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

Data Summary Report

2012

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CONTENTS

1.0 INTRODUCTION

The Morro Bay National Estuary Program's Implementation Effectiveness Program (IEP) and its Volunteer Monitoring Program (VMP) conducted environmental monitoring throughout the Morro Bay watershed to track both ambient water quality trends and the outcome of specific implementation projects.

The time period of data covered by this report is from approximately January 2006 through June 2012. Where this is not the case, the time period for the data is provided. Data was collected by volunteers and program staff with funding support from the following sources: CWA Section 319(h), Proposition 13 Coastal Nonpoint Source Pollution Control Program, Proposition 50 Coastal Nonpoint Source Pollution Control Program, ARRA funding through the Clean Water State Revolving Fund, and CWA Section 320.

DATA ANALYSIS: OVERVIEW

The Morro Bay National Estuary Program (MBNEP) monitoring program has conducted monitoring in the following areas: creek water quality, creek discharge volume, pathogen indicator bacteria, stream cross section profiling, riparian bioassessment and macroinvertebrate analysis, bay water quality, phytoplankton, shorebird monitoring, Surface Elevation Tables, and algae documentation. The following table summarizes the parameters monitored through these efforts and the frequency of monitoring.

Component	Sub-component	Analytes	Frequency	Year Data Collection Initiated	Number of Sites
Water Quantity	Flow	instantaneous flow volume (depth and width of water, velocity)	monthly	1995	19 total
Bacteria	Bacteria	total coliform, *E. coli*, *Enterococcus spp*.	monthly	2002	8 bay and 14 creek sites
Water Quality - Chemistry & Nutrients	Freshwater Sampling	temperature, dissolved oxygen concentration (mg/L), dissolved oxygen percent saturation (%), turbidity, pH, conductivity, nitrate as N, orthophosphate as PO_4	monthly	2001	20 total
	Estuarine Sampling (Dawn Patrol)	dissolved oxygen, salinity, temperature	monthly	2002	7 total

Component	Sub-component	Analytes	Frequency	Year Data Collection Initiated	Number of Sites
Geomorphology	Cross-Sectional Profiles	cross-sectional area, bankfull width and depth, floodprone width, channel slope	variable, depending on rainfall	1993	22 (all Chorro Basin)
	Bay Sediment Monitoring (SETs)	change in surface elevation, mean sediment accretion	variable, depending on rainfall	2004	6 salt marsh, 4 mudflat
Biotic	Macro - invertebrates	canopy cover, bank stability, substrate measurement, stream gradient, temperature, dissolved oxygen, conductivity, pH, alkalinity, SAFIT Level II taxonomic classification	annually	1995	12 water-shed sites (not all sites monitored each year)
	Algal Cover	point-intercept data (percent cover)	annually	2011	12 creek sites (not all sites monitored each year)
	Plankton Diversity	community density and diversity, % *Alexandrium spp*., % *Pseudonitzschia spp*.	monthly	1998	north T-Pier
	Shorebird Monitoring	species count, population count	annually	2003	15 sectors in bay, sand spit and strand
	Eelgrass Mapping	eelgrass acreage, other aquatic vegetation acreage	biennially	2002	baywide
	Eelgrass Monitoring	shoot density, above-ground biomass	biannually	2012	baywide

Water quality data collected by the program is compared to various standards to understand its implications. The Central Coast Region Basin Plan contains standards established to protect the beneficial uses of water bodies within this immediate region. Another source of criteria for analyzing local data is the Central Coast Ambient Monitoring Program (CCAMP). Managed by the Central Coast Regional Water Quality Control Board (CCRWQCB), CCAMP provides additional informal attention levels for various chemical analytes. While these are not regulatory standards, they provide a regional context for the data.

NOTE ON REPORT STRUCTURE

The water quality, bacteria, macroinvertebrate and algae data are discussed in a single section called Creek Data Analysis. The discussions are focused around each waterbody, rather than each analytical constituent. Thus, the chapter for Dairy Creek will include discussion of monitoring parameters for the sites on that waterbody. The Morro Bay watershed was divided into the following chapters based on subwatersheds: Dairy Creek, Pennington Creek, San Luisito Creek, San Bernardo Creek, Chorro Creek, and Los Osos and Warden Creeks.

A summary section titled Creek Water Quality Sites Overview contains overview plots of the data by parameter, with sites across all waterbodies compared amongst each other. Monitoring methods for each parameter are described in this section.

The MBNEP's marine monitoring efforts are combined in a separate section, which includes shorebird surveys, bay bacteria, bay water quality, and phytoplankton enumeration.

Within this report, each monitoring site is referenced with a three-letter code. In an effort to improve consistency with historical and ongoing collaborative monitoring efforts, some monitoring site codes have been updated. These changes are noted throughout the text.

Data from eelgrass and sediment monitoring efforts are not included in this report. Separate reports were developed for each of these topics and are available on the program's website, www.mbnep.org/understand.

No discussion was included of stream profiling because this monitoring was not conducted during the most recent year.

The data included in this report was collected by monitoring program staff and volunteers between January 2006 and June 2012, unless otherwise stated. In each section, the number of samples and time period during which they were collected is summarized to provide context for the analysis. Previous data reports included additional data (going back as early as 2002). For ease of presentation, this report does not include this earlier data.

Additionally, some parameters for some sites were not included in the data visualizations and tables in this report's analysis. Long-term monitoring has demonstrated consistent compliance with Basin Plan standards and other benchmark levels of concern for select parameters at many of the sites. For parameters at sites where data is showing minimal or no cause for concern, statistical analysis and graphical representations were not generated for this report. In the Creek Water Quality Sites Overview section, a narrative description describes the method, frequency and other details on how data was collected. If macroinvertebrate and algae data were not included in a discussion section, it is because it was not monitored in 2012.

2.0 CREEK DATA ANALYSIS

The following analysis includes data collected from the creeks throughout the Morro Bay watershed.

CREEK WATER QUALITY SITES OVERVIEW

Data presented in this section compares water quality data among sites throughout the watershed. The table below details the program's creek monitoring sites. The length of the data record varies among each site. Unless otherwise stated, the data included in the analysis spans from January 2006 through June 2012.

Site Code	Waterbody	Description
CHO	Chorro Creek	Chorro Creek at Camp San Luis Obispo, near Hwy 1
UCR	Chorro Creek	Chorro Creek bridge crossing upstream of Gilardi Road at the Cal Poly bridge
CER	Chorro Creek	Chorro Creek crossing between Gilardi and Canet Roads on the Chorro Creek Ecological Reserve
CAN	Chorro Creek	Chorro Creek at Canet Road bridge off Hwy 1
CCC*	Chorro Creek	Chorro Creek at Chorro Creek Road
TWB	Chorro Creek	Chorro Creek at South Bay Blvd bridge, near State Park Road
DAU	Dairy Creek	Dairy Creek at El Chorro Regional Park and Camp SLO Boundary, at the creek crossing
DAM	Dairy Creek	Dairy Creek upstream of dog park, near locked gate across road
DAL	Dairy Creek	Dairy Creek upstream of culvert under park entrance road
APN	Pennington Creek	Upper Pennington Creek, above UPN
UPN	Pennington Creek	Upper Pennington Creek, stream crossing near Cal Poly Beef Unit
CPN	Pennington Creek	At the Pennington Creek Rd bridge, on the border of Cal Poly property
PEN	Pennington Creek	Pennington Creek at El Chorro Outdoor School amphitheater
SLU	San Luisito Creek	San Luisito Creek at Adobe Road bridge crossing
MNO*	San Bernardo Creek	San Bernardo Creek, upstream of SBE
SBE	San Bernardo Creek	San Bernardo Creek at Adobe Road crossing
CLV	Los Osos Creek	Clark Valley branch at road crossing
CLK	Los Osos Creek	Clark Valley branch at upstream road crossing
LVR	Los Osos Creek	Los Osos Creek crossing under Los Osos Valley Road
TUR	Warden Creek	Warden Creek crossing under Turri Road near Los Osos Valley Road
SYB	Los Osos Creek	Los Osos Creek off Turri Road near South Bay Blvd
COO	Coon Creek	Coon Creek trail at first bridge in Montana De Oro State Park

Note: Coon Creek, which is not in the Morro Bay watershed, is monitored as a control site for comparison to watershed sites. It is not included on the following map.

**The CCC site was formerly referenced as UCF in previous reports. The MNO site was formerly referenced as USB in previous reports.*

Legend

- Monitoring Sites
- Creeks
- Watershed Boundary
- Highways
- Major Roads

0 1 2 4 Miles

1:100,000

N W E S

MORRO BAY NATIONAL ESTUARY PROGRAM

TEMPERATURE

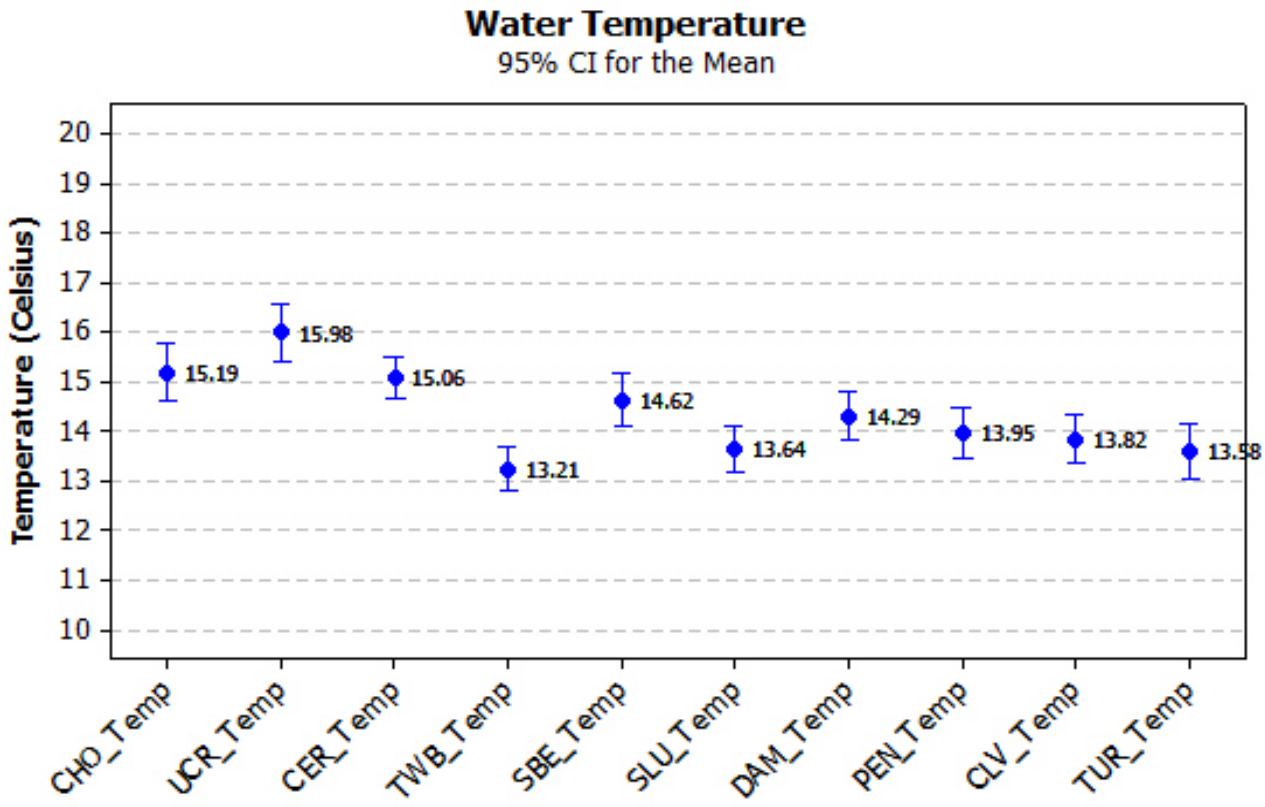
Water temperature was measured as part of the water quality monitoring effort, which could take place at any time during daylight hours, not necessarily at a consistent time of day. Water quality was generally monitored at each site once or twice monthly, depending on volunteer availability and site hydrology.

Temperature data was collected with a YSI Model 55 or 85 multi-parameter meter, which uses a thermistor to determine water temperature in degrees Celsius. The meter's range is -5 to +65°C with a resolution of 0.1°C. Starting in 2007, the YSI Model 55 was replaced with Model 85 units.

The circle on the plots indicates the mean temperature for each site, and the interquartile range is represented by the whiskers (Q1 to Q3).

The level of concern for protection of steelhead habitat is 21°C, which is a CCRWQCB 303(d) Listing Guidance Value.

Water temperatures have very rarely exceeded levels of concern throughout the lengthy data record for most creek sites. Thus, detailed multi-year analysis was not conducted for all of the creek sites. Multi-year comparison graphs were created for water temperatures on Dairy, Pennington and Chorro Creeks, due to its relationship to dissolved oxygen concentrations.



DISSOLVED OXYGEN

Dissolved oxygen saturation and concentration were measured as part of the water quality monitoring effort, which could take place at any time during daylight hours, not necessarily at a consistent time of day. Dissolved oxygen was monitored at each site once or twice monthly, depending on volunteer availability and site hydrology.

Program volunteers measured dissolved oxygen (DO) concentration and percent saturation during each water quality field visit. Data was collected with a YSI 85 meter utilizing Clark Cell technology. The YSI 85 meter measures a range of 0 to 200% for saturation with a resolution of 0.1%. For DO concentration, the meter's range is 0 to 20 mg/L with a resolution of 0.01 mg/L. Prior to 2007, measurements were taken with a YSI model 55 meter.

The Central Coast Basin Plan regulatory standard states that at no time shall DO concentrations fall below 7.0 mg/L. Because this criteria is rarely violated, a detailed analysis was not conducted for comparison of this analyte across multiple sites. For creeks where dissolved oxygen has been variable or failed to consistently meet benchmarks, a more detailed analysis was included. This includes Dairy, Chorro, Los Osos and Warden Creeks.

TURBIDITY

Turbidity was measured as part of the water quality monitoring effort, which could take place at any time during daylight hours, not necessarily at a consistent time of day. Water quality was usually monitored at each site once or twice monthly, depending on volunteer availability and site hydrology.

Turbidity data was collected using a HACH 2100P field meter, which makes use of the autoranging nephelometric method of measurement. The meter has a range of 0 to 1,000 NTU and a resolution of 0.01 NTU.

The Basin Plan lists a level of concern of 25 NTU for protection of aquatic life in cold water and 40 NTU for protection of aquatic life in warm waters. The data record across all sites shows rare exceedances of these criteria (2.9% of 2,117 records exceeded 25 NTU, 1.6% of the samples exceeded 40 NTU). Exceedances are typically correlated with storm events, and do not reflect impaired ambient water quality conditions. Because these standards are rarely exceeded, a more detailed year-by-year analysis for each creek was not conducted.

CONDUCTIVITY

Conductivity was measured as part of the water quality monitoring effort, which could take place at any time during daylight hours, not necessarily at a consistent time of day. Water quality monitoring was conducted at each site once or twice monthly, depending on volunteer availability and site hydrology.

Temperature-corrected conductivity data was collected using a YSI 85 meter with nickel electrodes. The meter has a range of 0 to 200,000 uS/cm with a resolution of 0.1 uS/cm. Prior to 2007, the data was collected with an Oakton ECTestr with a range of 0 to 1,990 uS/cm with a resolution of 10 uS/cm.

The Central Coast Basin Plan includes a conductivity objective of 3,000 uS/cm to protect the Agriculture beneficial use. Elevated conductivity levels, as a measure of dissolved solids, can be indicative of pollution such as agricultural or road drainage runoff. At the majority of the sites, conductivity data rarely approaches the Basin Plan standard. Because these standards are rarely exceeded, a more detailed year-by-year analysis for each creek was not conducted. The only site of concern is located on

Warden Creek. This data is detailed in a multi-year statistical analysis conductivity in the Warden and Los Osos Creeks section.

pH

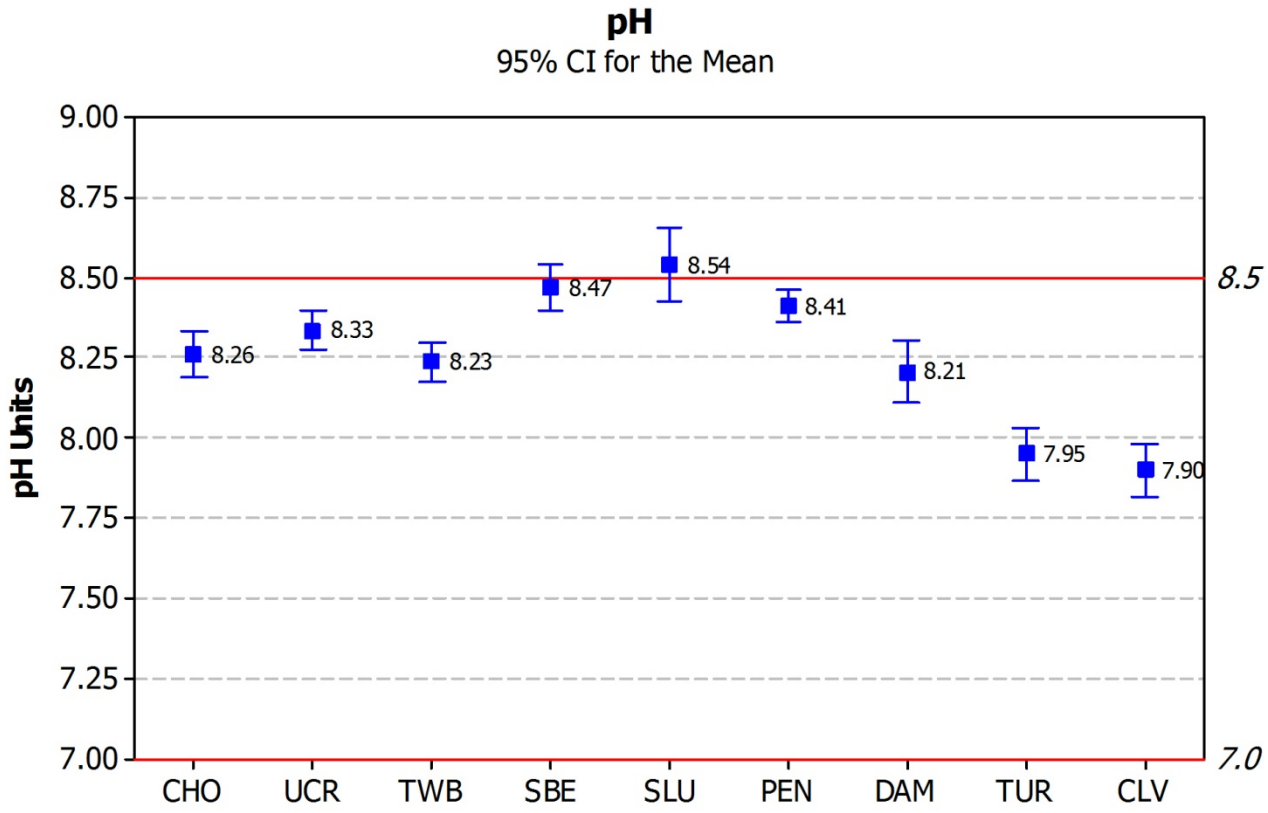
Beginning in July 2010, program volunteers measured pH during each water quality field visit using a pH probe. The meter has a range of -1.0 to 15.0 pH units, with a resolution of 0.1 pH units. Prior to July 2010, pH paper was used for the measurement. The paper has a range of 4.5 to 10.0 with a resolution of 0.5 pH units. Following extensive quality control comparisons of the probe and paper data with lab analysis, the pH probes appear to be very accurate, whereas the pH paper was consistently underestimating the pH.

The following analysis includes electronic pH probe data only, from July 2010 through June 2012.

The squares on the graph indicate the mean pH for each site, and the interquartile range is represented by the whiskers (Q1 to Q3, the middle 50% of the data).

Per the Central Coast Basin Plan, pH concentrations must remain between 6.5 and 8.3 to be protective of the recreational contact beneficial use (REC-1). For protection of aquatic life, the Basin Plan standard is between 7.0 and 8.5 (COLD, WARM). The elevated pH values in subwatersheds of the Chorro Valley are thought to be related to the local geology.

Because pH results are not considered to be of concern in the watershed, a more detailed annual analysis for each creek was not conducted.



** Values include pH meter data from July 2010 through June 2012.*

NUTRIENTS

Orthophosphates as PO_4^{3-} and nitrate as nitrogen were measured as part of the water quality monitoring effort. Monitoring could take place at any time during daylight hours, not necessarily at a consistent time of day. Samples were collected by volunteers, and analysis was conducted at the program office using chemical test kits.

The program's methodology for orthophosphates as PO_4^{3-} analysis has changed over the years in an effort to improve the quality of the data. Volunteer-generated data prior to April 2004 was discarded due to the determined inaccuracy of the test kit. From early 2004 through mid-2005, a Hanna meter and Hanna reagent was used. From mid-2006 through mid-2007, a YSI 9000 meter with YSI reagent was used. Starting in mid-2007 to the present, the analysis method uses a Hanna Low Range Phosphate colorimeter (HI 93713) with HACH PhosVer 3 Phosphate Reagent, which utilizes an ascorbic acid reaction. The meter has a range from 0.00 to 2.50 mg/L with a resolution of 0.01 mg/L. Out-of-range samples were analyzed by diluting the sample with deionized water and multiplying the result by the dilution factor. This is a simple colorimeter which was selected because it is safe and easy to use, but it does not yield data with the same precision and accuracy as lab-generated data.

The CCAMP informal attention level is 0.36 mg/L as PO_4^{3-}, a value created specifically for the Pajaro River but adapted for the Morro Bay watershed. Orthophosphates frequently exceed attention levels and are monitored closely on Chorro Creek, downstream from the California Men's Colony Wastewater Treatment Plan outfall. This data is provided in the Chorro Creek section of the report. Although orthophosphate concentrations are not of concern on Los Osos and Warden Creeks, the data was analyzed for comparison to Chorro Creek to illustrate how the nutrient issues differ between those two subwatersheds.

