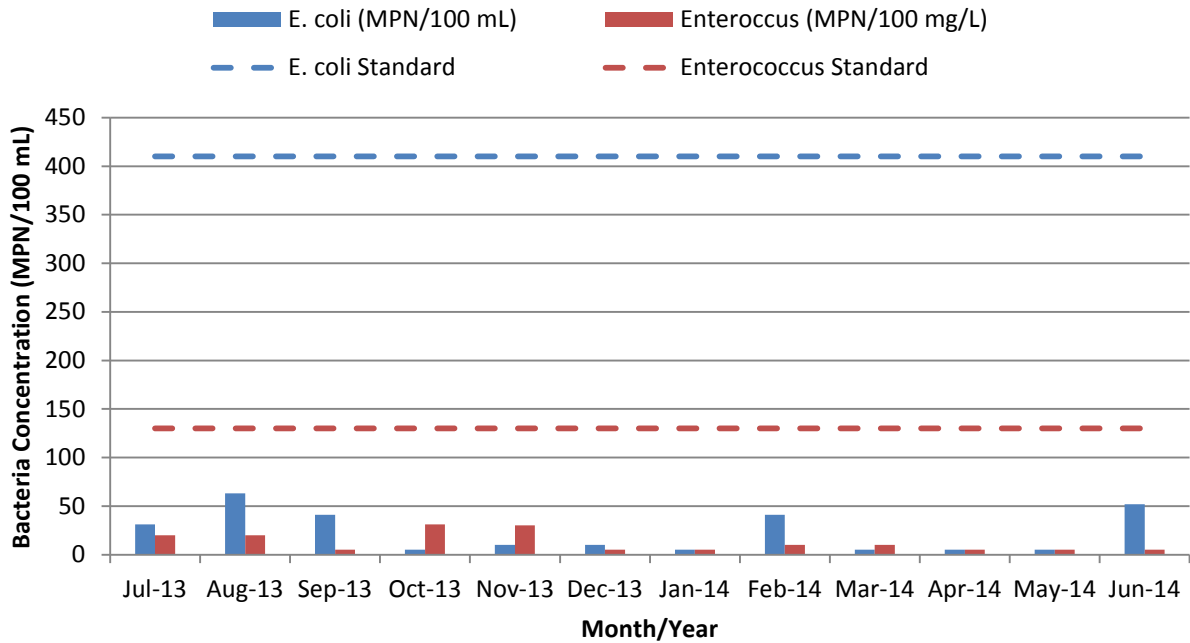
Tidelands Park (310TID) Bacteria, July 2013 to June 2014



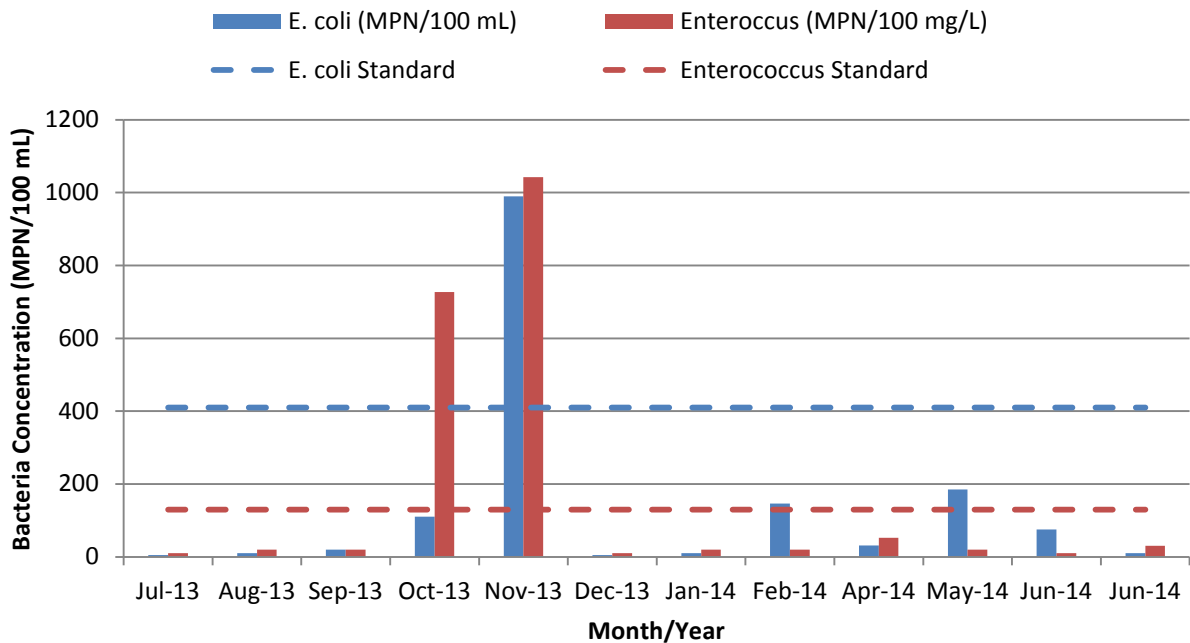
Windy Cove (310WIN) Bacteria, July 2013 to June 2014