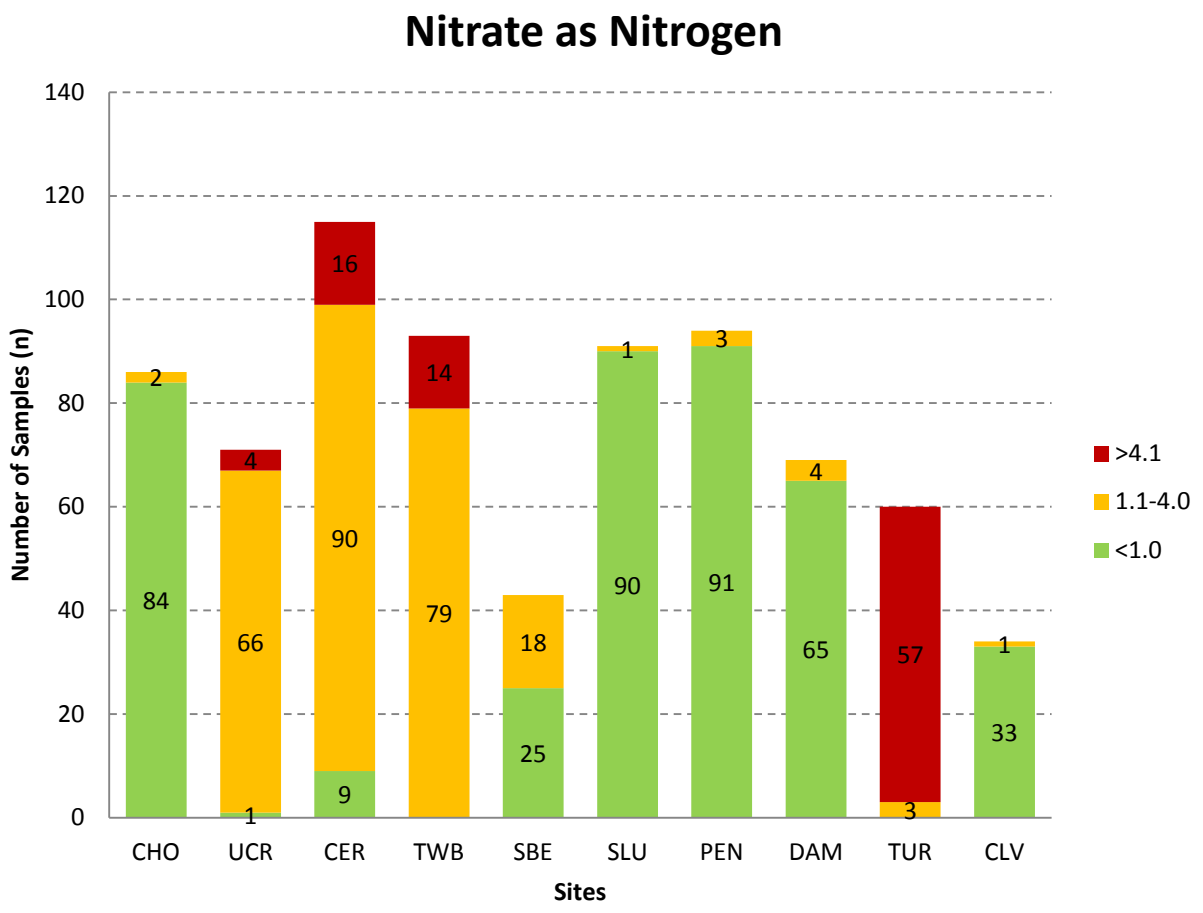
Nitrates as nitrogen was monitored from 2002 through 2011 with a LaMotte test kit (method 3354) that uses a zinc reduction reaction. The method utilizes a color change reaction and compares the reacted sample to a color chart with gradations at 0, 1, 2, 4, 6, 8, 10 and 15 mg/L. For this method, readings between 0 and 1 were considered to be non-detects and were reported as 0.5 mg/L for the purpose of analysis. This is a simple test kit which was selected because it is safe and easy to use, but it does not yield data with the same precision and accuracy as lab generated data.

Beginning in January 2012, the program changed analysis methods and began using a HACH model DR/890 colorimeter run with Method 10020, a chromatropic acid method. The test can enumerate a range from 0 to 30 mg/L nitrates as N. In comparisons of split samples with laboratory analysis, the meter is much more accurate than the previously used LaMotte method. Comparison with laboratory data will continue in order to determine the quantitation limit for the meter.

The following plot shows the number of samples with nitrate concentrations in three categories: less than or equal to 1 mg/L, between 1.1 and 4 mg/L, and greater than or equal to 4.1 mg/L. The graph combines data from the LaMotte test kit and the HACH colorimeter.

The CCRWQCB 303(d) Listing Guidance Value for nitrates as nitrogen is 1.0 mg/L for the protection of aquatic life.

Nutrients are primarily of concern on Chorro, Los Osos and Warden Creeks. Thus, more detailed analyses were conducted for those sites. The tributaries to Chorro Creek seldom exceed the levels of concern, so no additional analysis was conducted.

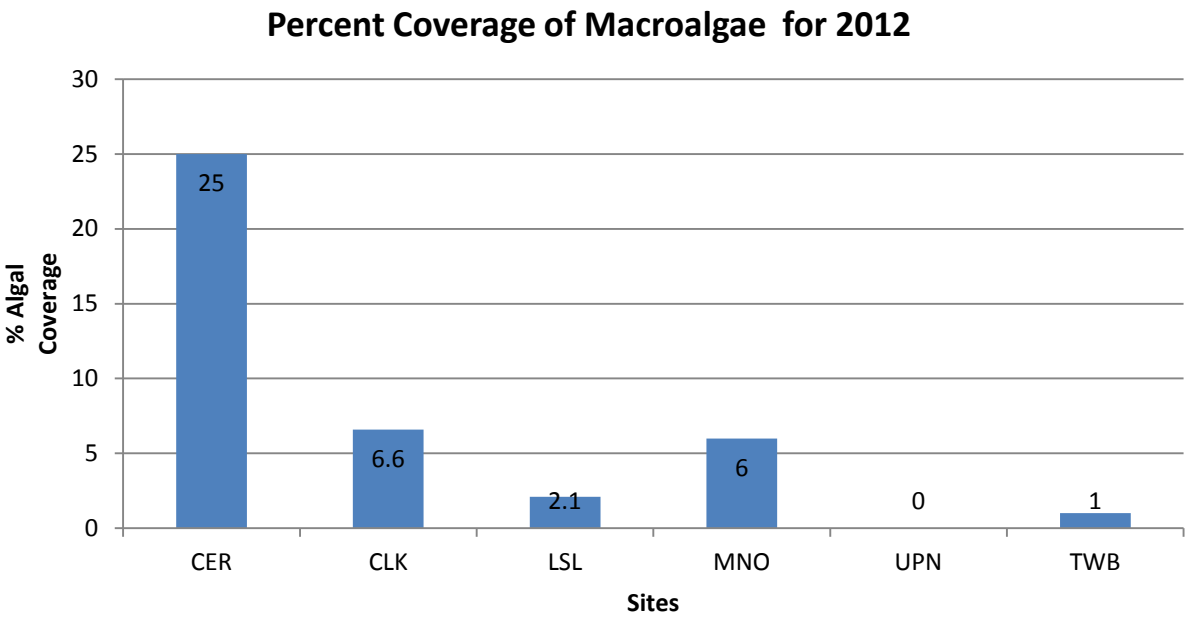


ALGAE DOCUMENTING

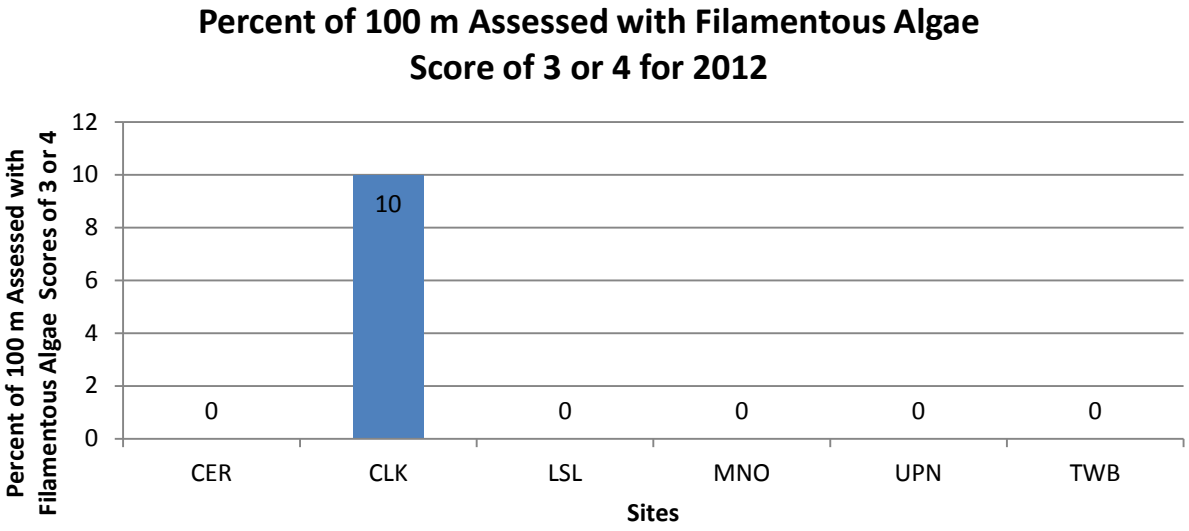
Since 2011, algae data has been collected using the *Standard Operating Procedures for Collecting Stream Algae Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California*, 2010. The protocol involves recording the presence or absence of macroalgae and filamentous algae while collecting habitat assessment data throughout a 150 meter reach of the stream. The complete SWAMP algae monitoring protocol, including sample collection and analysis, was not conducted due to limited financial and staff resources.

The CCRWQCB utilizes the data in assessing 303(d) listings and de-listings, as well as TMDL implementation effectiveness. Algal blooms can be considered supporting information when making a decision to list a waterbody as impaired, in particular when nutrient concentrations are elevated and dissolved oxygen concentrations are erratic.

Betty Fetscher of the Southern California Coastal Water Research Project, one of the authors of the SWAMP algae monitoring protocol, recommended calculating the percent coverage of macroalgae and the percent of heavy filamentous algae coverage. The following graph displays the percent coverage of macroalgae present during the habitat assessment. This was calculated by tallying the number of assessed points at a site where water was present. The number of wet points in the creek with macroalgae present was tallied, and a percent algal coverage was calculated. Ideally, sites have less than 40% coverage of algae.



As part of the habitat assessment, the percent coverage of filamentous algae was scored for defined areas 5 m above and 5 m below each of ten transects assessed within each site. Each assessment area (10 m of wetted reach) was assigned a score between 0 to 4, with 0 indicating less than 5% algae coverage, 1 indicating < 10% coverage, 2 indicating 10 to 40% coverage, 3 indicating 40 to 75% coverage, and 4 indicating > 75% coverage. Ms. Fetscher recommended tallying the areas scored with a 3 or 4 out of the 100 m assessed at each site. The graph below shows the percent of area with filamentous algae scores of 3 or 4 out of the 100 m assessed at each site.



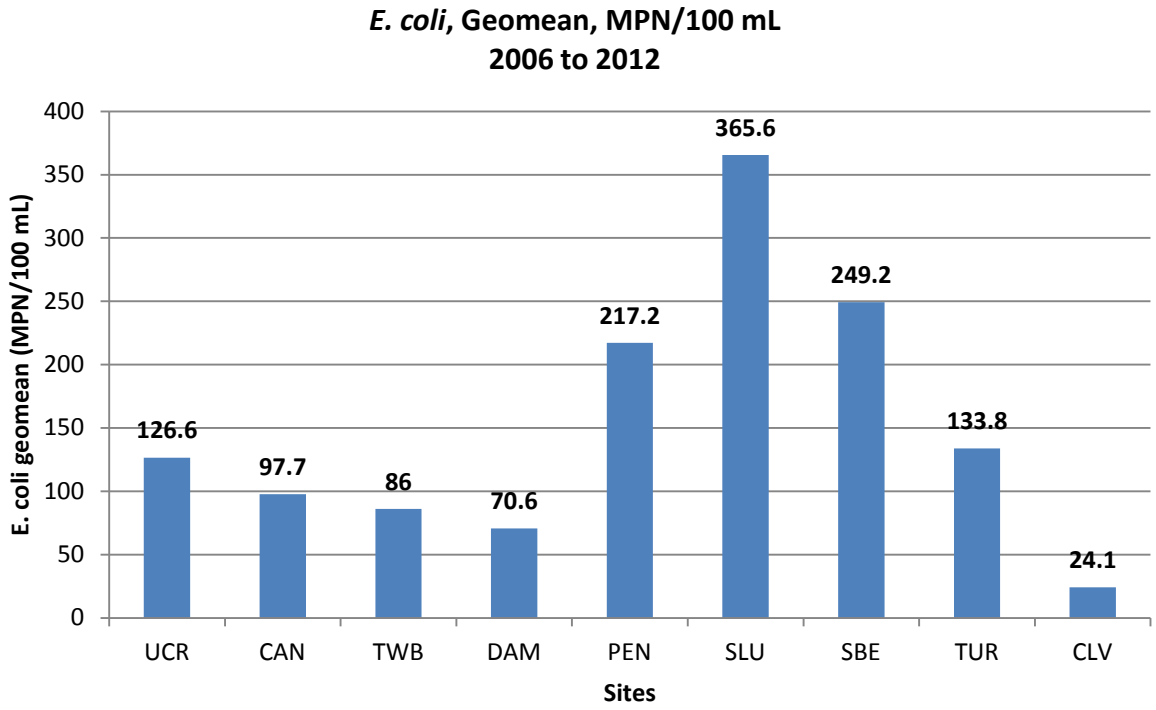
BACTERIA

Program volunteers monitored total coliform and *E. coli* bacterial indicators. Monthly samples were collected and then analyzed by volunteers with the IDEXX method using Colilert-18 reagent. Analysis took place at the Morro Bay-Cayucos Wastewater Treatment Plant Laboratory. Bacteria monitoring was not timed to coincide with monthly or bi-weekly water quality monitoring at these sites.

Based on typical sample dilutions, the range of detection for the test is from < 1 MPN/100 mL to 24,196 MPN/100 mL. The regulatory criteria for comparison are the recommended standards in EPA's 1986 guidance document *Ambient Water Quality Criteria for Bacteria*. For *E. coli* for a single grab sample, the water is considered to have an acceptable risk for swimming (REC-1 contact) if the concentration is below 235 MPN/100 mL. The analysis in this report is focused on *E. coli* rather than total coliform because the presence of *E. coli* is a better indicator of the presence of fecal contamination from warm-blooded animals. Total coliform is a broader indicator of bacterial contamination and could be caused by plant matter, soil and other sources.

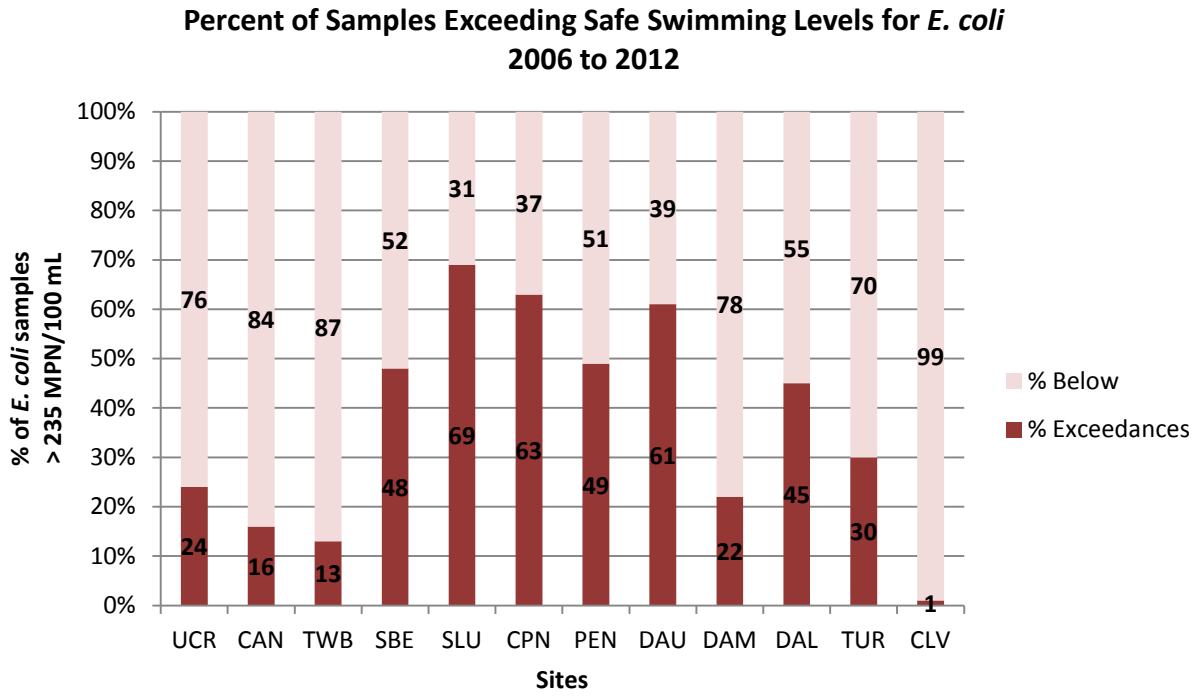
Due to frequent exceedances of the safe swimming standard for *E. coli*, detailed bacteria analysis has been conducted for each creek.

The following graph shows the geomean of *E. coli* data collected from January 2006 through June 2012 for select sites.



** At site UCR, monitoring began in 2007.*

The following graph indicates the percent of *E. coli* results from 2006 through June 2012 that were greater than 235 MPN/100 mL, which is the single grab sample standard for recreational contact (REC-1).

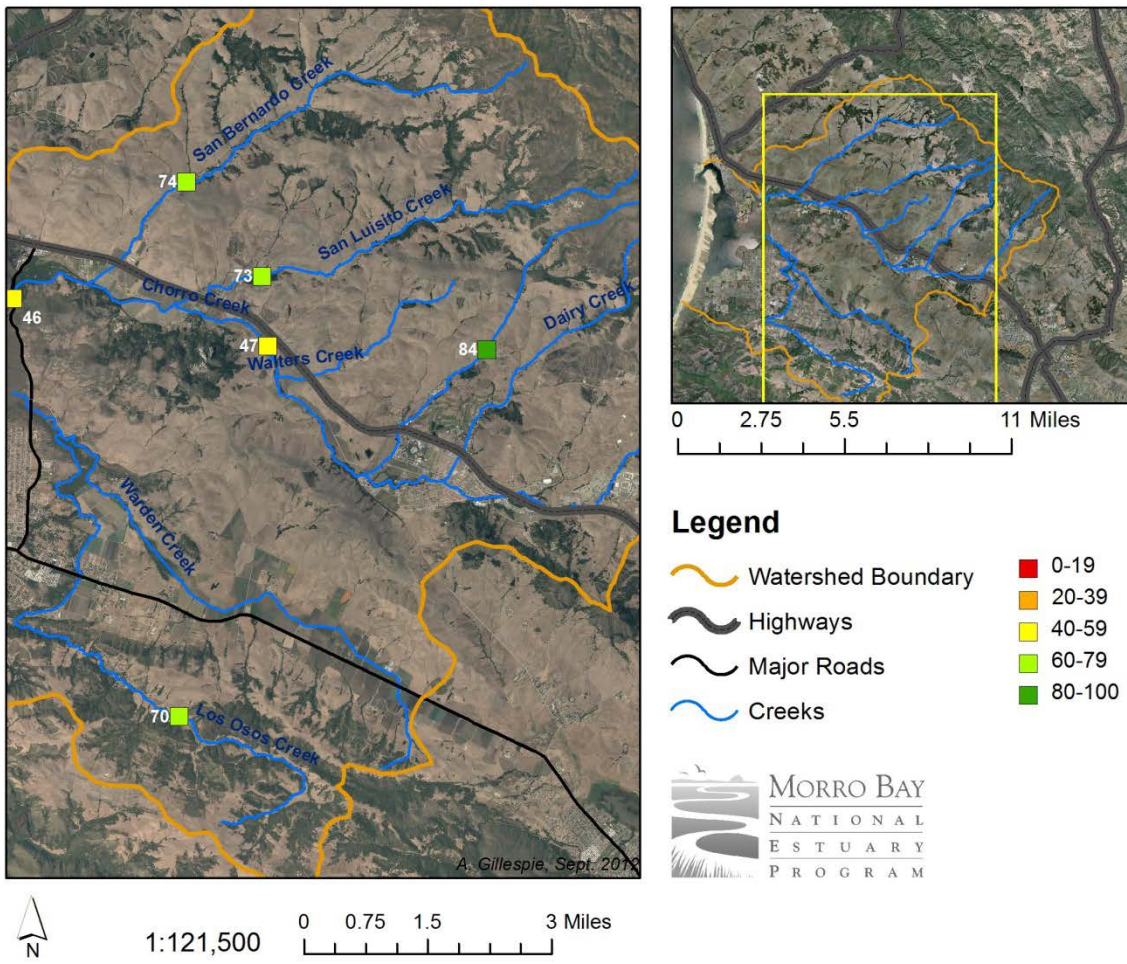


** At site UCR, monitoring began in 2007. At CPN, monitoring began in 2008.*

MACROINVERTEBRATES

Data collected between 2007 and 2012 utilized the SWAMP bioassessment procedures titled *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California*, which was approved in spring 2007. The method involves monitoring a 150 m reach at each creek site using the reach-wide benthos procedure. Measurements and observations on substrate, water depth, canopy cover, bank stability and other physical parameters were taken at each of 11 equidistant transects and ten inter-transects. Macroinvertebrate samples were collected from each transect, rotating between the margin and center of the creek. The samples were composited into a single sample, which was sent to a lab for sorting and counting until 500 organisms were identified. The lab provided a count of the individual taxa as well as several calculated metrics.