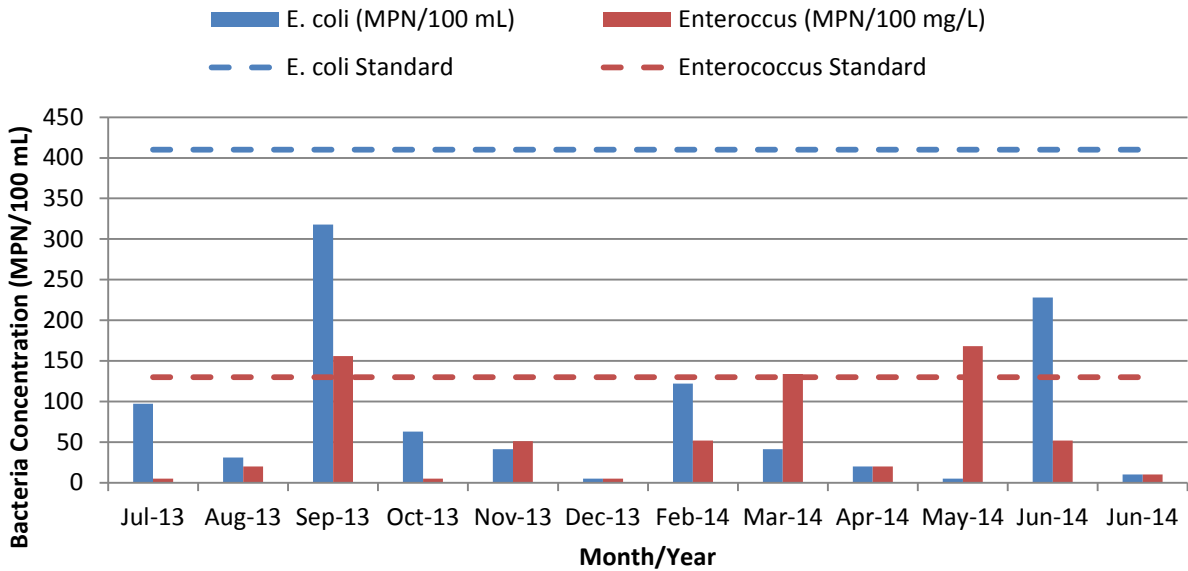
State Park Marina (310SPM) Bacteria, July 2013 to June 2014



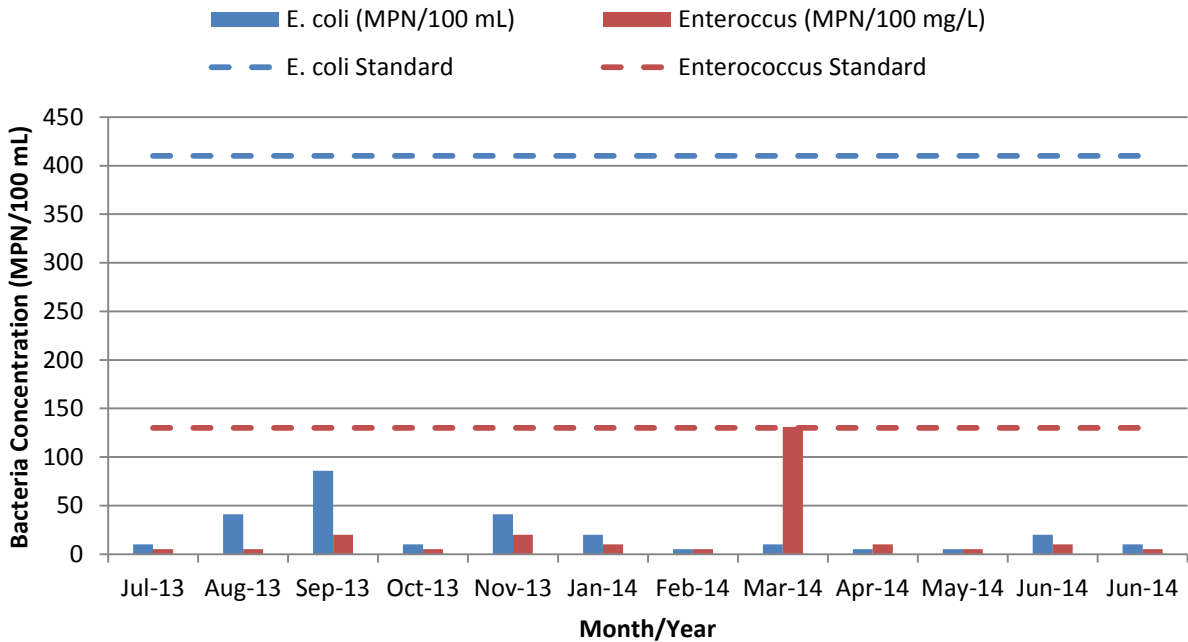
Pasadena Point (310PAS) Bacteria, July 2013 to June 2014

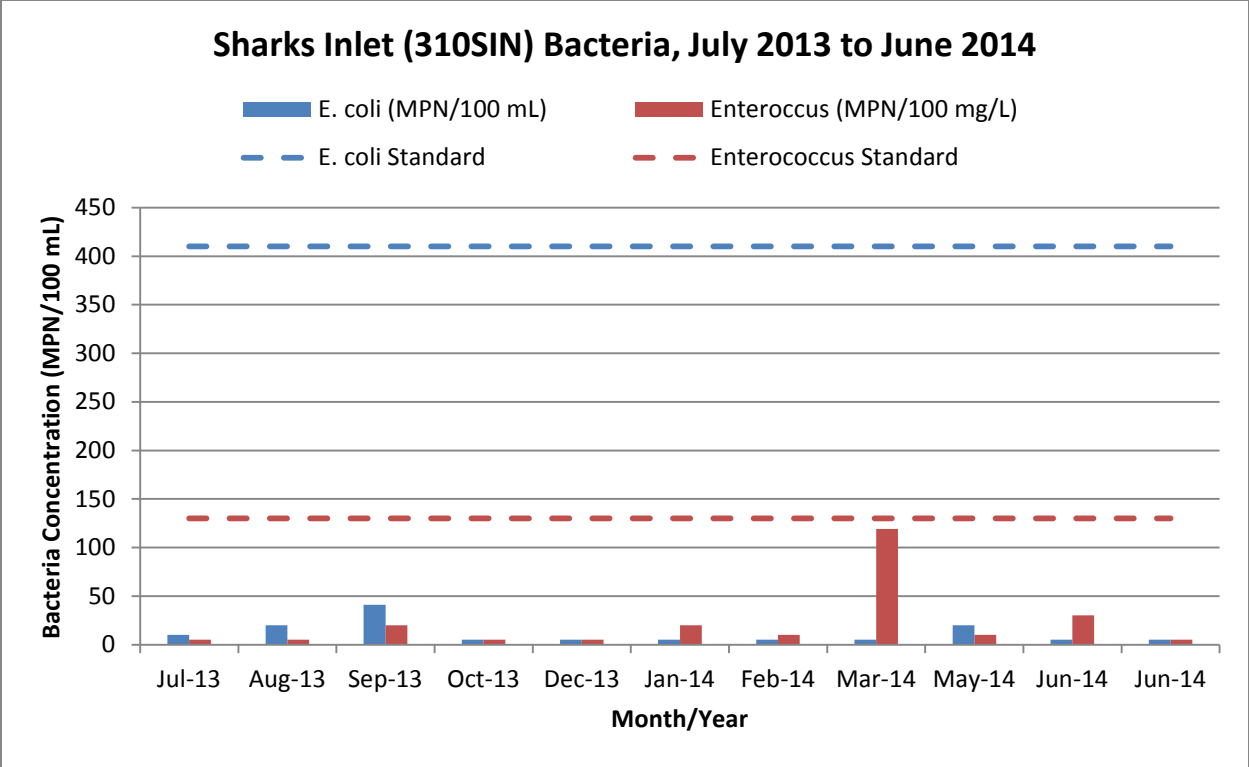


Baywood Pier (310BAY) Bacteria, July 2013 to June 2014

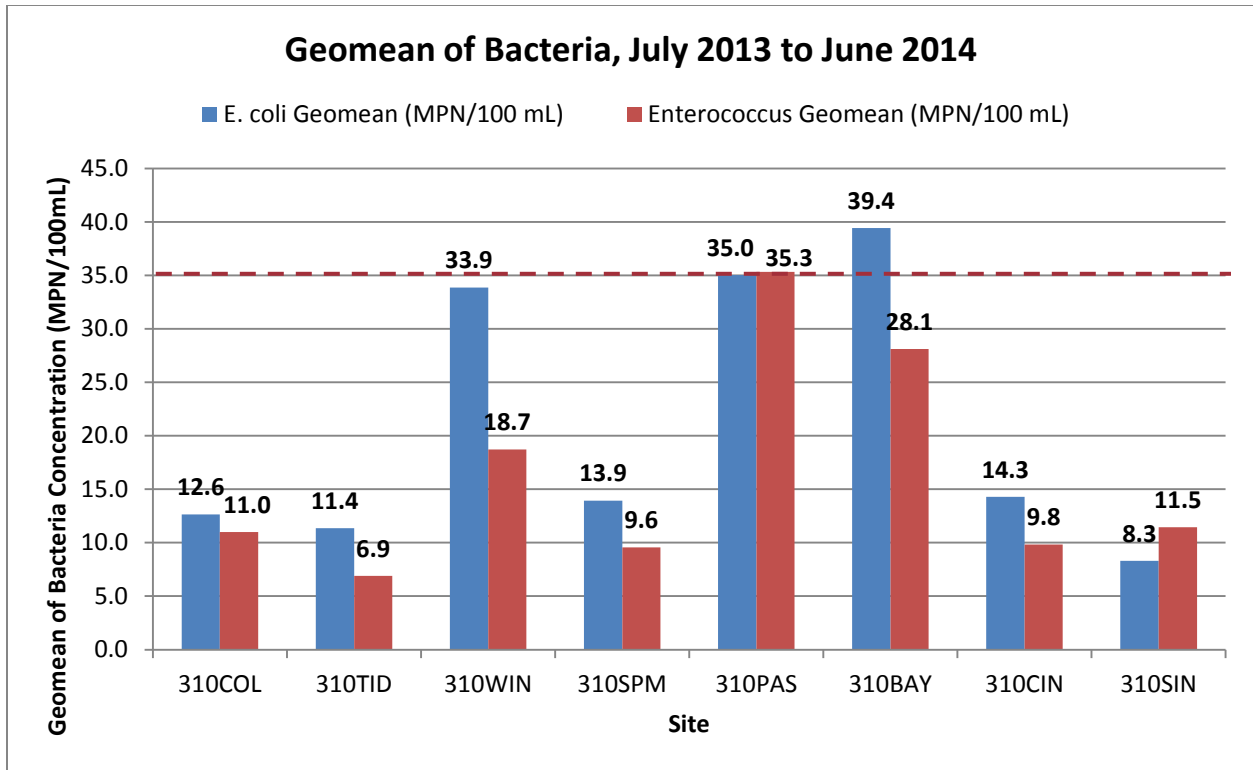


Cuesta Inlet (310CIN) Bacteria, July 2013 to June 2014





The 2012 Recreational Water Quality Criteria also contain criterion for the geomean of the data. The Recommendation 1 criterion for enterococcus is 35 MPN/100 mL, and for *E. coli* in freshwater is 126 MPN/100 mL. The geomean value for each site for each indicator are presented in the following graph. The dotted red line represents the target geomean for enterococcus. The target geomean for *E. coli* is not shown on the graph because none of the samples exceeded that standard.



Overall, no exceedances of either indicator occurred at Tidelands Park, State Park Marina, Cuesta Inlet or Sharks Inlet during the analyzed time period. Coleman Beach and Windy Cove each had one *E. coli* result exceed the standard during the year. More frequent exceedances for both indicators were seen at Baywood Pier and Pasadena Point.

Creek Data for Total coliform, *E. coli* and Enterococcus

Analysis conducted for data from Chorro Creek at Twin Bridges (310TWB) and Los Osos Creek (310SYB) is included in this report.