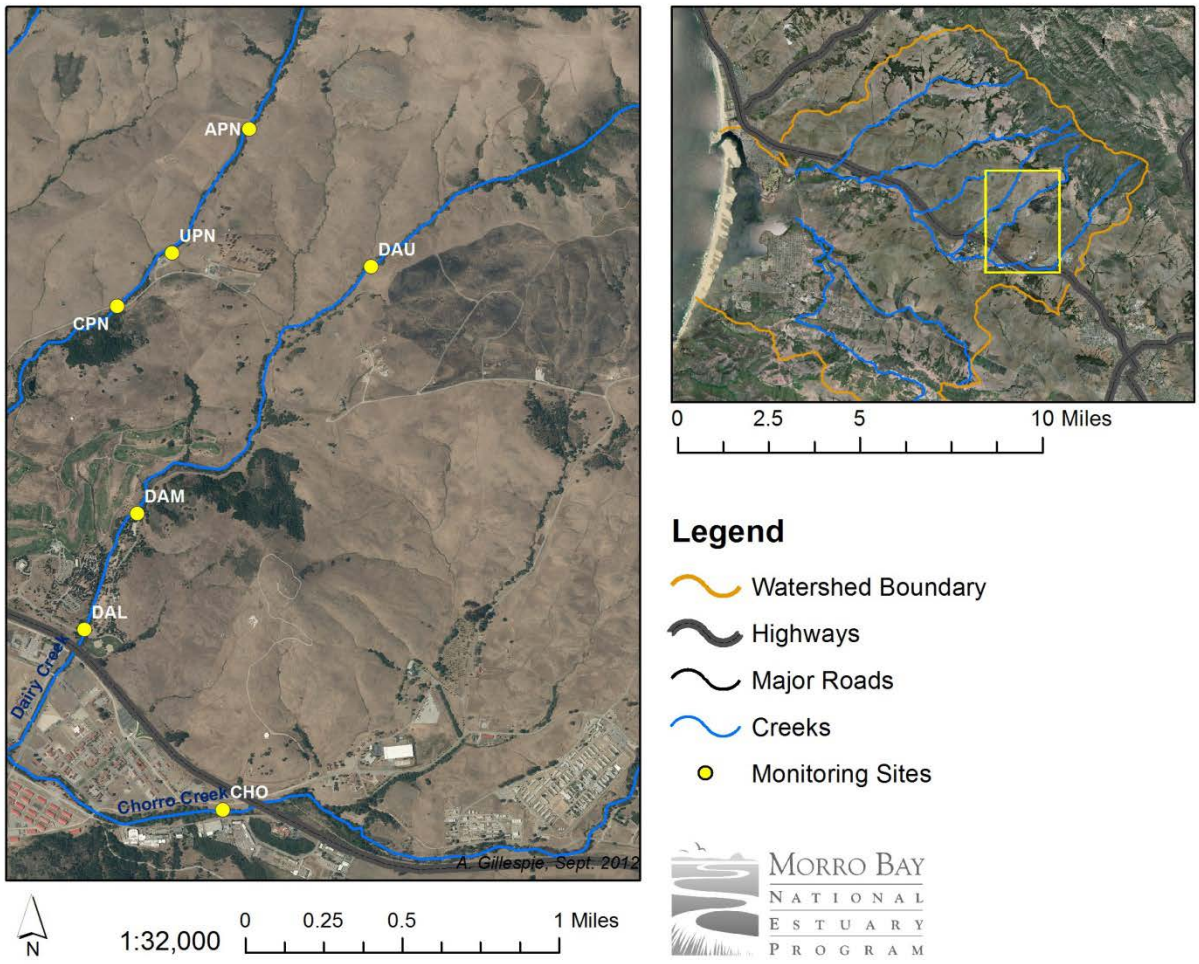
The metrics included in this report are taxa richness, EPT richness, EPT% and IBI score. These metrics are detailed in site specific chapters later in this report. The Index of Biotic Integrity (IBI) score used in this report is the Southern California Coastal IBI developed by the Aquatic Bioassessment Laboratory of the California Department of Fish & Game. IBI scores of 0 to 19 are considered to be very poor, 20 to 39 are poor, 40 to 59 are fair, 60 to 79 are good, and 80 to 100 are very good. The figure below demonstrates the site locations and IBI scores for sites monitored in 2012. The following table displays the IBI score for each creek site monitored from 2008 through 2012.



	CHD	CER	TWB	DAU	DAM	DAL	UPN	WAL	USL	LSL	USB	MNO	CLK	LVR	COO
2008 IBI Score	44.3	30.0	55.8	80.1	50.1	50.1	78.7	38.6	*	67.2	*	75.8	58.6	*	81.5
2009 IBI Score	57.2	*	*	91.5	74.4	*	*	*	*	70.1	*	*	*	*	*
2010 IBI Score	*	*	*	71.5	52.9	60.1	*	28.6	91.5	75.8	77.2	67.2	65.8	41.5	*
2011 IBI Store	54.3	34.3	*	58.6	65.7	*	85.7	*	58.6	54.3	*	62.9	52.9	48.6	*
2012 IBI Score	*	47.1	45.7	*	*	*	84.3	*	*	72.9	*	74.3	70.0	*	*
Avg IBI	51.9	37.1	50.8	75.4	60.8	55.1	82.9	33.6	75.1	68.1	77.2	70.1	61.8	45.1	81.5

DAIRY CREEK

SITE MAP AND DESCRIPTION



The Dairy Creek subwatershed encompasses an area of approximately 2.5 square miles. The watershed is predominately utilized as rangeland for beef cattle operations. Most of the watershed is publicly owned by the County of San Luis Obispo, the U.S. Forest Service, Cal Poly and Camp San Luis Obispo (California Army National Guard). The volunteer monitoring program monitors Dairy Creek at three sites in El Chorro Regional Park: Dairy Creek Upper (DAU), Dairy Creek Middle (DAM) and Dairy Creek Lower (DAL). These sites were established in the early 1990's as part of the National Monitoring Program (NMP), and data collection was continued by the VMP following the conclusion of the NMP in 2001.

At the three Dairy Creek sites, water quality, bacteria and bioassessment monitoring is conducted when adequate flow is present.

WATER QUALITY N VALUE SUMMARY

A challenge with monitoring at Dairy Creek was the intermittent nature of the flow. DAL rarely flowed year-round. Flows appeared to go sub-surface above DAM and re-appear at the small impoundment waterfall where the monitoring site is located. Site DAU flowed for more of the year, although flows typically become quite low by the end of the dry season. In particularly dry years, such as 2009,

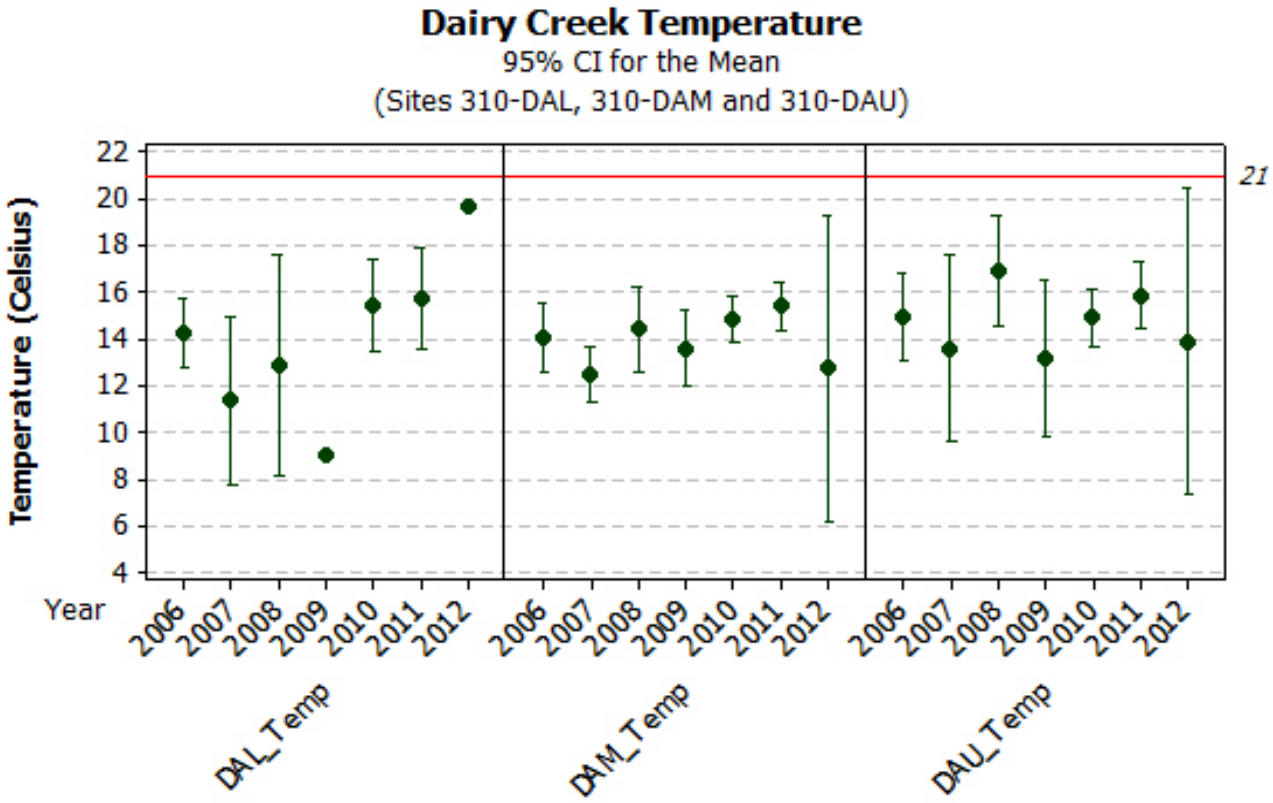
minimal data could be collected. In 2009, DAU was likely flowing for more of the year, however monitoring was limited due to the condition of the road out to the site. The table below indicates the frequency of water quality monitoring at Dairy Creek sites throughout the monitoring period.

Site	2006	2007	2008	2009	2010	2011	2012*	Sum
DAL	20	7	5	1	13	1	10	**57**
DAM	12	12	10	9	18	20	3	**84**
DAU	11	5	8	4	18	11	4	**61**
Sum	**43**	**24**	**23**	**14**	**49**	**32**	**17**	

** 2012 values include January to June 2012.*

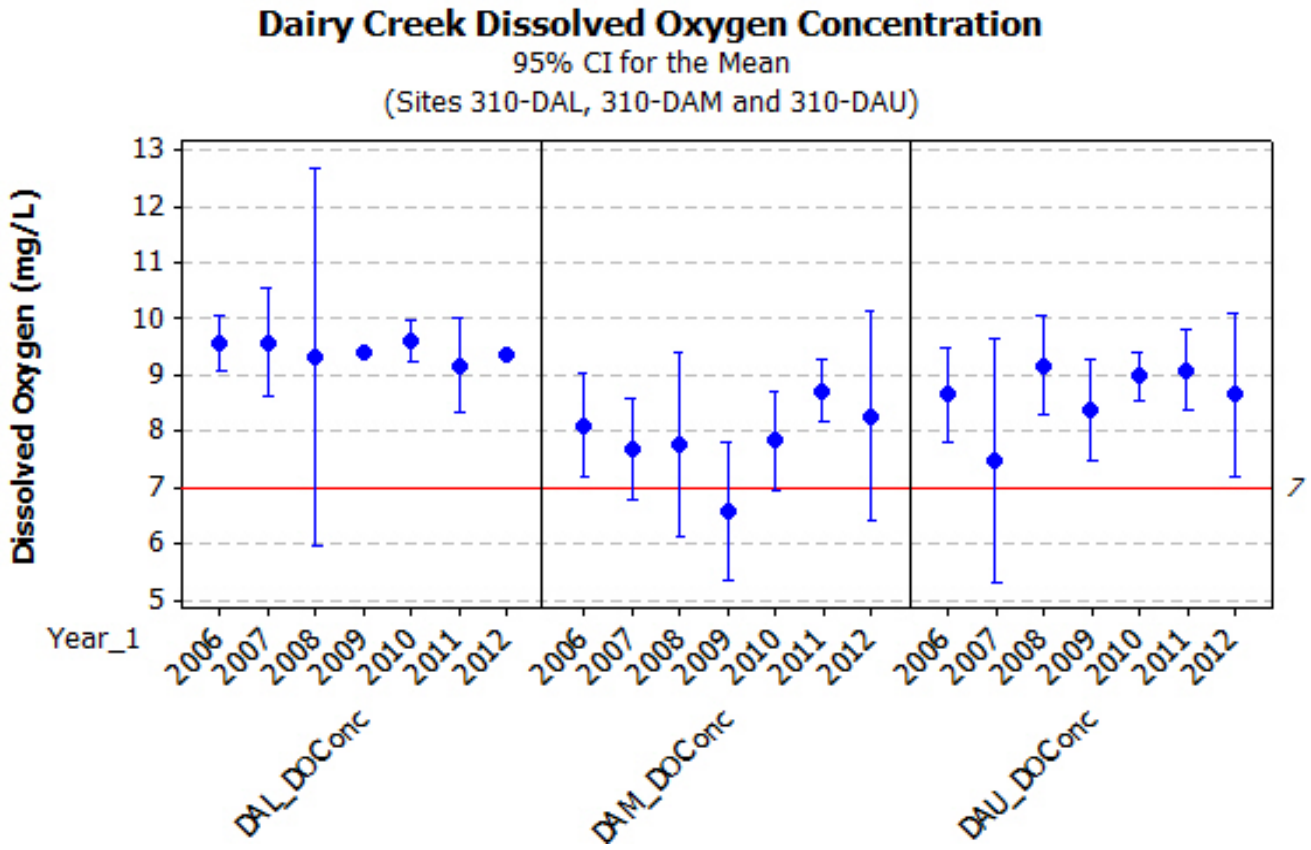
TEMPERATURE

The following plot shows the mean water temperature for each year, with the results grouped by site. The interval bars indicate the 95% confidence interval (CI) for the mean, which is the range within which 95% of the data can be expected to fall. The 21°C level of concern for protection of steelhead habitat is a CCRWQCB 303(d) Listing Guidance Value, which is indicated on the graph by a red line.



DISSOLVED OXYGEN

The following graph shows the mean and 95% CI for the dissolved oxygen concentration at Dairy Creek. The Central Coast Basin Plan regulatory standard that states that at no time shall DO concentrations fall below 7.0 mg/L.



BACTERIA

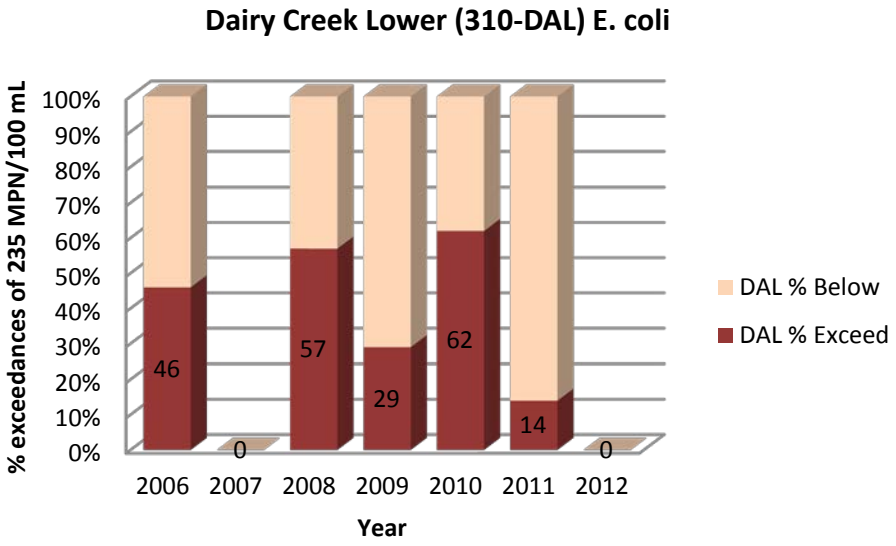
The following table contains the number of bacteria samples collected each year at the sites and the number of samples that exceeded the criteria.

	2006	2007	2008	2009	2010	2011	2012†
DAL n	13	1	7	7	13	7	3
DAL % Exceed	46	*	57	29	62	86	*
DAM n	11	2	10	9	17	11	4
DAM % Exceed	28	*	10	0	35	18	*
DAU n	11	1	12	7	19	11	6
DAU % Exceed	64	*	66	43	74	35	67

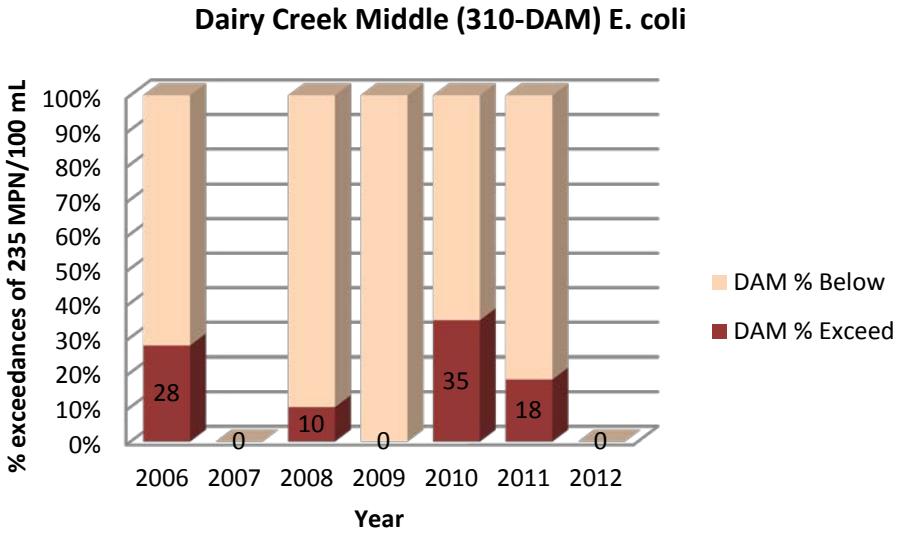
**The sample size n < 6 was deemed too small for inclusion in the analysis.*

† 2012 values include January to June 2012.

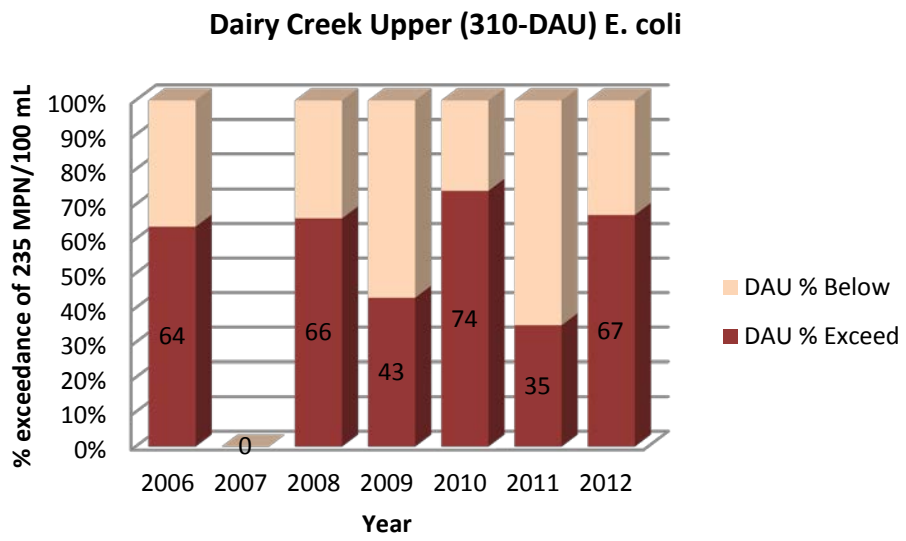
The following graphs depict the % of samples that exceeded the 235 MPN/100 mL recreational contact standard for *E. coli* each year. The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.



Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.

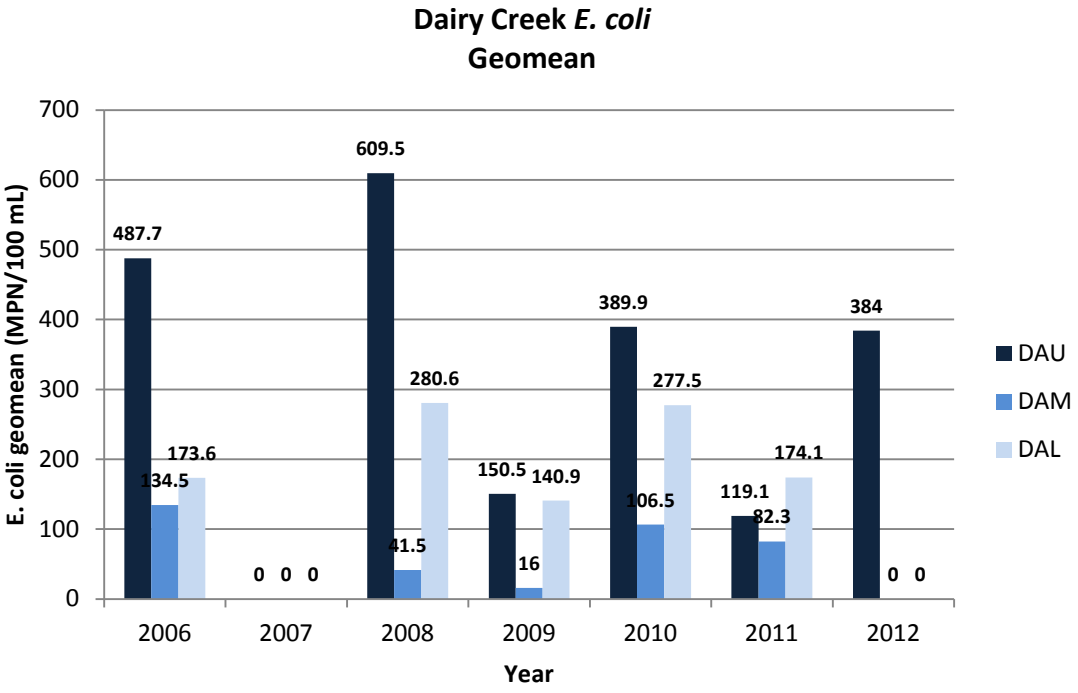


Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.



Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.

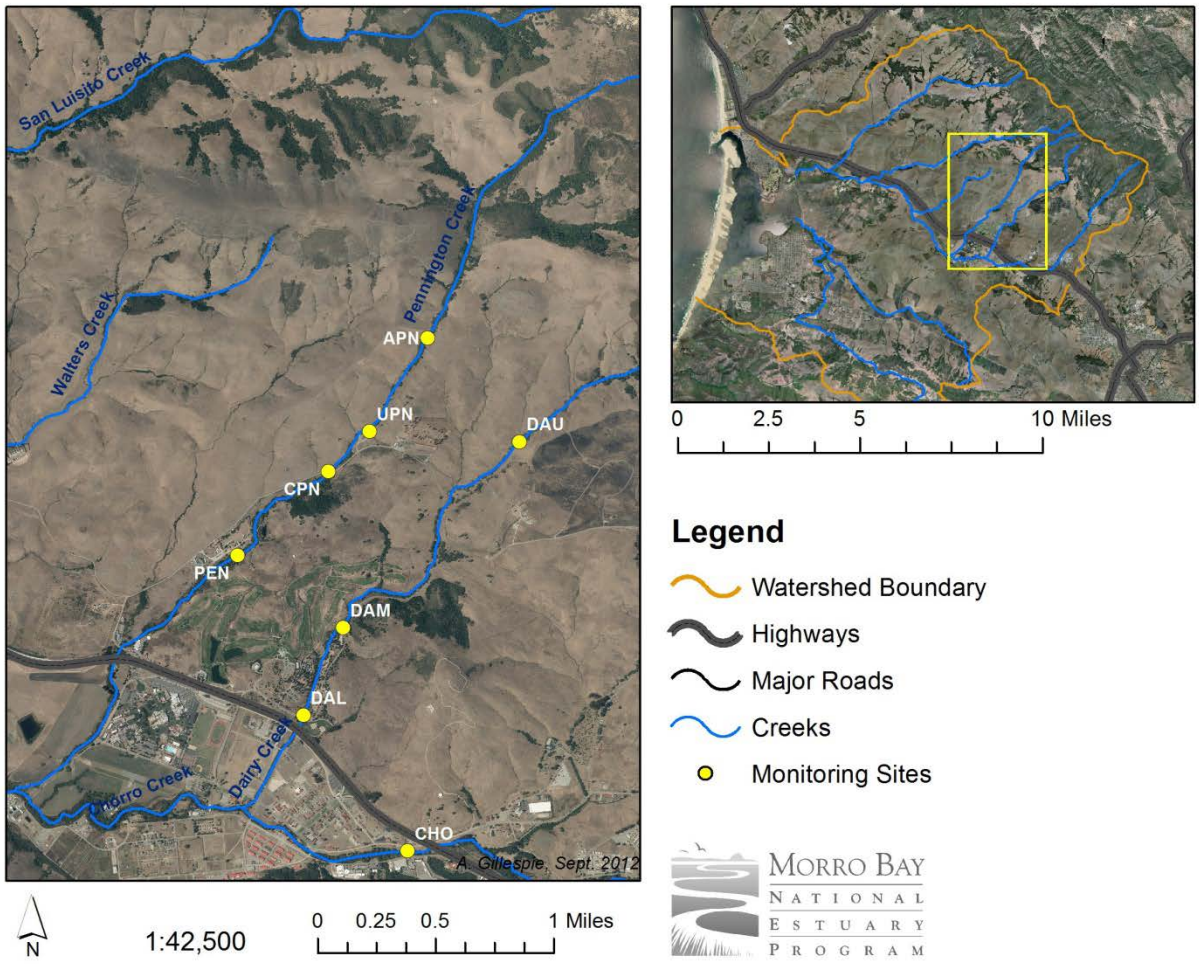
The following graph illustrates the geomean of the *E. coli* data on Dairy Creek from January 2006 through June 2012.



Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.

PENNINGTON CREEK

SITE MAP AND DESCRIPTION



The Pennington Creek subwatershed encompasses an area of approximately 3.1 square miles. The watershed is predominantly utilized as parkland and beef cattle rangeland. Most of the acreage is publicly-owned by the County of San Luis Obispo, the U.S. Forest Service and Cal Poly State University. The Rancho El Chorro Outdoor School and Cal Poly Escuela Ranch Cattle Enterprise operation dominate the acreage in the watershed.

The VMP has conducted long term monitoring for water quality and bacteria on Pennington Creek at two sites. The PEN site is located near the outdoor amphitheater and picnic area at the Ranch El Chorro Outdoor School. This site was established in the early 1990's as part of the National Monitoring Program (NMP), and data collection was continued by the VMP following the conclusion of the NMP in 2001. The CPN site is approximately 0.5 miles upstream from PEN at the bridge crossing on Pennington Creek Road. This site was established in 2007 with cooperation from Cal Poly State University.

In support of planned water conservation projects, two upstream sites were added to the monthly water quality monitoring regime in this watershed. Frequent water quality monitoring, including flow monitoring, was begun in January 2011 on two sites (APN and UPN). The UPN site was established as a

macroinvertebrate monitoring site in 2006 but was not included as part of regular ongoing water quality monitoring efforts until 2010. The APN site is currently only monitored for water quality.

Water quality monitoring on the four sites on Pennington Creek are monitored in sets of two. Teams are assigned to APN and UPN as a set of sites or to CPN and PEN. The monitoring team monitors both sites on the same day, one immediately after the other. At CPN and PEN, water quality and bacteria monitoring are conducted. At APN and UPN, water quality monitoring is conducted. At UPN, bioassessment monitoring is conducted.

WATER QUALITY N VALUE SUMMARY

Although Pennington Creek is a perennial stream, summer flows can become too shallow to facilitate monitoring. Flow data for this creek is limited by the shallow depth of surface flows and large cobbles which prevent accurate measurement of water velocity. The table below indicates the frequency of water quality monitoring at Pennington Creek sites throughout the monitoring period.

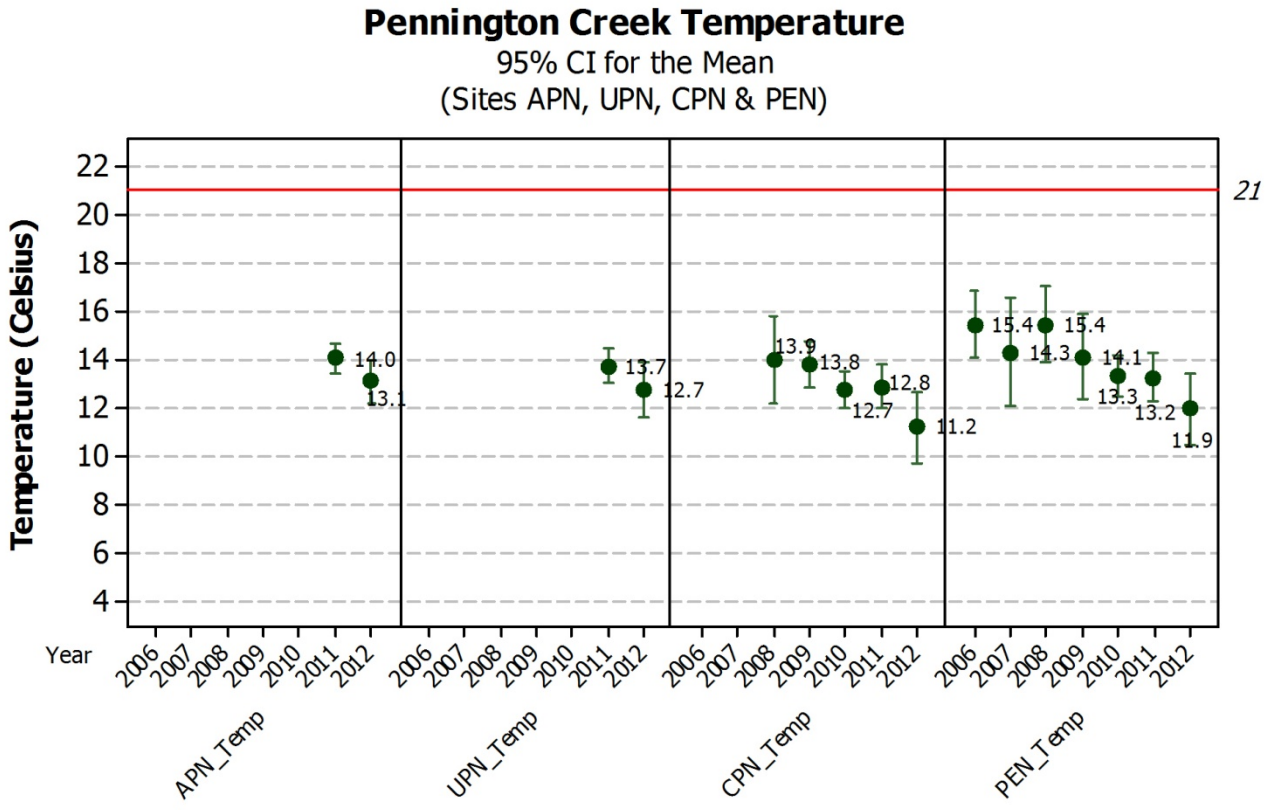
Site	2006	2007	2008	2009	2010	2011	2012*	Sum
PEN	21	16	11	12	24	23	11	**118**
CPN	0	3	12	19	23	24	11	**92**
UPN	-	-	-	-	-	32	12	**44**
APN	-	-	-	-	-	29	12	**41**
Sum	**21**	**19**	**23**	**31**	**47**	**108**	**46**	

** 2012 values include January to June 2012.*

TEMPERATURE

The plot shows the mean temperature for each year, with the results grouped by site and year. The interval bars indicate the 95% confidence interval (CI) for the mean, which is the range within which 95% of the data can be expected to fall. The 21°C level of concern for protection of steelhead habitat is a CCRWQCB 303(d) Listing Guidance Value, which is indicated on the graph by a red line.

Although water temperatures typically do not exceed levels of concern in Pennington Creek, the data is of interest due to the water conservation project installed on the nearby Cal Poly Beef Unit. The rainwater harvesting project consists of piping and tanks to store rainfall from the wet months, which will be utilized during the dry months to supply cattle troughs. This replaces pumping of riparian wells during the dry summer months, thus keeping more water in the creek. More water in the creek during dry months could result in lower water temperatures.



ALGAE DOCUMENTING

Algae data was analyzed through two data sets generated by 2012 assessments at the UPN monitoring site. The percent coverage of macroalgae at the site was determined by calculating algae presence at wetted points located on the transects and inter-transects. This calculated value is used to represent percent algal coverage throughout the 150 m reach. UPN, the only site monitored on Pennington Creek, had a score of 0% coverage by macroalgae in 2012. Additionally, the qualitative spatial coverage of filamentous algae was scored for defined areas 5 m above and 5 m below each of ten transects assessed within each site. Each assessment area (10 m of wetted reach) was assigned a score between 0 to 4, with 0 indicating less than 5% algae coverage, 1 indicating < 10% coverage, 2 indicating 10 to 40% coverage, 3 indicating 40 to 75% coverage, and 4 indicating > 75% coverage. With this metric, UPN scored a 0%, with no scores of 3 or 4 for filamentous algae.

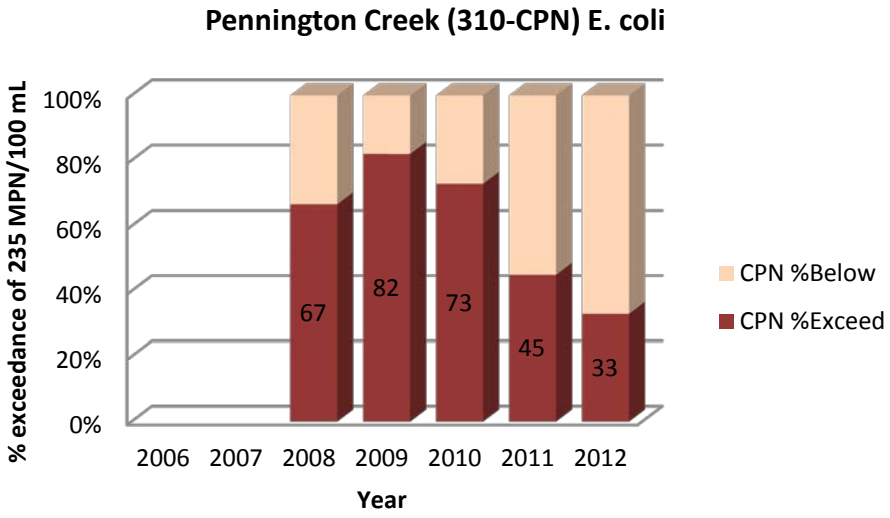
BACTERIA

The following table contains the number of bacteria samples collected each year at the Pennington Creek sites and the percentage of samples that exceeded the REC-1 contact standard for *E. coli* of 235 MPN/100 mL.

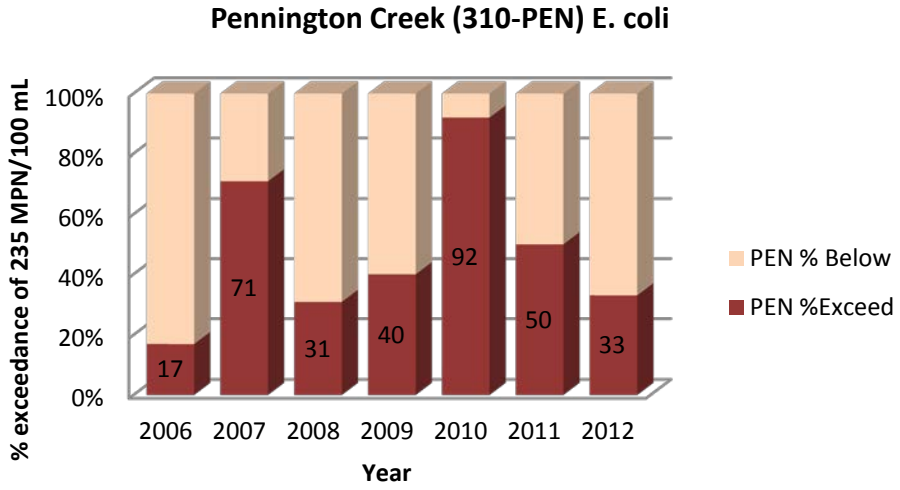
	2006	2007	2008	2009	2010	2011	2012[†]
CPN n	0	0	12	11	11	11	6
CPN %Exceed	-	-	67	82	73	45	33
PEN n	12	14	13	10	12	12	6
PEN %Exceed	17	71	31	40	92	50	33

**The sample size n < 6 was deemed too small for inclusion in the analysis.*
† 2012 values include January to June 2012.

The following graphs depict the % of samples that exceeded the recreational contact standard for *E. coli* each year at the two monitoring sites. The blank columns with zeroes in the graphs depict that no data was collected or that a sample size that was too small (n < 6) for inclusion in the analysis, rather than a lack of exceedances of the standard.

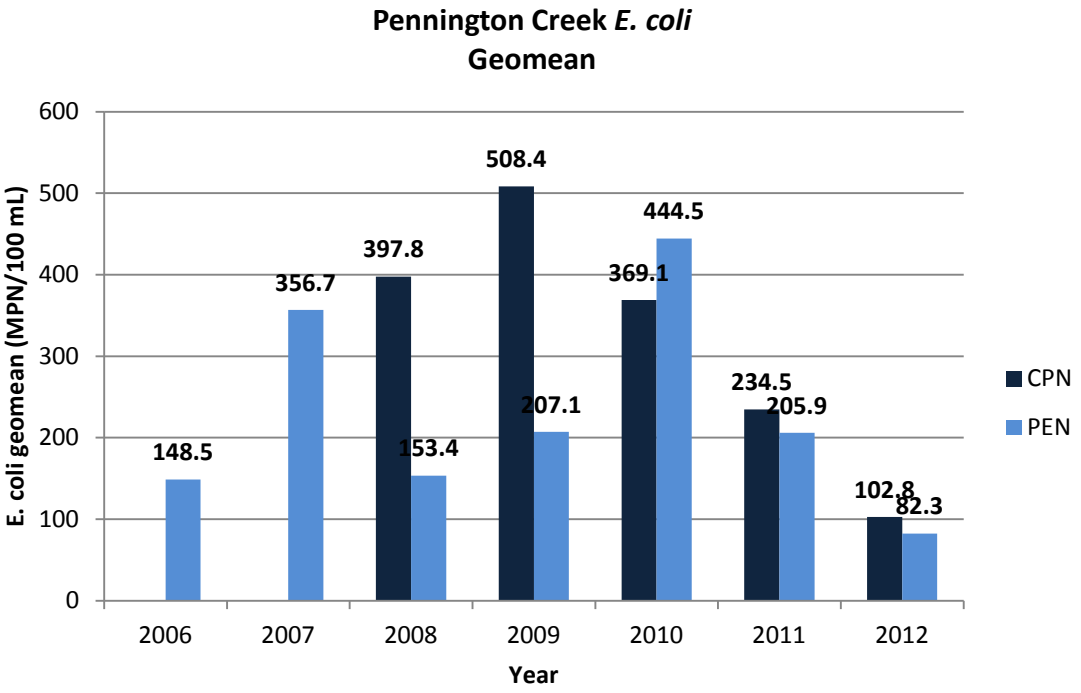


Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.



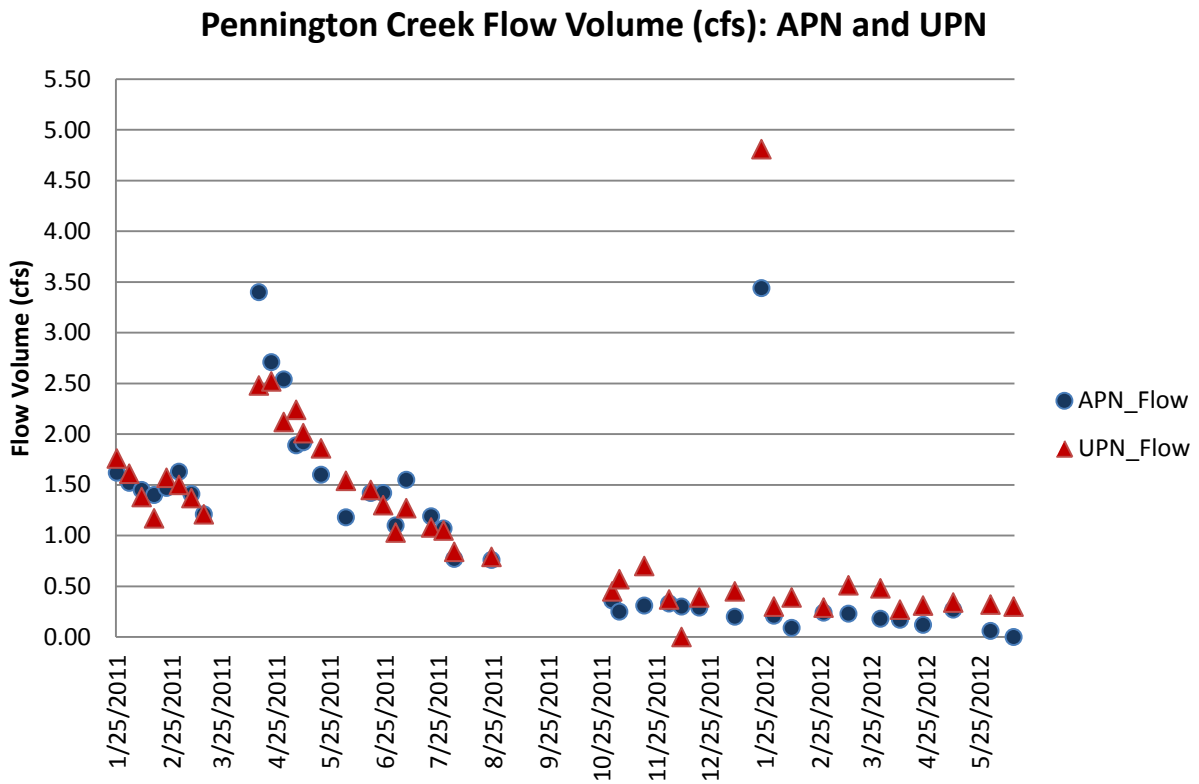
Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.

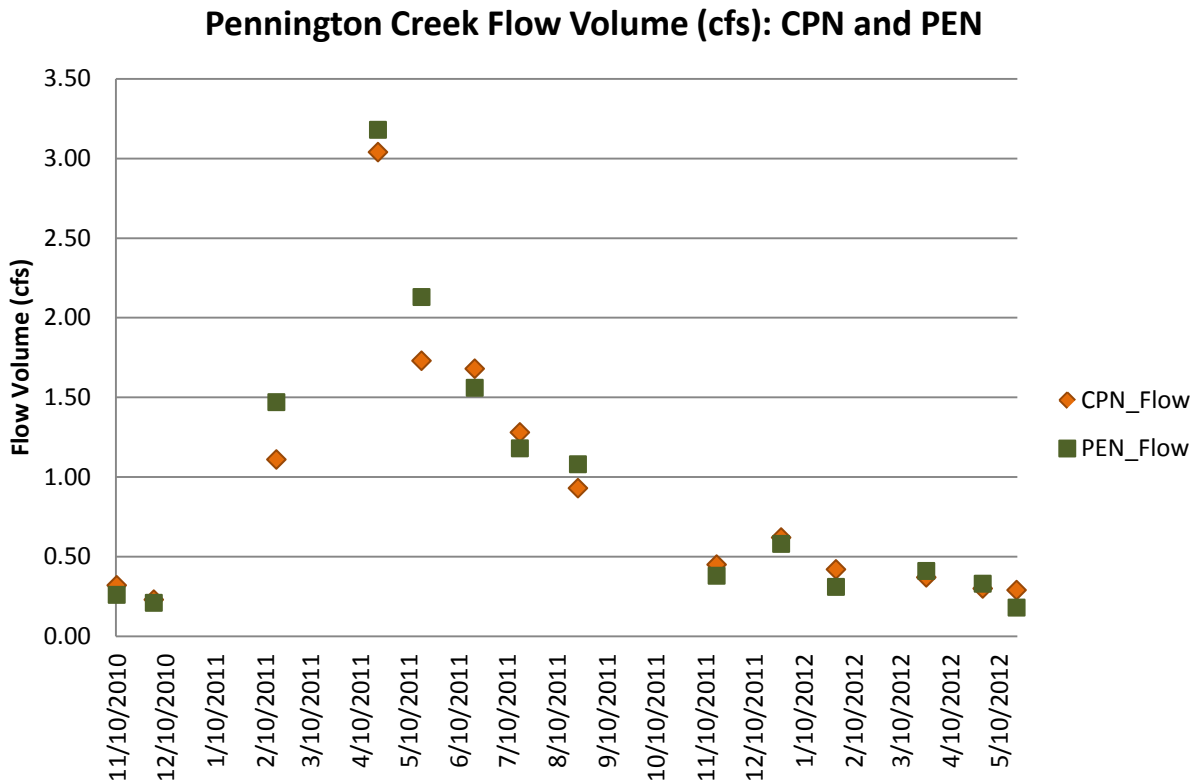
The following graph illustrates the geomean of the *E. coli* data from Pennington Creek from January 2006 through June 2012.