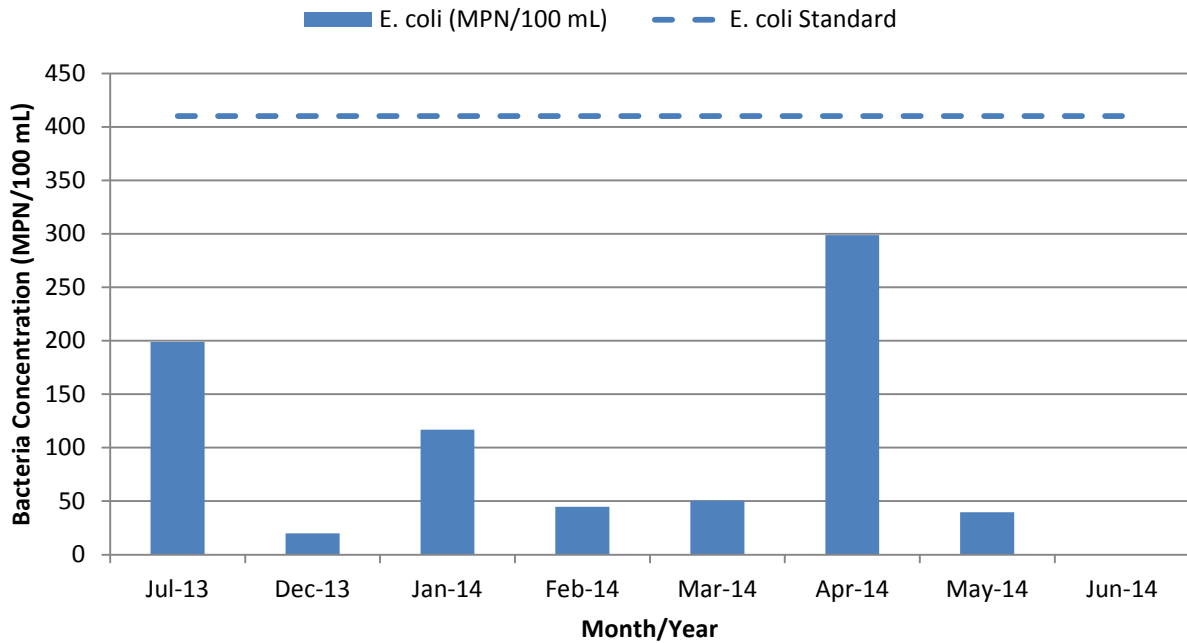
Chorro Creek

Creek samples were analyzed for total coliform and *E. coli*. Although total coliform results are generally not of interest when assessing safety of waters for swimming, a graph of total coliform values is presented for 310TWB. The *E. coli* results are presented in the graphs with a dotted line indicating the Recommendation 1 contact standard of 410 MPN/100 mL.

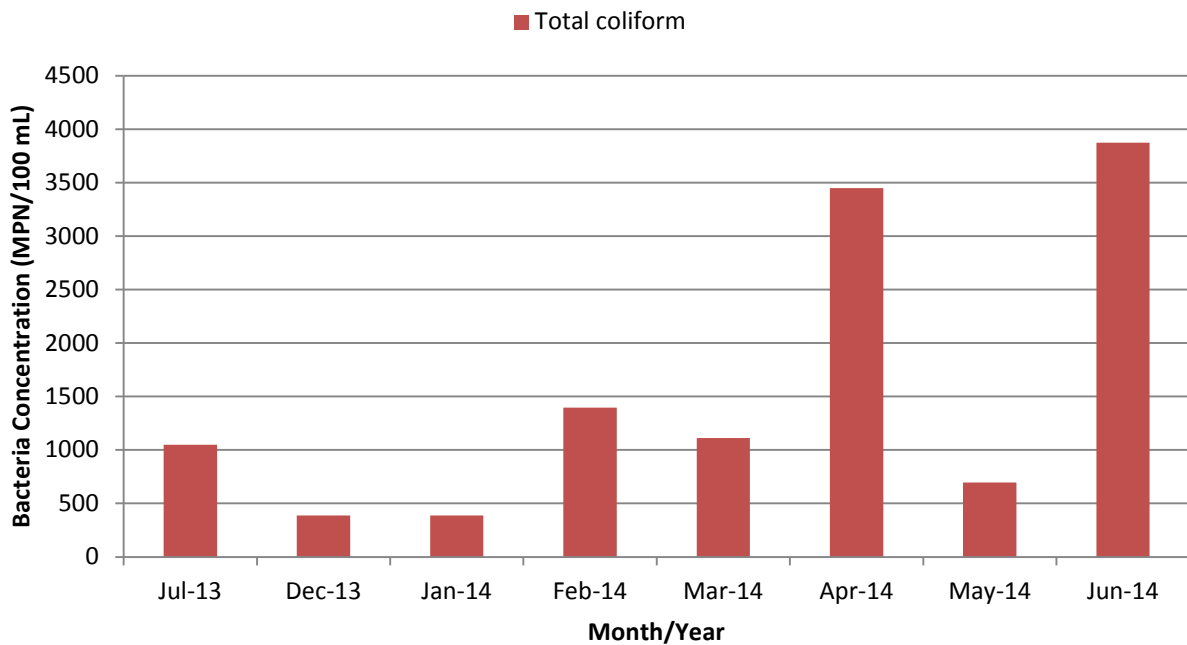
The gap in data from June 2013 through December 2013 is due to lack of surface flow at the site.

The geomean of the *E. coli* data for July 2013 to June 2014 was 39.7 MPN/100 mL, which is well below the 126 MPN/100 mL geomean criteria set forth by EPA.

Chorro Creek (310TWB) Bacteria, July 2013 to June 2014



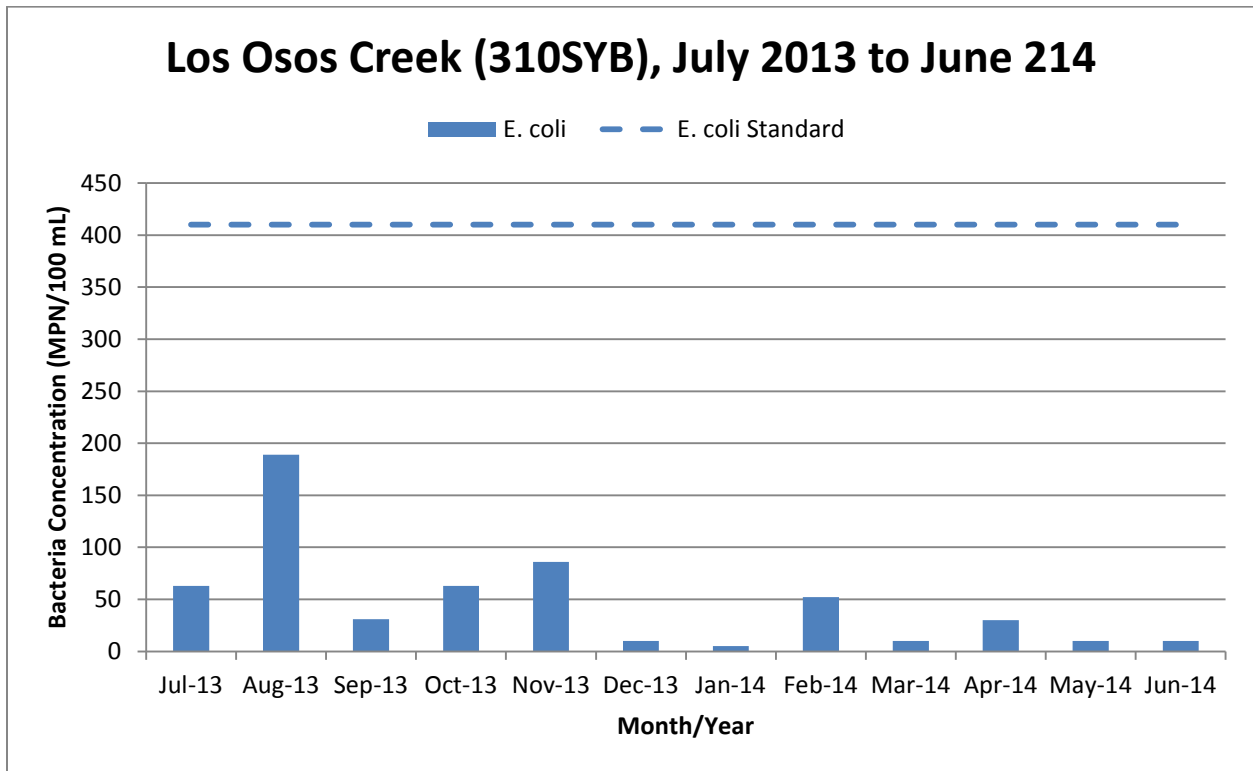
Chorro Creek Bacteria (310TWB), July 2013 to June 2014



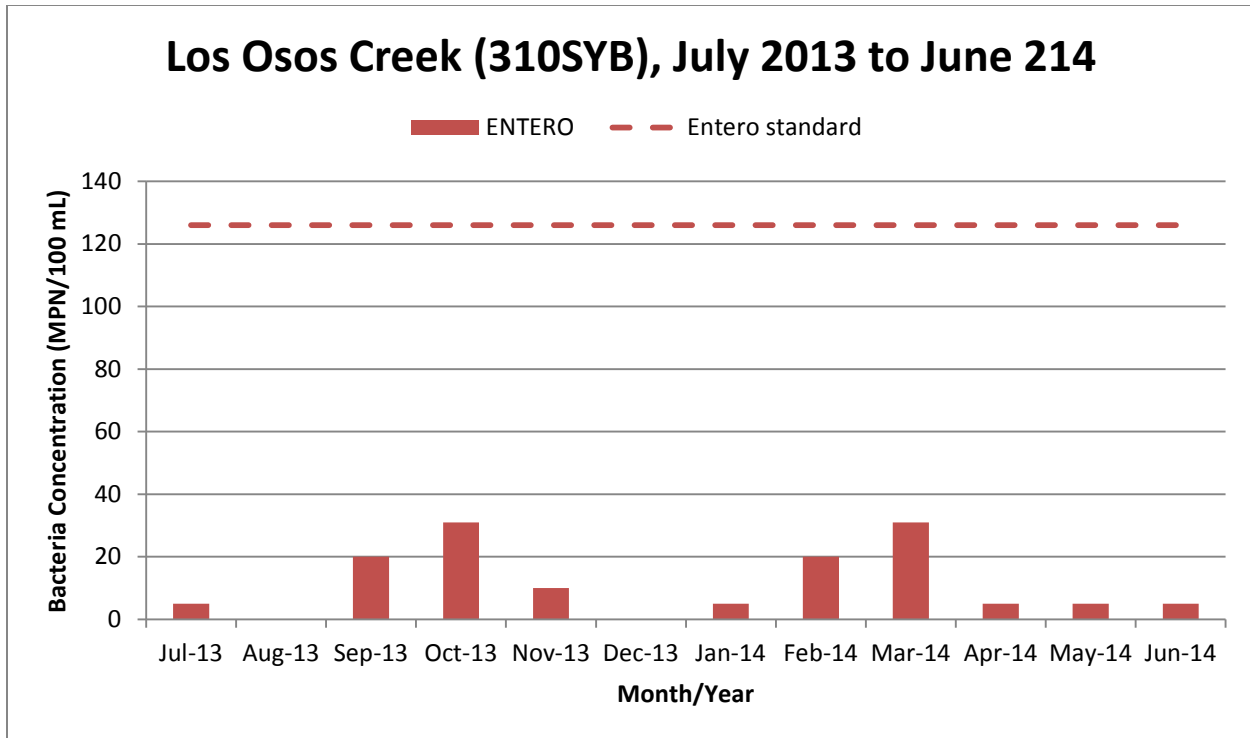
E. coli exceedances of the Recommendation 1 standard are rare at this site on Chorro Creek, with none of the eight samples exceeding the 410 MPN/100 mL standard from 2013 to 2014.