FLOW VOLUME

The following two graphs show flow measurements obtained from the creek at each site. The graph provides an overview of the range and frequency of flow measurements. Flow volume was infrequently measured at Pennington Creek due to the shallow depth of the water in fast moving habitats. Since paired sites were measured on the same date, the data is displayed in the graphs as pairs of data (APN and UPN, CPN and PEN) to show the relative differences in flow volume.





MACROINVERTEBRATES

The metrics included in this section are taxa richness, EPT richness, EPT% and IBI score. Taxa richness is a measure of the number of different species of organisms in the sample. EPT richness is a measure of

the total number of taxa within the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). Taxa richness and EPT richness typically decrease with poor water quality. EPT% is the total number of EPT individuals divided by the total number of individuals in the sample. The Index of Biotic Integrity (IBI) score used in this report is the Southern California Coastal IBI developed by the Aquatic Bioassessment Laboratory of the California Department of Fish & Game. Seven uncorrelated biotic measurements were selected to be included in the calculation. They include collector-gatherer + collector-filterer individuals, percent non-insect taxa, percent tolerant taxa, coleoptera richness, predator richness, percent intolerant individuals and EPT richness. For the IBI scores, scores of 0 to 19 are considered to be very poor, 20 to 39 are poor, 40 to 59 are fair, 60 to 79 are good, and 80 to 100 are very good. The metrics are displayed below for both Pennington Creek sites.

Upper Pennington Creek (UPN)	***Taxa Richness***	***EPT Richness***	***EPT %***	***IBI Score***
2002	*	*	*	*
2003	*	*	*	*
2004	*	*	*	*
2005	*	*	*	*
2006	49	16	44.0	-
2007	62	21	21.0	-
2008	47	17	18.4	79.0
2009	*	*	*	*
2010	*	*	*	*
2011	59	25	64.4	85.7
2012	56	21	48.5	84.3

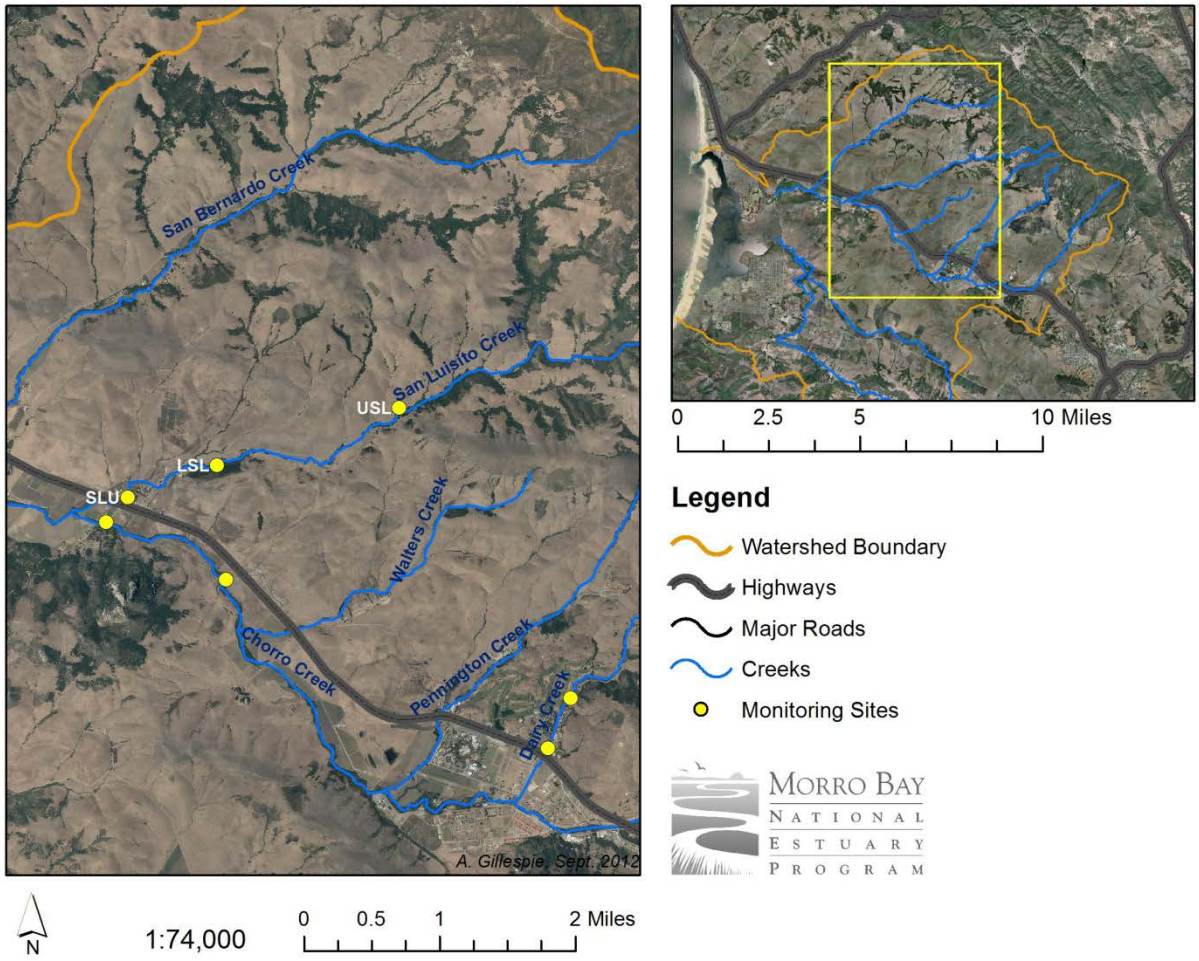
** No data collected this year.*
- Metric scores not currently available.

Lower Pennington (PEN)	***Taxa Richness***	***EPT Richness***	***EPT %***	***IBI Score***
2002	*	*	*	*
2003	*	*	*	*
2004	29	11	38.0	-
2005	*	*	*	*
2006	42	17	33.2	-
2007	*	*	*	*
2008	*	*	*	*
2009	*	*	*	*
2010	*	*	*	*
2011	*	*	*	*
2012	*	*	*	*

** No data collected this year.*
- Metric scores not currently available.

SAN LUISITO CREEK

SITE MAP AND DESCRIPTION



The San Luisito Creek subwatershed encompasses an area of approximately 8.28 square miles. The watershed is predominately utilized as beef cattle rangeland with a small amount of acreage allocated to row crops and dry farming. There is a cluster of private residences near the Highway 1 crossing and a limited number of rural residences spread throughout the subwatershed. Most of the acreage is privately owned, with a few holdings by the U.S. Forest Service and the California Department of Fish and Game.

The VMP has several monitoring sites on San Luisito Creek. The most downstream site, SLU, was established in the early 1990's as part of the National Monitoring Program (NMP), and data collection was continued by the VMP following the conclusion of the NMP in 2001. This site was monitored for water quality and bacteria either monthly or bi-weekly depending on volunteer availability.

Three additional monitoring sites, including USL and LSL, were established through cooperative agreement on private property in 2006. A fourth was established through cooperative agreement on private property in 2009. These four sites were monitored bi-weekly for bacteria only, and no water quality data was collected. In 2012, the frequency of bacteria monitoring was reduced to once a month. Macroinvertebrate data has been collected intermittently at sites LSL and USL since 2008.

WATER QUALITY N VALUE SUMMARY

Water quality monitoring took place monthly or twice monthly at SLU since 2002. San Luisito Creek is a perennial stream, and there are few gaps in the data during the study period. In a few instances, flow data collection was limited by shallow depths in fast water habitats. The table below indicates the frequency of water quality monitoring at the San Luisito Creek site (SLU) throughout the monitoring period.

	2006	2007	2008	2009	2010	2011	2012*	Sum
SLU	18	23	12	22	23	19	7	**124**

** 2012 values include January to June 2012.*

ALGAE DOCUMENTING

Algae data was analyzed through two data sets generated by 2012 assessments at the LSL site. The percent coverage of macroalgae at the site was determined by calculating algae presence at wetted points located on the transects and inter-transects. This calculated value is used to represent percent algal coverage throughout the 150 m reach. The lower site on San Luisito Creek, LSL, had 2% algal coverage in 2012.

Additionally, the qualitative spatial coverage of filamentous algae was scored for defined areas 5 m above and 5 m below each of ten transects assessed within each site. Each assessment area (10 m of wetted reach) was assigned a score between 0 to 4, with 0 indicating less than 5% algae coverage, 1 indicating < 10% coverage, 2 indicating 10 to 40% coverage, 3 indicating 40 to 75% coverage, and 4 indicating > 75% coverage. With this metric, LSL scored 0%, with none of the assessed area scoring a 3 or 4.

BACTERIA

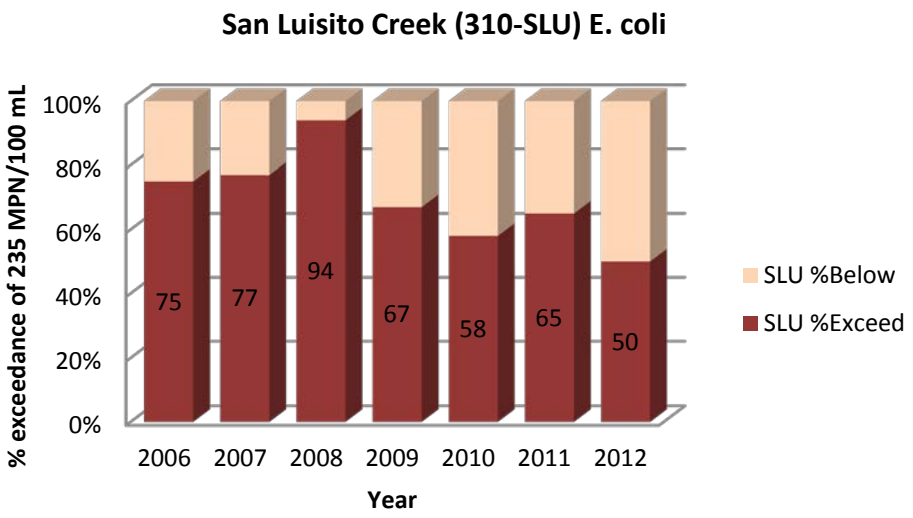
Due to the effectiveness of the riparian fencing project at reducing bacterial contamination, in 2012 the frequency of bacteria monitoring was reduced from twice monthly (at 5 sites) to once a month.

The following table contains the number of bacteria samples collected each year at the historic SLU site and the percentage of samples that exceeded the regulatory standard.

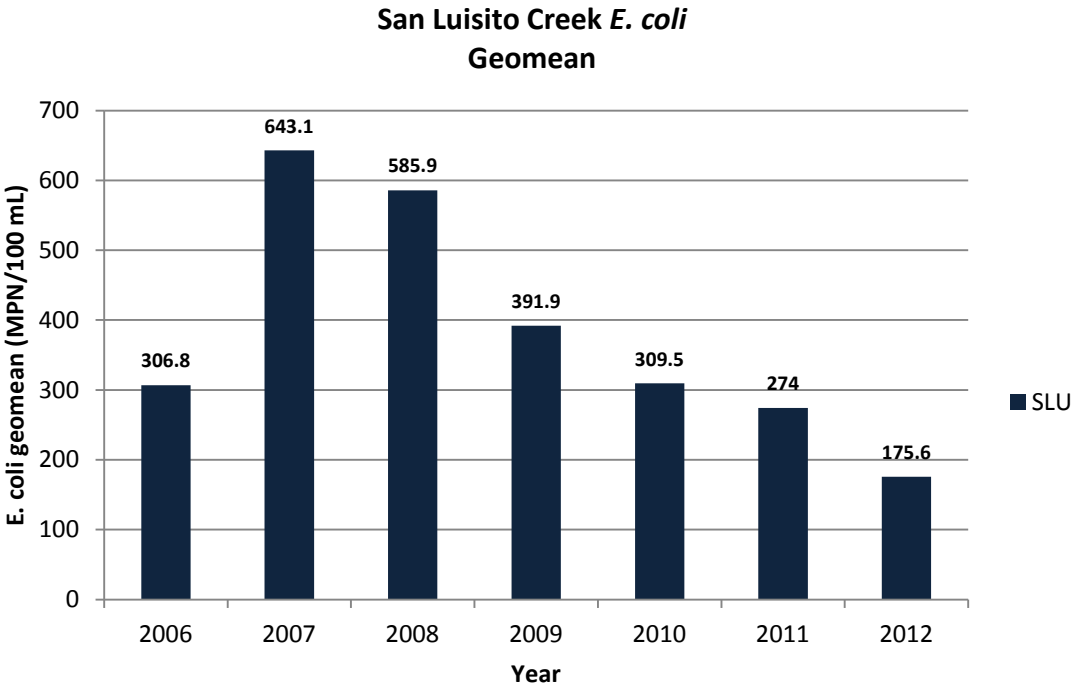
	2006	2007	2008	2009	2010	2011	2012†
SLU n	12	13	17	24	24	23	8
SLU %Exceed	58	75	77	94	67	65	50

† 2012 values include January to June 2012.

The following graph depicts the percent of samples that exceeded the recreational contact standard of 235 MPN/100 mL for *E. coli* each year.



The following graph is a plot of the geomean of *E. coli* data from January 2006 through June 2012 at the SLU site.



MACROINVERTEBRATES

The metrics included in this report are taxa richness, EPT richness, EPT% and IBI score. Taxa richness is a measure of the number of different species of organisms in the sample. EPT richness is a measure of the total number of taxa within the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). Taxa richness and EPT richness typically decrease with poor water quality. EPT% is the total number of EPT individuals divided by the total number of individuals in the sample. The Index of Biotic Integrity (IBI) score used in this report is the Southern California Coastal IBI developed by the Aquatic Bioassessment Laboratory of the California Department of Fish & Game. Seven uncorrelated biotic measurements were selected to be included in the calculation. They include

collector-gatherer + collector-filterer individuals, percent non-insect taxa, percent tolerant taxa, coleoptera richness, predator richness, percent intolerant individuals and EPT richness. For the IBI scores, scores of 0 to 19 are considered to be very poor, 20 to 39 are poor, 40 to 59 are fair, 60 to 79 are good, and 80 to 100 are very good. The metrics are displayed below.

San Luisito Creek, Lower (LSL)	***Taxa Richness***	***EPT Richness***	***EPT %***	***IBI Score***
2002	*	*	*	*
2003	*	*	*	*
2004	*	*	*	*
2005	*	*	*	*
2006	*	*	*	*
2007	*	*	*	*
2008	55	14	25.2	67
2009	49	15	12.4	70.1
2010	48	18	50.6	75.8
2011	45	17	44.5	54.3
2012	61	22	18.3	72.9

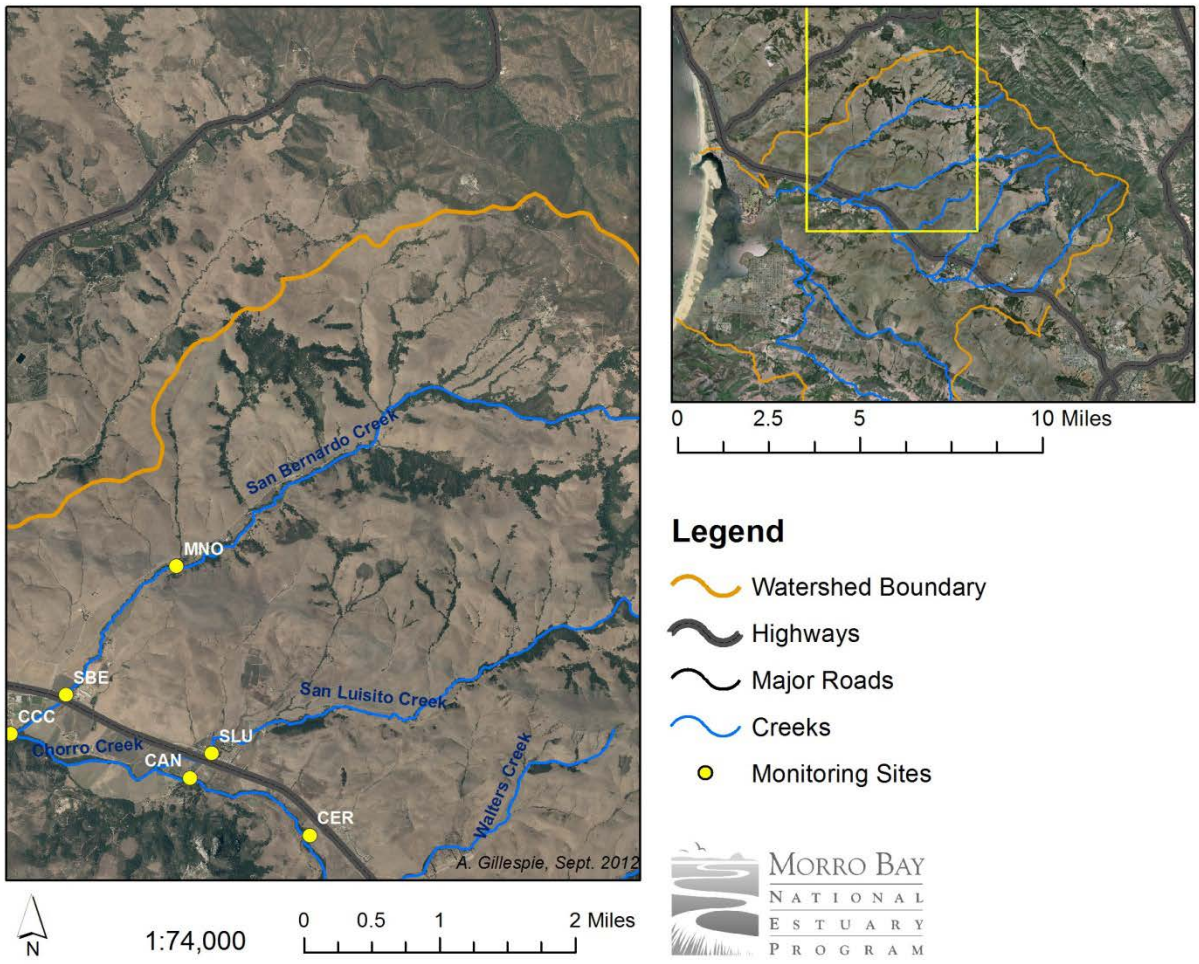
** No data collected this year.*

San Luisito Creek, Upper (USL)	***Taxa Richness***	***EPT Richness***	***EPT %***	***IBI Score***
2010	60	24	35.2	91.5
2011	38	18	76.7	58.6
2012	*	*	*	*

** No data collected this year.*

SAN BERNARDO CREEK

SITE MAP AND DESCRIPTION



The San Bernardo Creek subwatershed encompasses an area of approximately 8.49 square miles. The watershed is predominately utilized as beef cattle rangeland with a small amount of acreage allocated to row crops, small livestock operations, and dry farming. There are a limited number of rural residences spread throughout the subwatershed. Most of the acreage is privately-owned, with a few holdings by the U.S. Forest Service in the upper watershed.

The VMP has two monitoring sites on San Bernardo Creek. The most downstream site, SBE, was established in the early 1990's as part of the National Monitoring Program (NMP), and data collection was continued by the VMP following the conclusion of the NMP in 2001. Hydrologic conditions at this site have limited the amount of data collection. During many months of the year, the creek goes underground at the lower reach. Monthly water quality and bacteria monitoring are conducted at this site when adequate flows are present.

The limitations of the SBE site prompted staff to seek another upstream site for annual macroinvertebrate monitoring. Site MNO was established with agreement from private landowners on both sides of the creek. Due to difficult terrain and limited access, this site was not included as part of

ongoing water quality or bacteria monitoring efforts. Site MNO was formerly called MSB. The code was changed to coincide with the code used at the site for historical monitoring as part of the NMP.

WATER QUALITY N VALUE SUMMARY

The table below indicates the frequency of water quality monitoring at San Bernardo Creek site SBE throughout the monitoring period.

Sites	2006	2007	2008	2009	2010	2011	2012*	Sum
SBE	23	7	5	0	8	1	5	**49**

** 2012 values include January to June 2012.*

ALGAE DOCUMENTING

Algae data was analyzed through two data sets generated by the 2012 assessment at the site. The percent coverage of macroalgae at the site was determined by calculating algae presence at wetted points located on the transects and inter-transects. This calculated value is used to represent percent algal coverage throughout the 150 m reach. MNO scored 6% algal coverage.

Additionally, the qualitative spatial coverage of filamentous algae was scored for defined areas 5 m above and 5 m below each of ten transects assessed within each site. Each assessment area (10 m of wetted reach) was assigned a score between 0 to 4, with 0 indicating less than 5% algae coverage, 1 indicating < 10% coverage, 2 indicating 10 to 40% coverage, 3 indicating 40 to 75% coverage, and 4 indicating > 75% coverage. With this metric, MNO scored 0% of the assessed area having scores of 3 or 4.

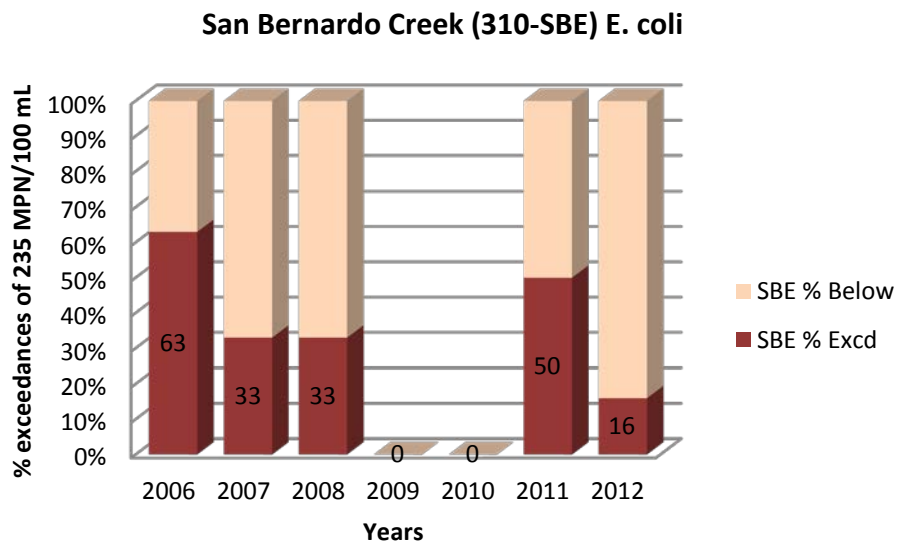
BACTERIA

The following table contains the number of bacteria samples collected each year and the number of samples that exceeded the criteria.

	2006	2007	2008	2009	2010	2011	2012†
SBE n	11	6	6	2	5	14	6
SBE % Exceed	63	33	33	*	*	50	16

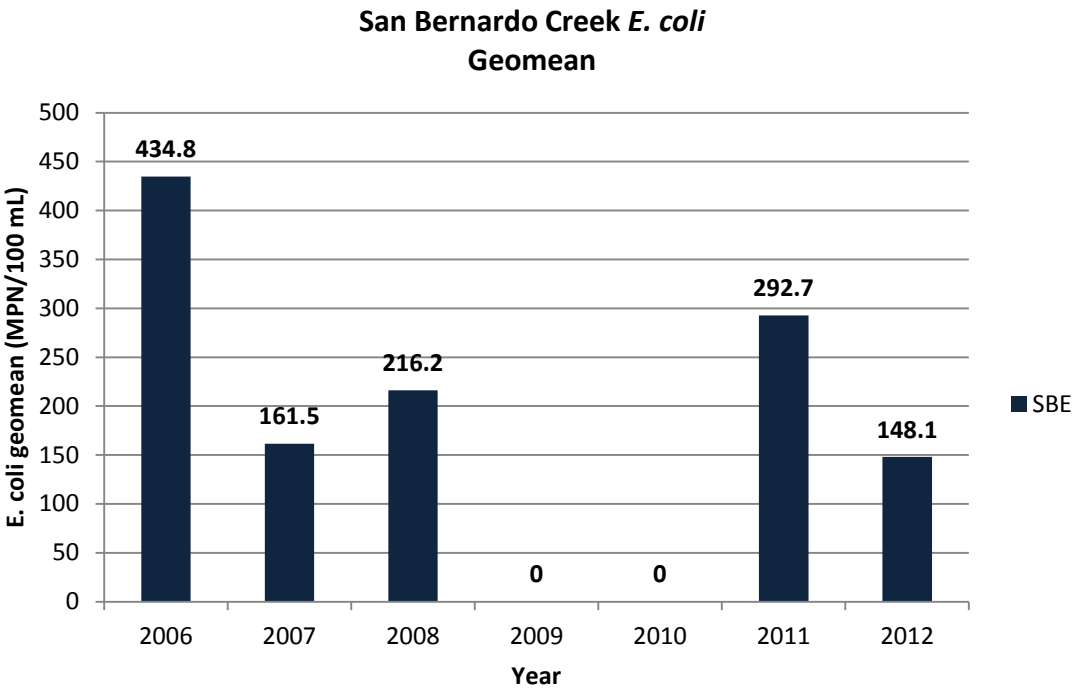
**The sample size n < 6 was deemed too small for inclusion in the analysis.*
†2012 values include January to June 2012.

The following graph depicts the % of samples that exceeded the 235 MPN/100 mL recreational contact standard for *E. coli* each year. The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.



Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.

The following graph is a plot of the geomean of data from 2006 through June 2012 at the SBE site. The columns with zeroes denote a sample size that was too small for including in the analysis, rather than a lack of exceedances of the standard.



MACROINVERTEBRATES

The highly variable hydrology of San Bernardo Creek proved challenging for macroinvertebrate monitoring. Prior to 2008, the monitoring program did not have access to the creek beyond the SBE site. In 2008, landowners on both sides of the creek allowed macroinvertebrate monitoring to take

place at site MNO, a location upstream of SBE. Although the creek reach near MNO is also intermittent, the longer hydroperiod allowed sufficient time to conduct bioassessment monitoring.

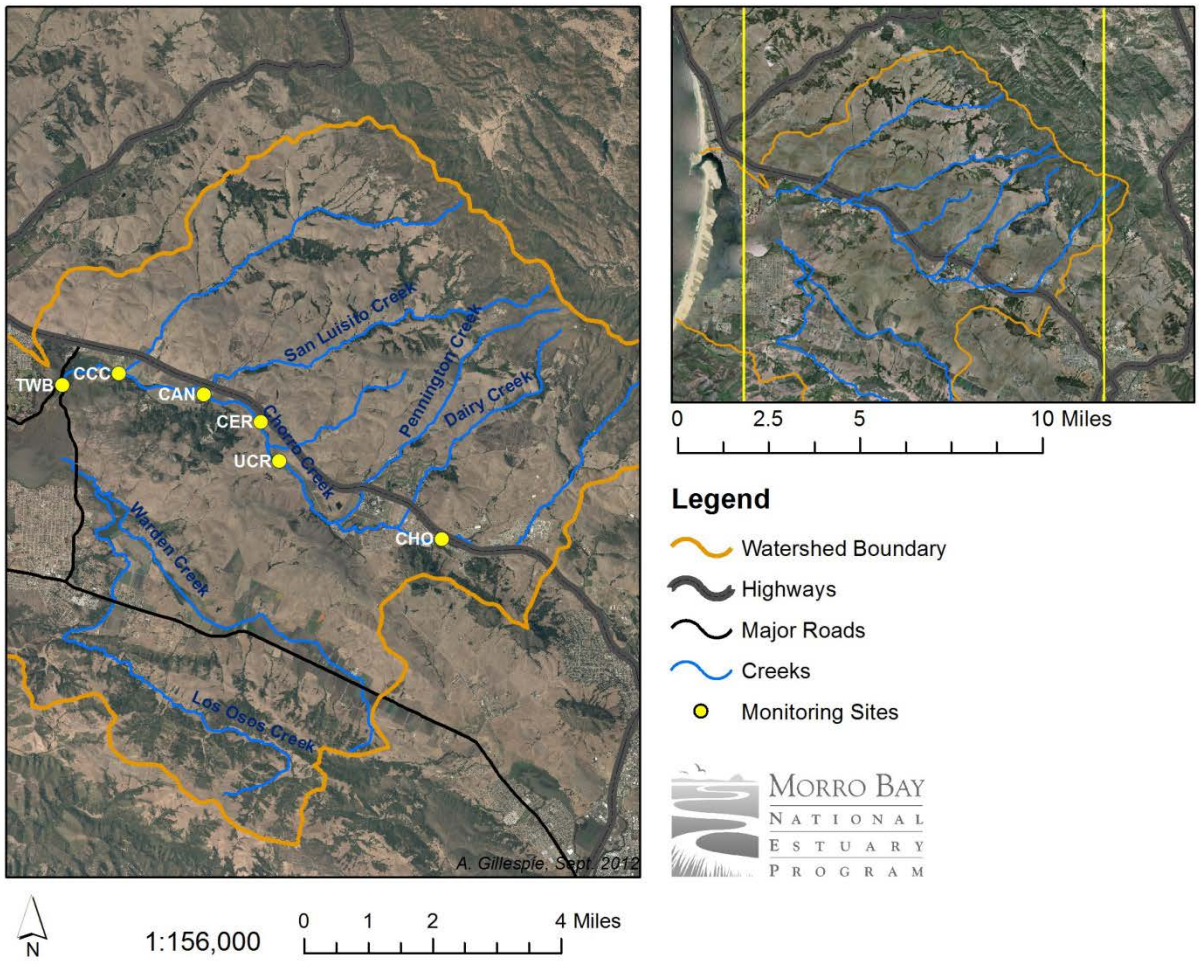
The metrics included in this report are taxa richness, EPT richness, EPT% and IBI score. Taxa richness is a measure of the number of different species of organisms in the sample. EPT richness is a measure of the total number of taxa within the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). Taxa richness and EPT richness typically decrease with poor water quality. EPT% is the total number of EPT individuals divided by the total number of individuals in the sample. The Index of Biotic Integrity (IBI) score used in this report is the Southern California Coastal IBI developed by the Aquatic Bioassessment Laboratory of the California Department of Fish & Game. Seven uncorrelated biotic measurements were selected to be included in the calculation. They include collector-gatherer + collector-filterer individuals, percent non-insect taxa, percent tolerant taxa, coleoptera richness, predator richness, percent intolerant individuals and EPT richness. For the IBI scores, scores of 0 to 19 are considered to be very poor, 20 to 39 are poor, 40 to 59 are fair, 60 to 79 are good, and 80 to 100 are very good. The metrics are displayed below.

Middle San Bernardo Creek (MNO)	Taxa Richness	EPT Richness	EPT %	IBI Score
2002	*	*	*	*
2003	*	*	*	*
2004	*	*	*	*
2005	*	*	*	*
2006	*	*	*	*
2007	*	*	*	*
2008	64	20	50.4	75.8
2009	*	*	*	*
2010	42	14	61.8	67.2
2011	52	17	37.6	62.9
2012	69	22	42.8	74.3

** No data collected this year.*

CHORRO CREEK

SITE MAP AND DESCRIPTIONS



The Chorro Creek watershed encompasses an area of approximately 43 square miles and includes the tributaries Dairy Creek, Pennington Creek, Walters Creek, San Luisito Creek and San Bernardo Creek. The watershed is predominately utilized as beef cattle rangeland with a small amount of acreage allocated to row crops and rural residences. The San Luis Obispo County Operations Center, California Men's Colony and Cuesta College are all located within close proximity to Chorro Creek. Publicly-owned property includes the California Army National Guard Camp San Luis Obispo, the Chorro Creek Ecological Reserve, and rangeland owned by Cal Poly.

The VMP has six monitoring sites on the mainstem of Chorro Creek. The most upstream site, CHD, was established below Chorro Dam during the NMP. It is monitored periodically for macroinvertebrates. The site CHO is located on Camp San Luis Obispo property near the Highway 1 overpass. The California Department of Corrections Wastewater treatment plant discharges tertiary treated effluent to Chorro Creek downstream of the CHO monitoring site. CHO is monitored monthly for water quality. The UCR site was established in 2007 with cooperation from Cal Poly. This site is located downstream of the wastewater plant and the confluences of Dairy and Pennington Creeks. It is monitored monthly for water quality and bacteria. Site CER was established in 2003 at the main creek crossing on the Chorro Creek Ecological Reserve. This site differs hydologically from UCR in that it includes the confluence of

Walters Creek. It is monitored monthly for water quality and bacteria and is also a macroinvertebrate site. Site CAN was established in the early 1990's as part of the National Monitoring Program (NMP), and data collection has been continued by the VMP following the conclusion of the NMP in 2001. This site has also been the focus of suspended sediment monitoring efforts and is an instrumented gauging station. It is monitored monthly for water quality and bacteria. Site CCC is located at the road crossing of Chorro Creek Road. The VMP began monitoring the site in late 2009, and it is monitored monthly for water quality and bacteria. Historical data exists from monitoring during the NMP. The site is also monitored regularly by the Cooperative Monitoring Program of the Central Coast Water Quality Preservation, Inc. The most downstream site, TWB, was also established in the early 1990's as part of the NMP and is a CCAMP Coastal Confluences site. This site has been monitored consistently either monthly or twice monthly since 2002. It is monitored for water quality, bacteria and macroinvertebrates.

Site CCC was formerly called UCF. The code was changed to coincide with the code used for historic monitoring efforts.

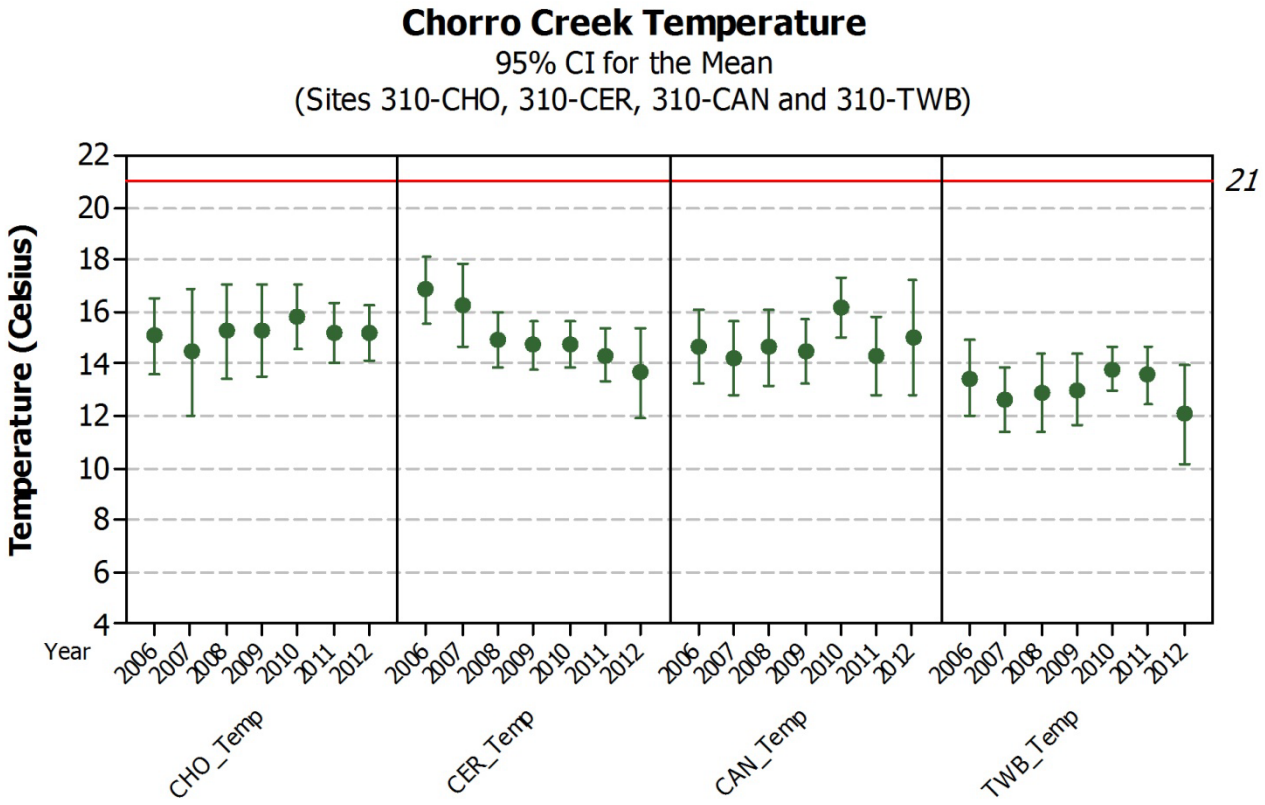
WATER QUALITY N VALUE SUMMARY

	2006	2007	2008	2009	2010	2011	2012†	Sum
CHO	16	12	11	11	15	13	6	**84**
UCR	-	9	17	20	17	17	9	**89**
CER	20	17	17	28	26	24	12	**144**
CAN	18	20	13	18	21	21	12	**123**
CCC	-	-	*	3	8	24	12	**47**
TWB	17	15	13	18	24	20	9	**116**
Sum	**71**	**73**	**71**	**98**	**111**	**119**	**60**	

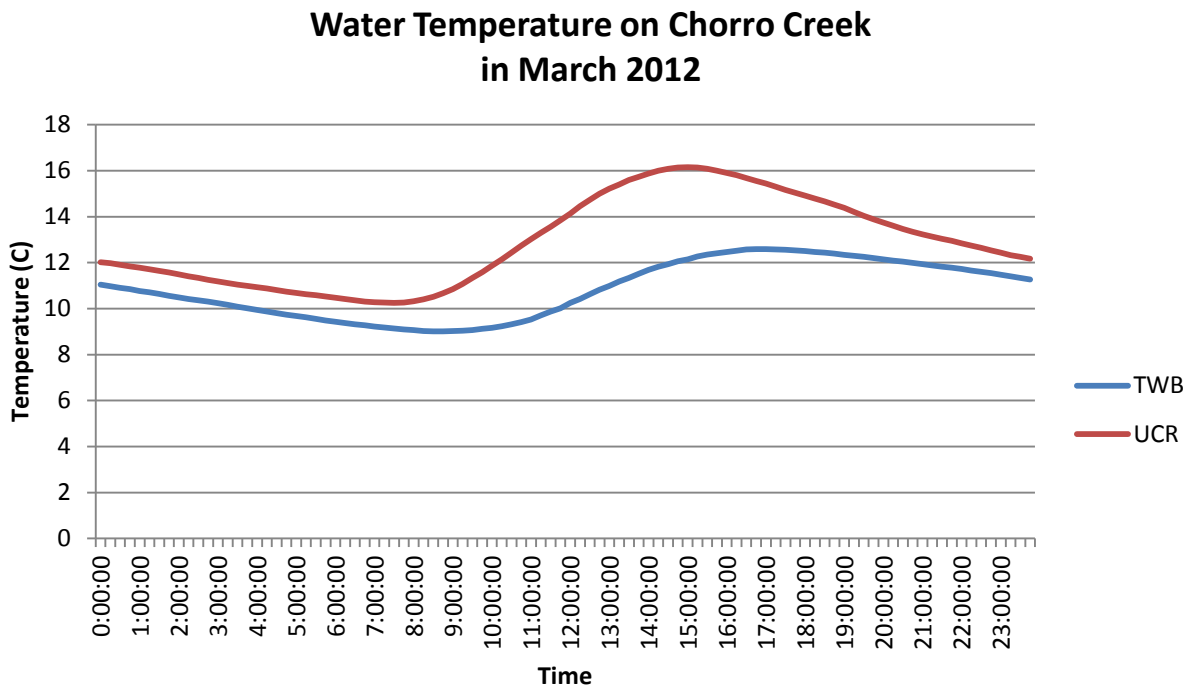
†2012 values include January to June 2012.

TEMPERATURE

While temperature levels on Chorro Creek have not approached the level of concern for protection of aquatic life, nutrients and therefore DO have been of concern. Due to its link to DO concentrations, an analysis of temperature data on Chorro Creek was conducted. The plot shows the mean temperature for each year, with the results grouped by site. The interval bars indicate the 95% confidence interval (CI) for the mean, which is the range within which 95% of the data can be expected to fall. The 21°C level of concern for protection of steelhead habitat is a CCRWQCB 303(d) Listing Guidance Value, which is indicated on the graph by a red line.



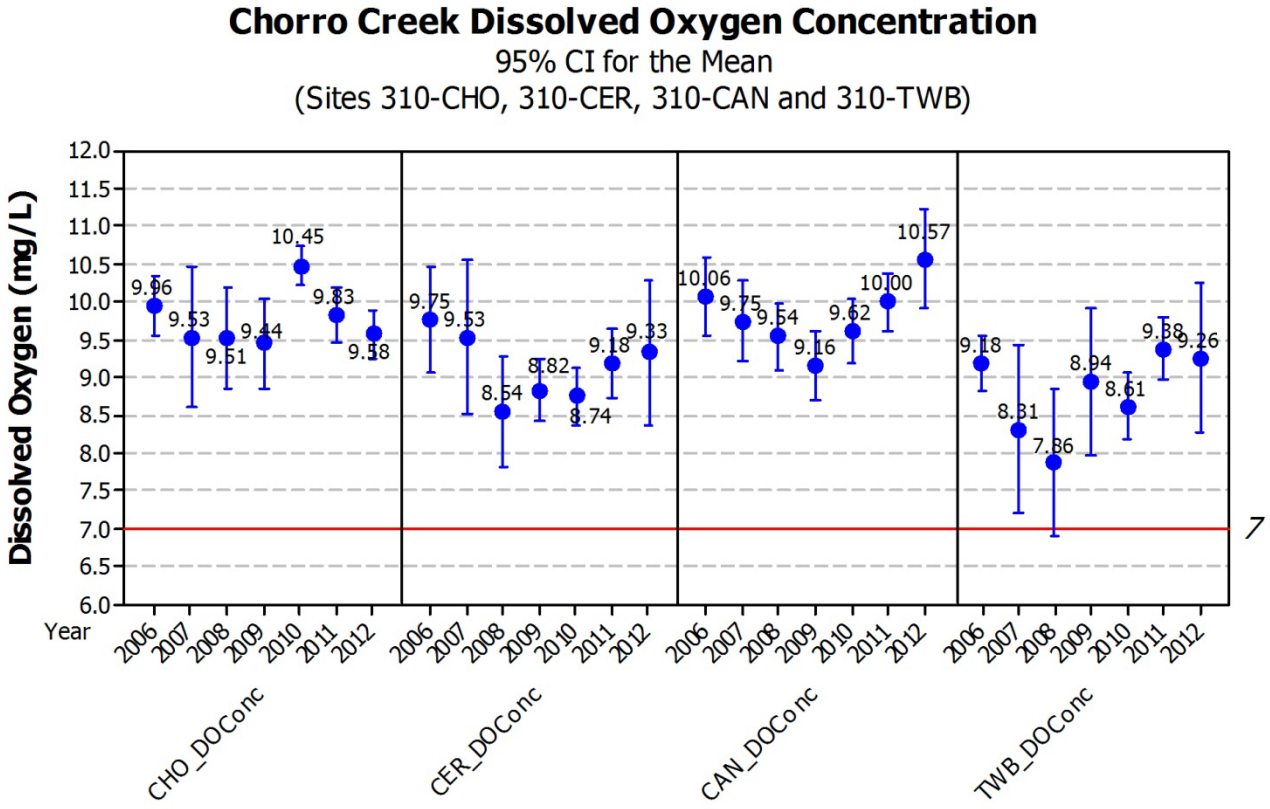
In addition to monthly monitoring of water quality, continuous monitoring meters are occasionally deployed. Data was collected in March 2012 at TWB and UCR, and a temperature plot was compiled over a 24-hour time period. The elevated temperatures at UCR relative to TWB are potentially related to the CMC WWTP's effluent outfall and less riparian canopy to provide shade upstream of the UCR site. Note that the two sets of data were not collected on the same day. TWB was monitored on March 1 and UCR was monitored on March 3 of 2012.