Los Osos Creek

In Los Osos Creek, none of the monthly samples had *E. coli* levels that exceeded the 410 MPN/100 mL standard. The geomean of the *E. coli* data for the same time period was 27.1 MPN/100 mL, well below the 126 MPN/100 mL criteria set forth by EPA. Due to the tidal influence of 310SYB, total coliform analysis was not conducted.



Los Osos Creek is tidally-influenced and thus is treated like a bay site. In addition to *E. coli* analysis, the site is tested for enterococcus levels. The geomean for the enterococcus data from July 2013 to June 2014 was 10.2 MPN/100 mL, well below the 35 MPN/100 mL geomean standard protective of human health.



TMDL Wasteload Allocation Attainment Plan

For both the city of Morro Bay and the county of San Luis Obispo, TMDL Wasteload Allocation Attainment Plans (WAAPs) were developed as part of their Stormwater Management Plans. Both of these WAAPs were written by Geosyntec Consultants. The documents describe the existing data and monitoring to occur in the future. The WAAP for the city of Morro Bay contained an analysis of Estuary Program data for 2002 through 2010. To further assist local municipalities with stormwater management, this analysis was repeated with Estuary Program data from January 2011 through June 2014.

Estuary Program bay monitoring is conducted with *E. coli* and enterococcus as the indicators. The city of Morro Bay WAAP compared Estuary Program *E. coli* data to REC-1 thresholds for fecal coliform. The explanation for this assumption was provided in the WAAP document, as follows:

“...For simplicity, measured E. coli concentrations are compared with the fecal coliform objective by assuming a 1:1 E. coli to fecal coliform ratio consistent with approaches used in (SDRWQCB, 2008)... However, even if the MBNEP beach E. coli results were adjusted based on a lower E. coli to fecal coliform ratio (such as 0.6:1), the exceedance rates for all four beaches relative to the 400 MPN/100 mL REC-1 objective would still be less than... the 10% allowed REC-1 exceedance rate...”

The document referenced in Geosyntec’s explanation is the San Diego Regional Water Quality Control Board’s *Amendment to the Water Quality Control Plan for the San Diego Basin (9) to*

Incorporate Implementation Provisions for Indicator Bacteria Water Quality Objectives to Account for Loading from Natural Uncontrollable Sources Within the Context of a Total Maximum Daily Load, May 2008.

These same assumptions were applied for this analysis of recent data. The table contains the number of samples for each site, the number of *E. coli* results that exceeded the 400 MPN/100 mL fecal coliform standard, and the percent of samples that exceeded the standard.

The results in the following table are for city of Morro Bay sites, located in the northern portion of the bay.

Table 4. *E. coli* Results Compared to Fecal Coliform Standard of 400 MPN/100 mL for Morro Bay Sites from January 2011 to June 2014

Site	Sample Count	No. > 400 MPN/100 mL	% Exceedance
310COL	41	0	0%
310TID	42	0	0%
310WIN	42	3	7%
310SPM	42	0	0%
Total	167	3	2%

This analysis assumes a 1:1 E. coli to fecal coliform ratio consistent with the approach used by Geosyntec Consultants in the city of Morro Bay WAAP.

The results in the following table are for Los Osos sites, located in the southern portion of the bay.

Table 5. *E. coli* Results Compared to Fecal Coliform Standard of 400 MPN/100 mL for Los Osos Sites from January 2011 to June 2014

Site	Sample Count	No. > 400 MPN/100 mL	% Exceedance
310PAS	42	2	5%
310BAY	42	3	7%
310CIN	42	0	0%
310SIN	41	0	0%
Total	167	5	3%

This analysis assumes a 1:1 E. coli to fecal coliform ratio consistent with the approach used by Geosyntec Consultants in the city of Morro Bay WAAP.