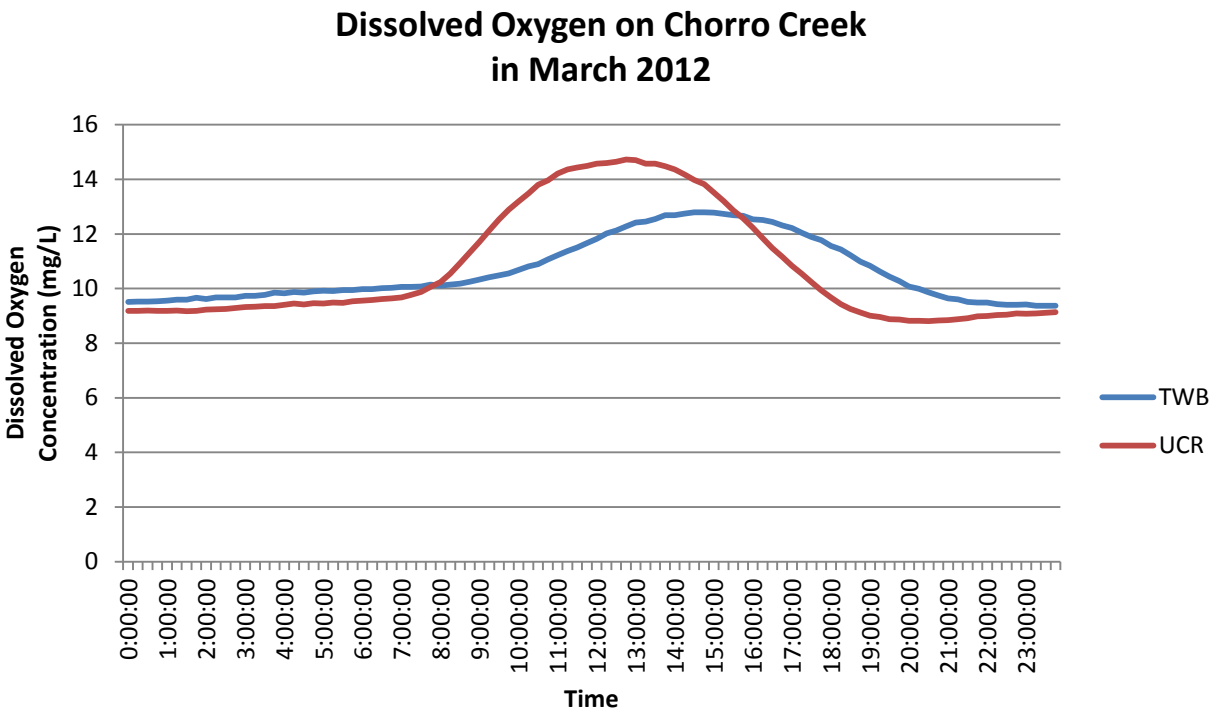
DISSOLVED OXYGEN

Dissolved oxygen measurements were collected as a concentration in mg/L. The following graph shows the mean and 95% CI for the dissolved oxygen concentration data. The Central Coast Basin Plan sets a regulatory standard that states that at no time shall DO concentrations fall below 7.0 mg/L.

While DO concentrations on Chorro Creek rarely fell below 7.0 mg/L, nutrient concentrations have been of concern. Due to the link of DO concentrations to elevated nutrient levels and potentially degraded habitat quality, an analysis of DO data on Chorro Creek was conducted.

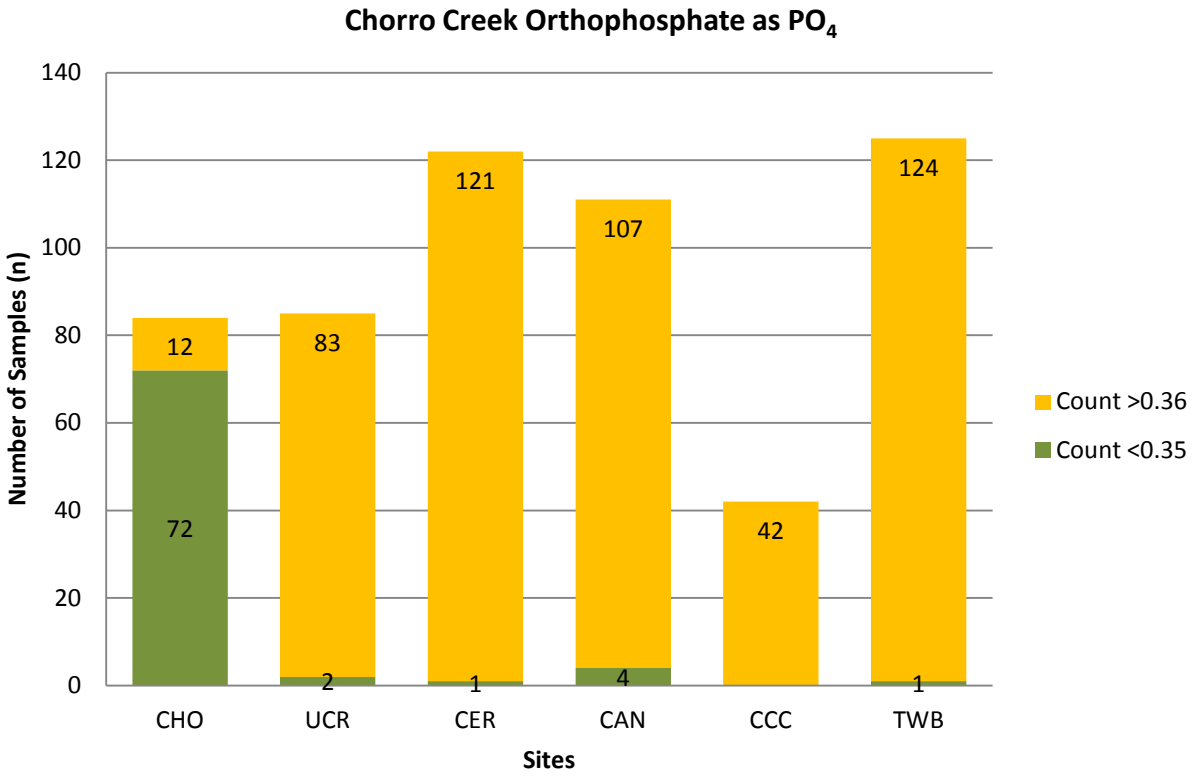


Continuous dissolved oxygen data from two sites on Chorro Creek were collected in March 2012. The following plot shows the DO concentration over a 24-hour period at UCR and TWB. A wider variation in DO concentrations over a diurnal period was detected at UCR compared to TWB. Note that the two sets of data were not collected on the same day. TWB was monitored on March 1 and UCR was monitored on March 3 of 2012.



NUTRIENTS

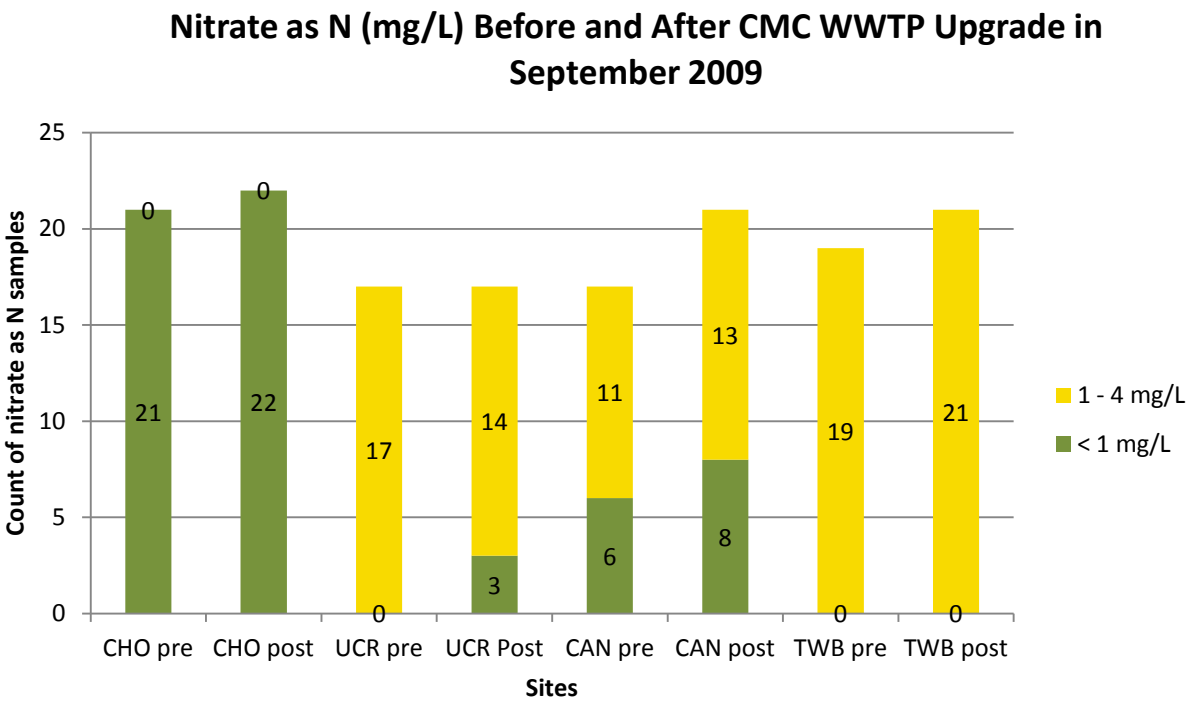
The following bar graph illustrates the number of samples with orthophosphate as PO_4 concentrations in two categories: less than or equal to 0.35 mg/L (shown in green) and greater than or equal to 0.36 mg/L (shown in yellow). Site CHO is located above the CMC WWTP outfall on Camp SLO property, while the remaining five sites are located downstream of the WWTP outfall. The data included in the graph is from 2006 through 2012.



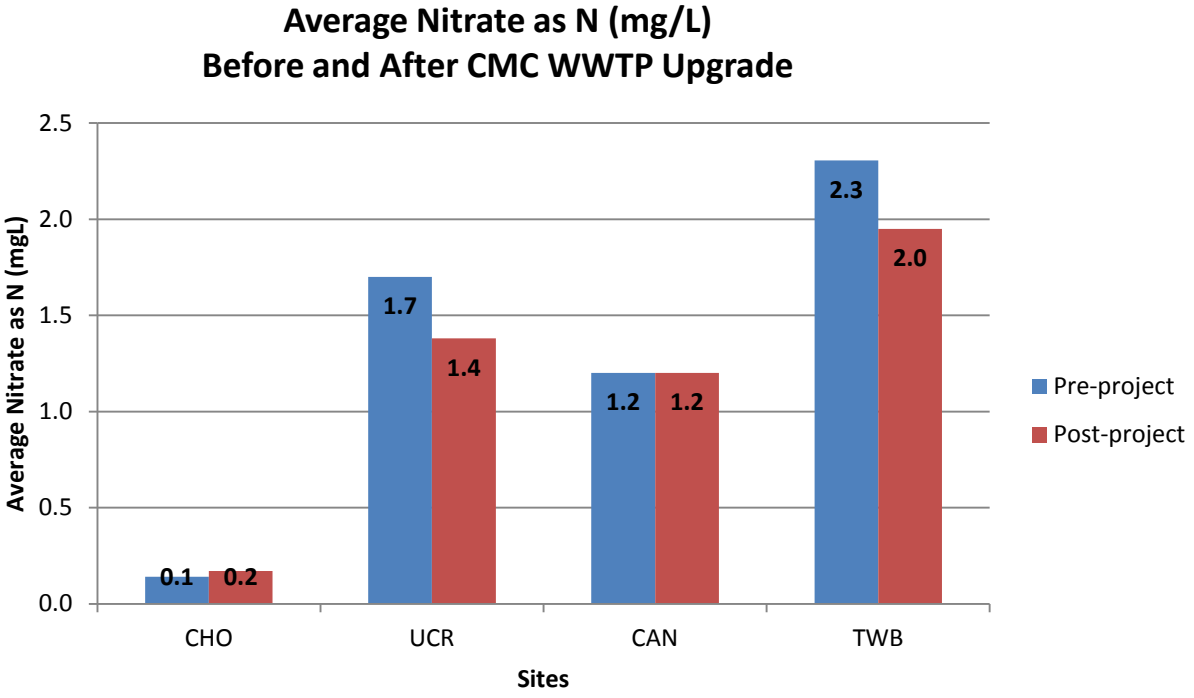
While program volunteers currently monitor nitrates using a colorimeter during the monthly monitoring, a separate nutrient monitoring effort was conducted from January 2008 through September 2011 to assess the effectiveness of the CMC WWTP's plant upgrade which was completed in September 2009. The nutrient concentrations on Chorro Creek were measured monthly and all samples were sent to a certified laboratory for nutrient analysis. All samples were collected within the same time period (typically one hour).

The CCRWQCB 303(d) Listing Guidance Value for nitrates as nitrogen is 1.0 mg/L to be protective of aquatic life.

The following plot shows the number of nitrate as nitrogen samples in each of three categories: less than or equal to 1 mg/L (shown in green) and between 1.1 to 4 mg/L (shown in yellow). There were no results greater than 4 mg/L. Nitrate results were plotted for before and after the treatment plant upgrade. The plot includes data collected from January 2008 through September 2011, and all nutrient analysis was conducted by a certified lab.



The following plot illustrates the average nitrate as N concentrations on Chorro Creek from before WWTP upgrade (January 2008 through August 2009) and after the WWTP upgrade (September 2009 through September 2011). All nutrient data is from a certified laboratory.



ALGAE DOCUMENTING

Algae data was analyzed through two data sets generated by 2012 assessments at two monitoring sites, CER and TWB. The percent coverage of macroalgae at the site was determined by calculating

algae presence at wetted points located on the transects and inter-transects. This calculated value is used to represent percent algal coverage throughout the 150 m reach. CER had a percent coverage of 25%, the highest score of the six sites monitored in 2012. TWB had a percent coverage of 1%.

Additionally, the qualitative spatial coverage of filamentous algae was scored for defined areas 5 m above and 5 m below each of ten transects assessed within each site. Each assessment area (10 m of wetted reach) was assigned a score between 0 to 4, with 0 indicating less than 5% algae coverage, 1 indicating < 10% coverage, 2 indicating 10 to 40% coverage, 3 indicating 40 to 75% coverage, and 4 indicating > 75% coverage. With this metric, CER and TWB both scored 0% of the assessed area with scores of 3 or 4.

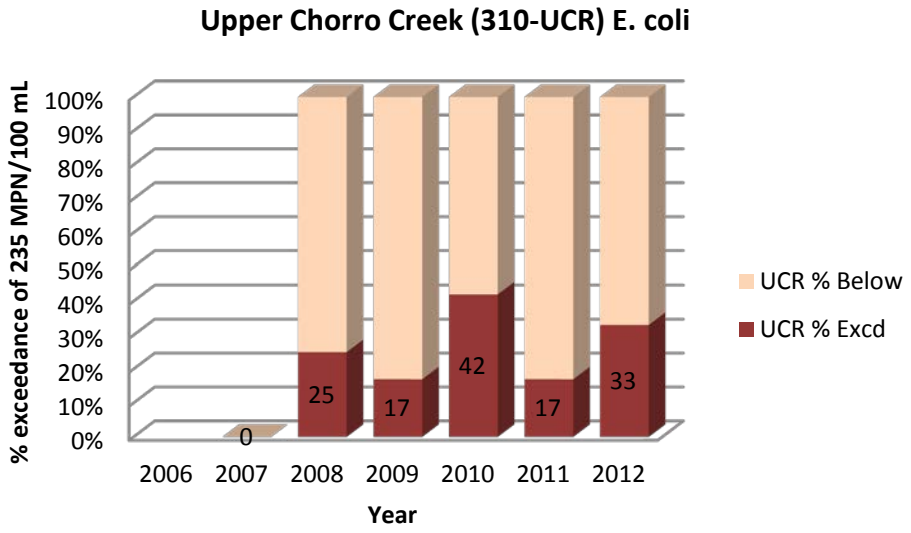
BACTERIA

The following table contains the number of bacteria samples collected each year at Chorro Creek sites and the percent of those samples that exceeded the regulatory standard protective of recreational contact (*E. coli* concentration of 235 MPN/100 mL).

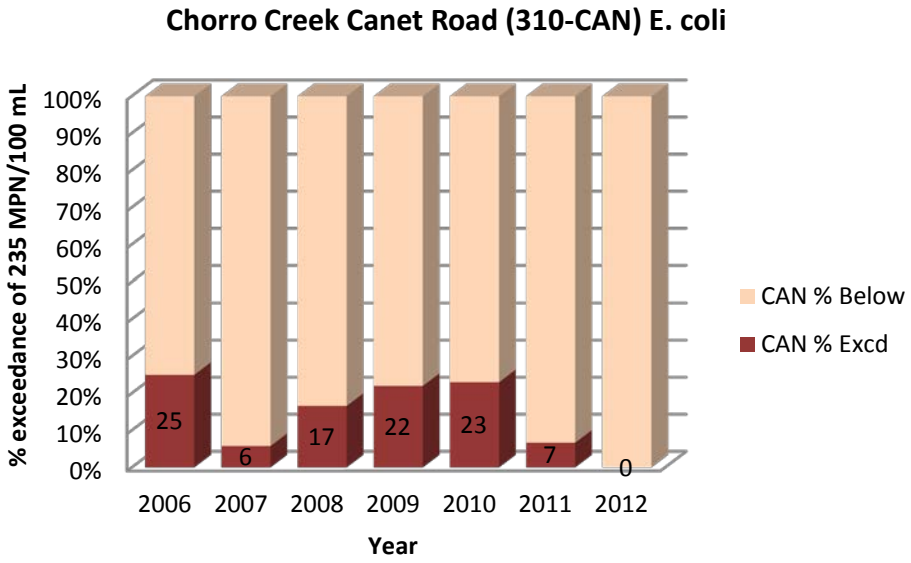
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012†**
UCR	**0**	4	12	12	12	12	6
UCR % Exceed	-	*	25	17	42	17	33
CAN n	12	17	12	23	22	15	6
CAN % Exceed	25	6	17	22	23	7	0
TWB n	11	13	12	19	22	15	6
TWB % Exceed	18	15	8	5	23	13	0

**The sample size n < 6 was deemed too small for inclusion in the analysis.*
†2012 values include January to June 2012.

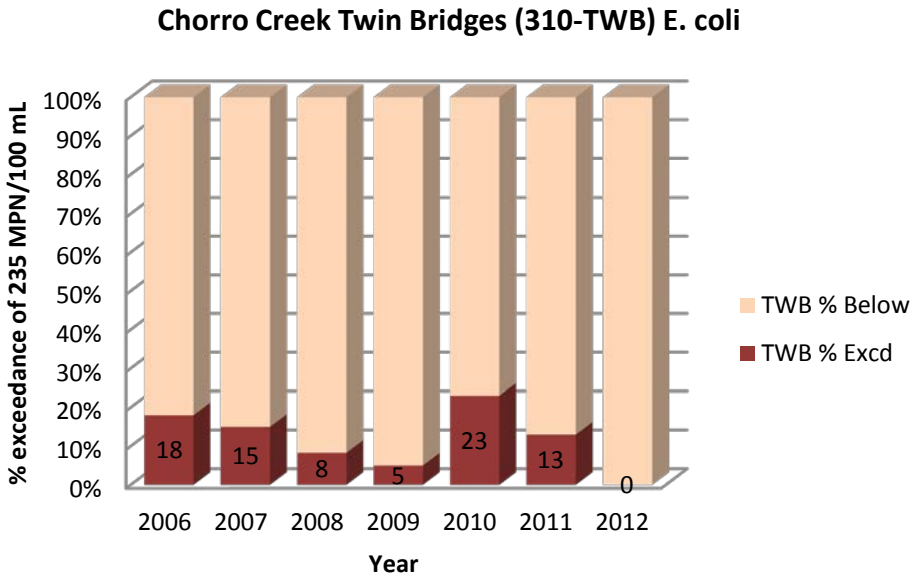
The following graphs depict the % of samples that exceeded the 235 MPN/100 mL recreational contact standard for *E. coli* each year. The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard. The data from 2012 is from January through June.



Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.



Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.



Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.

MACROINVERTEBRATES

The metrics included in this report are taxa richness, EPT richness, EPT% and IBI score. Taxa richness is a measure of the number of different species of organisms in the sample. EPT richness is a measure of the total number of taxa within the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). Taxa richness and EPT richness typically decrease with poor water quality. EPT% is the total number of EPT individuals divided by the total number of individuals in the sample. The Index of Biotic Integrity (IBI) score used in this report is the Southern California Coastal IBI developed by the Aquatic Bioassessment Laboratory of the California Department of Fish & Game. Seven uncorrelated biotic measurements were selected to be included in the calculation. They include collector-gatherer + collector-filterer individuals, percent non-insect taxa, percent tolerant taxa, coleoptera richness, predator richness, percent intolerant individuals and EPT richness. For the IBI scores, scores of 0 to 19 are considered to be very poor, 20 to 39 are poor, 40 to 59 are fair, 60 to 79 are good, and 80 to 100 are very good.

The metrics are displayed below for the three Chorro Creek sites, which are located just below Chorro Dam (CHD), on the Chorro Creek Ecological Reserve (CER) and just below the bridge on South Bay Boulevard and State Park Road (TWB). In recent years, CER and TWB have been monitored by the CCRWQCB. The data are not yet available from the CCRWQCB.

Chorro Creek, Chorro Dam (CHD)	Taxa Richness	EPT Richness	EPT %	IBI Score
2002	*	*	*	*
2003	31	11	35.0	-
2004	42	15	36.0	-
2005	*	*	*	*
2006	36	16	19.3	-
2007	59	12	16.4	-

Chorro Creek, Chorro Dam (CHD)	Taxa Richness	EPT Richness	EPT %	IBI Score
2008	54	13	33.4	44.3
2009	40	10	11.9	57.2
2010	*	*	*	*
2011	47	11	52.9	54.3
2012	*	*	*	*

** No data collected this year.*

- Metric scores not currently available.

Chorro Creek, Ecological Reserve (CER)	Taxa Richness	EPT Richness	EPT %	IBI Score
2002	*	*	*	*
2003	*	*	*	*
2004	27	6	22.0	-
2005	18	4	22.0	-
2006	*	*	*	*
2007	31	4	8.3	-
2008	48	6	14.6	30.0
2009	-	-	-	-
2010	-	-	-	-
2011	50	14	48.1	34.3
2012	42	12	35.6	47.1

** No data collected this year.*

- Metric scores not currently available.