The WAAP noted the relatively low bacteria concentrations in the data analyzed, relative to the 90th percentile REC-1 objective for fecal coliform of 400 MPN/100 mL. The additional analysis in this report indicates a similar trend of few exceedances of the REC-1 standard for fecal coliform.

The WAAP analysis also compared the Estuary Program *E. coli* data to the aquaculture beneficial use (designated as SHELL) water quality objective of an estimated 90th percentile

value of 43 MPN/100 mL. Making use of the same assumption as Geosyntec Consultants of a 1:1 *E. coli* to fecal coliform ratio, this analysis was repeated with recent Estuary Program data.

Table 6. *E. coli* Results Compared to Fecal Coliform Standard of 43 MPN/100 mL for Morro Bay Sites from January 2011 to June 2014

Site	Sample Count	No. > 43 MPN/100 mL	% Exceedance
310COL	41	7	17%
310TID	42	2	5%
310WIN	42	12	29%
310SPM	42	6	14%
Total	167	27	16%

This analysis assumes a 1:1 E. coli to fecal coliform ratio consistent with the approach used by Geosyntec Consultants in the city of Morro Bay WAAP.

Table 7. *E. coli* Results Compared to Fecal Coliform Standard of 43 MPN/100 mL for Los Osos Sites from January 2011 to June 2014

Site	Sample Count	No. > 43 MPN/100 mL	% Exceedance
310PAS	42	16	38%
310BAY	42	26	62%
310CIN	42	7	17%
310SIN	41	3	7%
Total	167	52	31%

This analysis assumes a 1:1 E. coli to fecal coliform ratio consistent with the approach used by Geosyntec Consultants in the city of Morro Bay WAAP.

The WAAP analysis looked at three of the monitoring sites in Morro Bay and noted that the SHELL threshold was exceeded in 10 to 15% of samples. For the sites in the Los Osos area, exceedances are frequent at Baywood Pier (62% of 42 samples) and Pasadena Point (38% of 42 samples).

When assuming a 1:1 ratio of *E. coli* to fecal coliform, all sites have less than 10% of the samples exceeding the 400 MPN/100 mL standard. When compared to the more stringent SHELL objectives, between 5 and 62% of the samples exceeded.

CDPH Fecal Coliform Data

In conjunction with CDPH, the Estuary Program has been collecting fecal coliform data from bay and creek sites. The sites and frequency are contained in Table 2.

This monitoring effort provides CDPH with additional information for managing shellfish growing waters in Morro Bay. Two active shellfish growing operations exist in the bay. CDPH is responsible for regulating water quality in the lease areas where shellfish farming is permitted.

CDPH will use the additional data to identify bacteria sources in the bay, which can assist with managing the growing areas.

The fecal coliform monitoring effort began in February of 2013. Monthly monitoring occurs at one site on Chorro Creek (site code TWB) and at one site on Los Osos Creek (site code GS1). Quarterly fecal coliform monitoring occurs at three bay shoreline sites (site codes PAS, SPM, TID). Samples are also collected from TWB and GS1 during storm flows, as logistics allow. Analysis of this data will be conducted by CDPH and included in the Estuary Program's upcoming *Data Summary Report 2014*, which will be issued in October 2014.

Conclusions and Next Steps

This stormwater report presents Estuary Program data in comparison to various regulatory standards and guidance documents. Some conclusions are clear, regardless of how the data is analyzed:

- **Sites with little to no indication of bacterial contamination:** Coleman Beach, Tidelands Park, Windy Cove and State Park Marina in Morro Bay; and Cuesta Inlet and Sharks Inlet in Los Osos. Only two results (one each at Coleman Beach and Windy Cove) from these sites indicated unsafe conditions for recreational contact from July 2013 through June 2014. When compared to the stricter standards for the protection of shellfish growing areas, all sites had some exceedances, varying from 5 to 29% of the total samples (2011 to 2014). Although Windy Cove was showing an increase in bacterial contamination in the analysis conducted in 2013, the most recent year of data had only one exceedance of safe standards. However, Windy Cove has the third highest % exceedance of the 43 MPN/100 mL SHELL criterion, with 29% of samples exceeding.
- **Sites with continued elevated bacterial levels:** Baywood Pier and Pasadena Point in Los Osos. These sites have historically had elevated bacteria concentrations that are in line with the current analysis. Enterococcus data from 2008 through 2012 showed 15% exceedances of the Enterococcus standard at Pasadena Point and 25% exceedances at Baywood Pier. From July 2013 through June 2014, that value was 16% at both sites. For the SHELL beneficial use, Pasadena Point had 38% exceedances of the criteria and Baywood Pier had 62% exceedances during the past year, the highest value of all of the monitoring sites.

The Estuary Program will continue with the data collection efforts outlined in this report. An update to this report will be conducted in September of 2015.

References

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