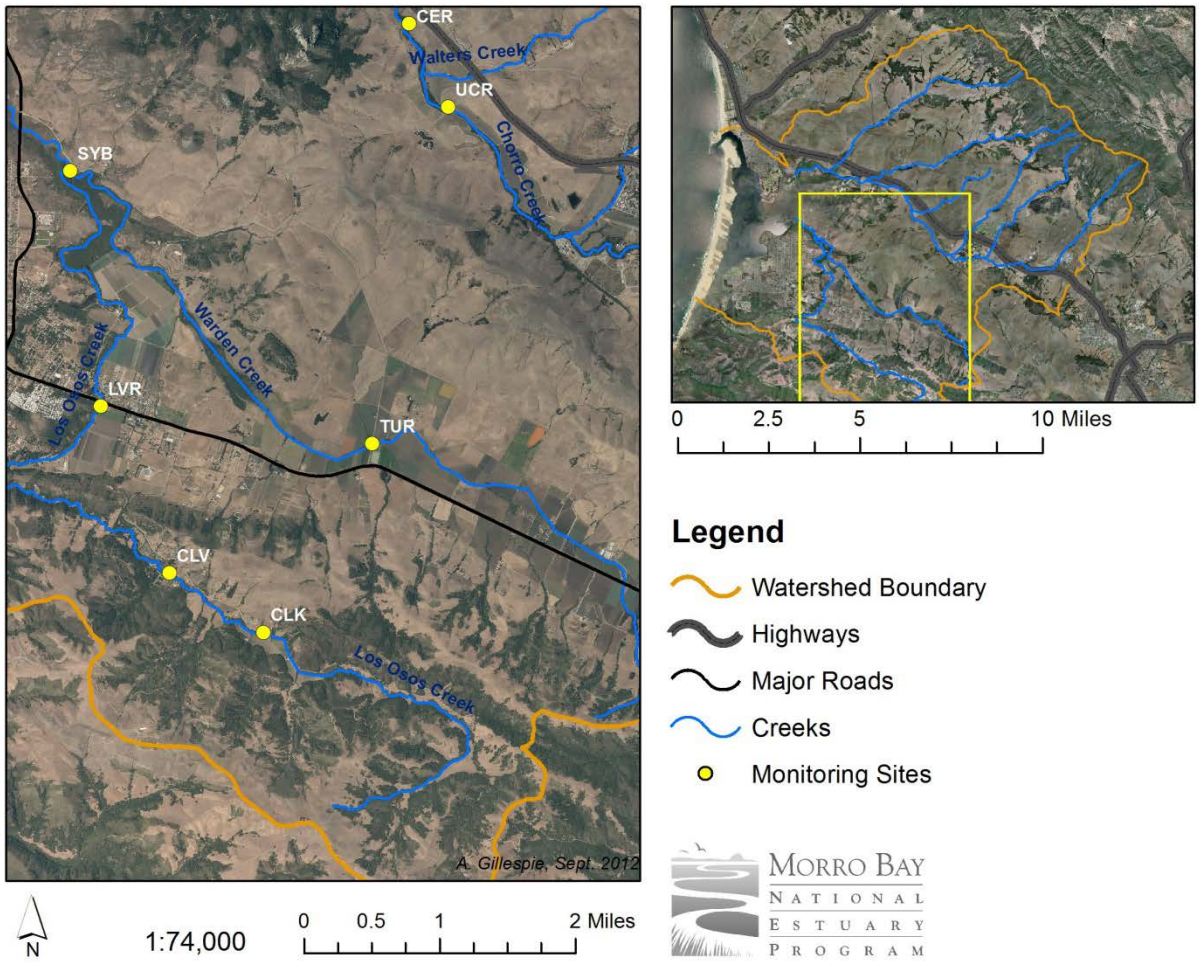
Chorro Creek, South Bay Blvd. (TWB)	Taxa Richness	EPT Richness	EPT %	IBI Score
2002	25	6	24.0	-
2003	23	6	26.0	-
2004	*	*	*	*
2005	*	*	*	*
2006	36	12	20.3	-
2007	37	7	2.9	-
2008	55	14	27.3	55.8
2009	-	-	-	-
2010	-	-	-	-
2011	-	-	-	-
2012	46	12	35.6	45.7

** No data collected this year.*

- Metric scores not currently available.

LOS OSOS AND WARDEN CREEK

SITE MAP



The Los Osos Creek and Warden Creek watersheds encompass an area of approximately 23 square miles. The program monitored two sites in Clark Valley on Los Osos Creek. Site CLK is located at a private road crossing and is monitored annually for macroinvertebrates. Monthly water quality and bacteria data are not collected at this site. Site CLV was established in 2008 at a private road crossing on Los Osos Creek and is monitored monthly for water quality and bacteria.

Site LVR is located at the Los Osos Valley Road bridge over Los Osos Creek. This site is monitored infrequently and only contains surface flows during brief periods of very wet years. When flowing, the site is monitored for water quality. On limited occasions, site LVR is monitored for macroinvertebrates.

Site SYB is the most downstream monitoring site and is located downstream of the Warden Creek confluence with Los Osos Creek. The site is tidally-influenced by Morro Bay, and the CCRWQCB is currently reclassifying the site as estuarine.

On Warden Creek, site TUR is located at the bridge crossing over Warden Creek on Turri Road. The bridge was rebuilt in 2009, and limited site access prevented data collection for several months. Although there is typically water present at the TUR site year-round, extremely low flow volumes and velocities often prevent monitoring during the dry season.

In 2011, the Coastal San Luis Resource Conservation District began a grant to implement agricultural water quality enhancement projects, including on-farm audits of irrigation and fertilizer use to reduce the impacts of run-off. Riparian fencing was installed to help ranches minimize the impacts of cattle on fragile streambanks and to improve water quality. As a partner in this project, the MBNEP is responsible for ambient monitoring of nutrients in the Los Osos Creek subwatershed, as well as bacteria monitoring to assess the effectiveness of individual fencing projects. This monitoring was begun in December 2010, and data is submitted quarterly to the CCRWQCB. At the end of the three year project, the data will undergo statistical analysis and a monitoring report will be compiled and submitted to the CCRWQCB. Data collected for this separate agricultural water quality project was not included in this data summary report.

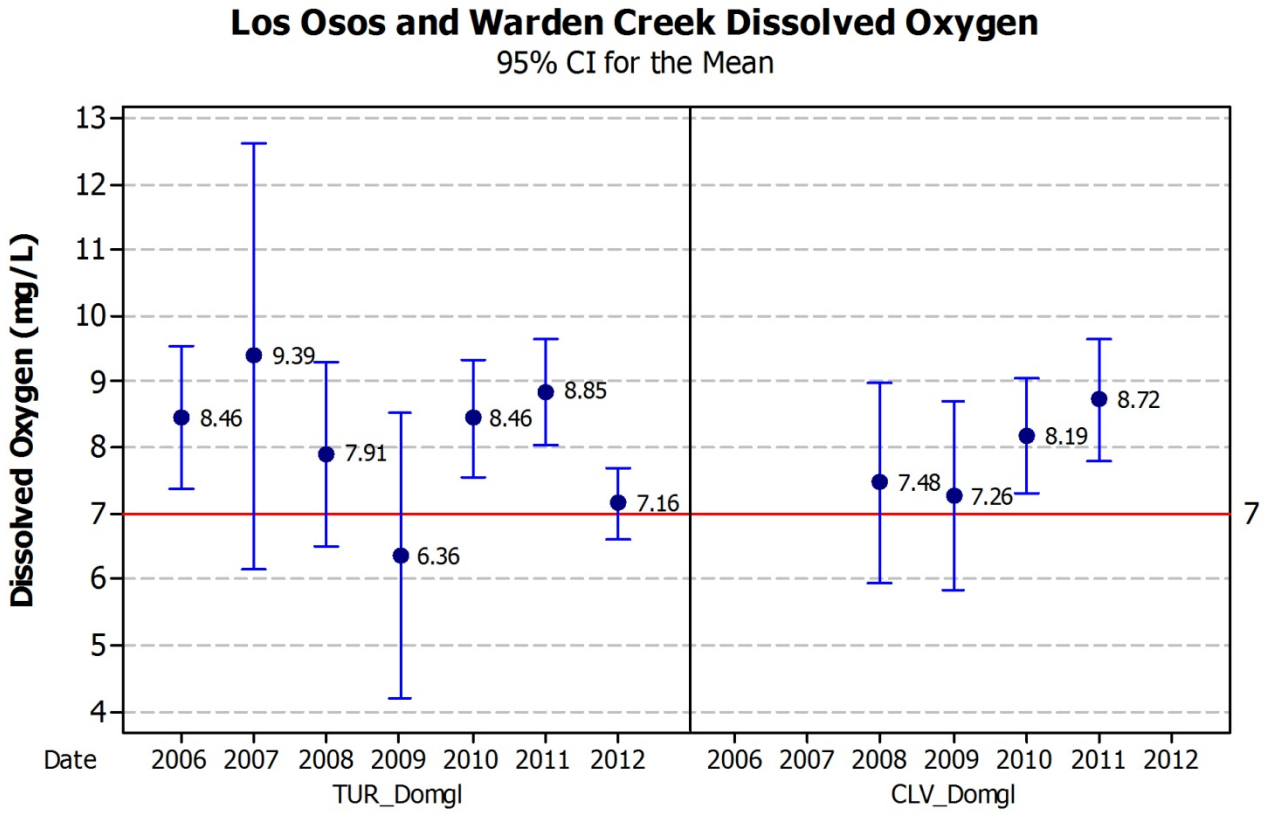
WATER QUALITY N VALUE SUMMARY

The table below indicates the frequency of water quality monitoring at Los Osos and Warden Creeks.

	2006	2007	2008	2009	2010	2011	2012*	Sum
CLV	0	0	7	8	12	10	0	**37**
LVR	1	0	0	0	7	9	0	**17**
TUR	5	6	8	4	13	13	14	**63**
SYB	11	7	12	13	13	12	6	**74**
Sum	**17**	**13**	**27**	**25**	**45**	**44**	**20**	

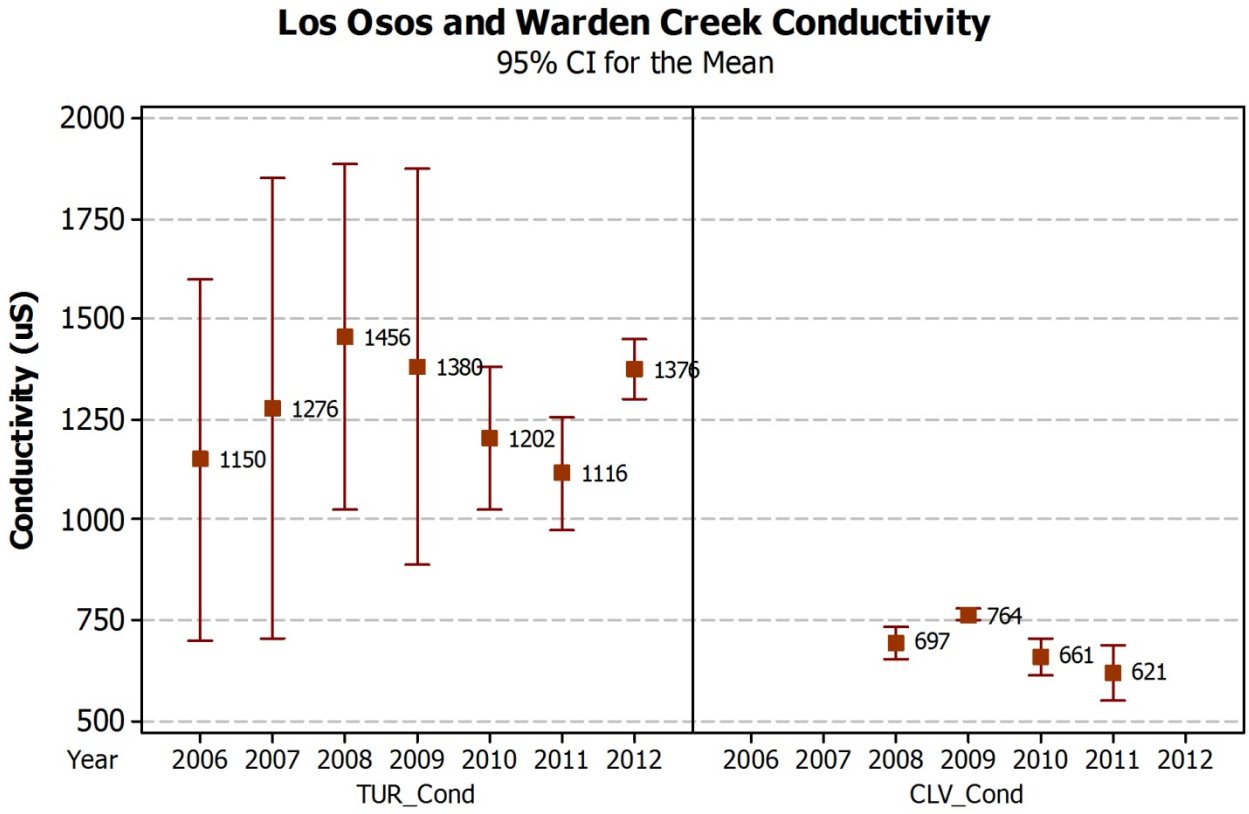
DISSOLVED OXYGEN

The following graph shows the mean and 95% CI for the DO concentration data at TUR on Warden Creek and CLV in Los Osos Creek. The Central Coast Basin Plan set a regulatory standard that states that at no time shall DO concentrations fall below 7.0 mg/L.



CONDUCTIVITY

The following graph illustrates the mean conductivity levels by year at TUR (on Warden Creek) from 2006 through June 2012 and at CLV (on Los Osos Creek) from 2008 through 2012. Average conductivity levels at TUR are consistently in the "Increasing Problems" range listed in the Basin Plan standards, but do not exceed 3,000 uS/cm where the problem would be considered '"Severe."

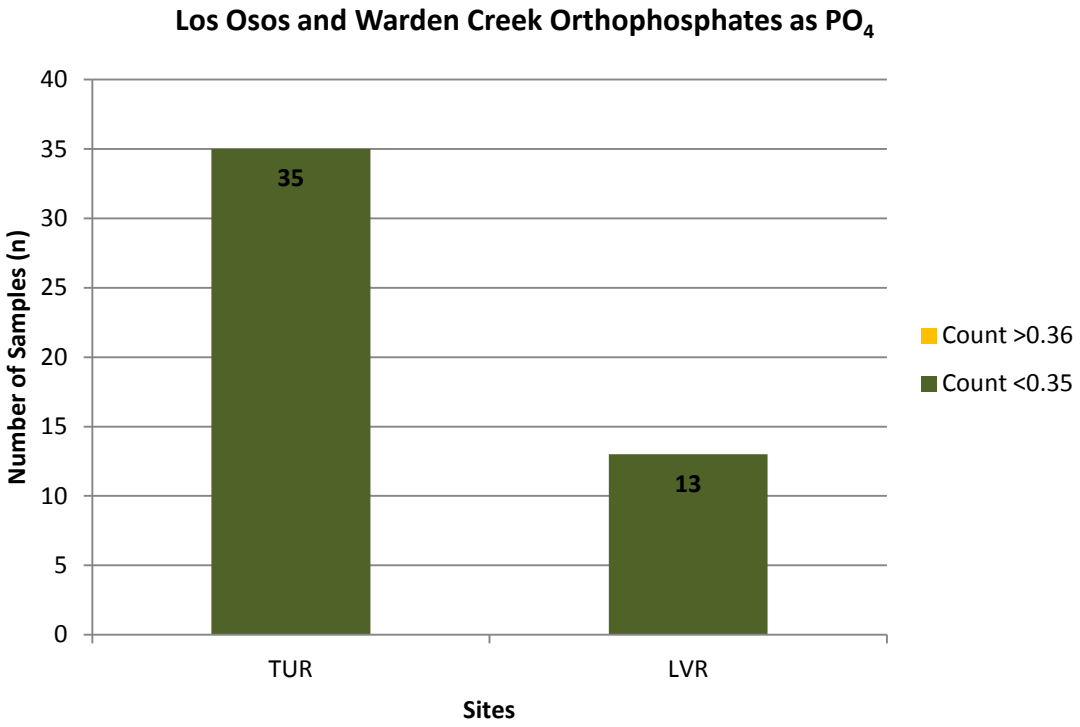


NUTRIENTS

Program volunteers measured orthophosphates as PO_4^{3-} and nitrates as nitrogen during each water quality field visit. Samples were collected by trained volunteers, and analysis was conducted at the MBNEP office using chemical test kits.

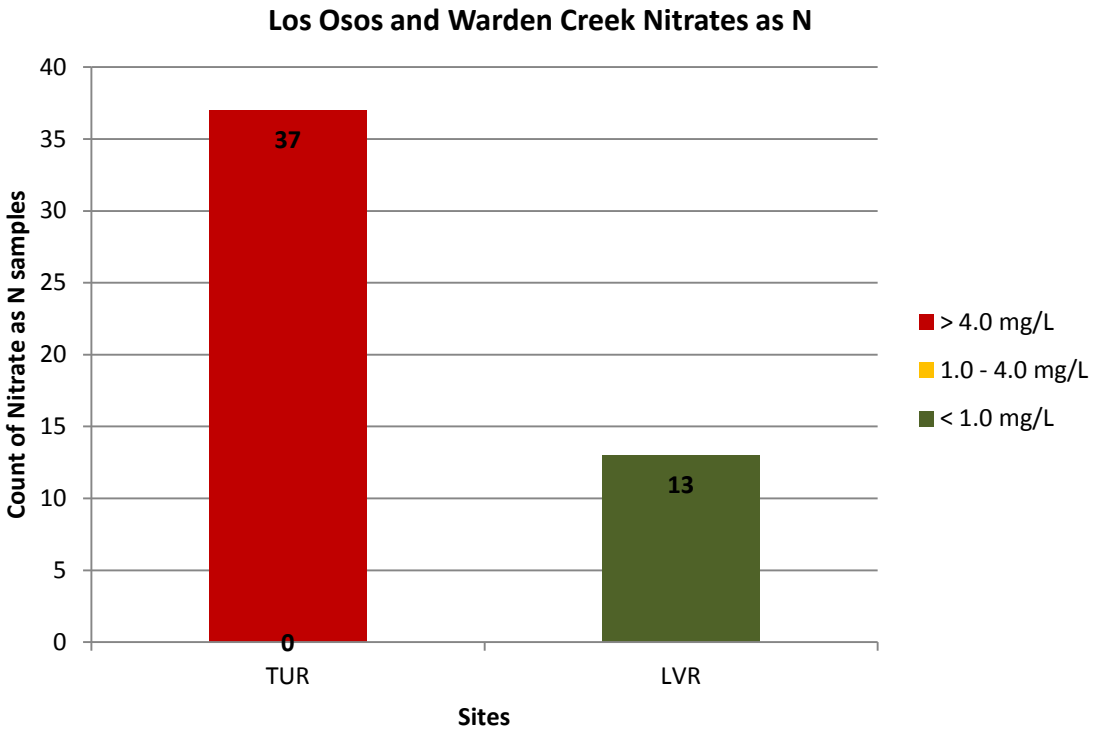
The VMP also collected samples which were sent to a certified laboratory for nutrient analysis. The following graphs contain the lab-generated nutrient data for sites TUR and LVR from 2010 through 2012. Due to lower than average annual rainfall, LVR did not have measurable surface flows during 2012.

For orthophosphates, the following bar graphs illustrates the number of samples with orthophosphate as PO_4 concentrations in two categories: less than or equal to 0.35 mg/L (shown in green) and greater than or equal to 0.36 mg/L (shown in yellow). Site TUR Is located on Warden Creek and site LVR is located on Los Osos Creek. Neither site had any exceedances of the 0.36 mg/L level of concern during the monitoring period.

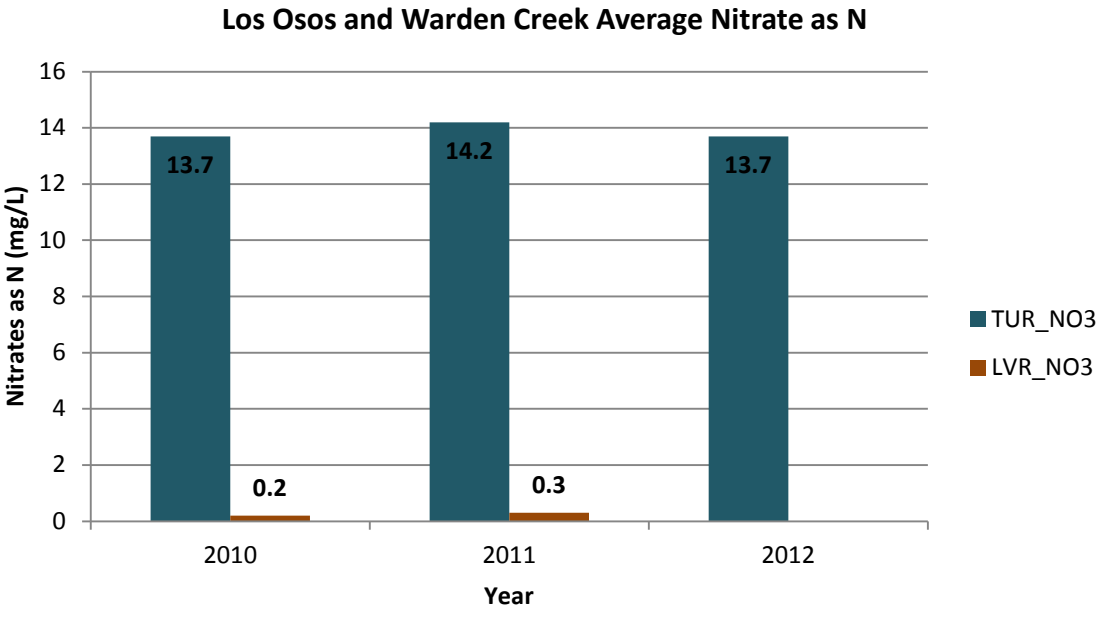


The CCRWQCB 303(d) Listing Guidance Value for nitrates as nitrogen is 1.0 mg/L to be protective of aquatic life.

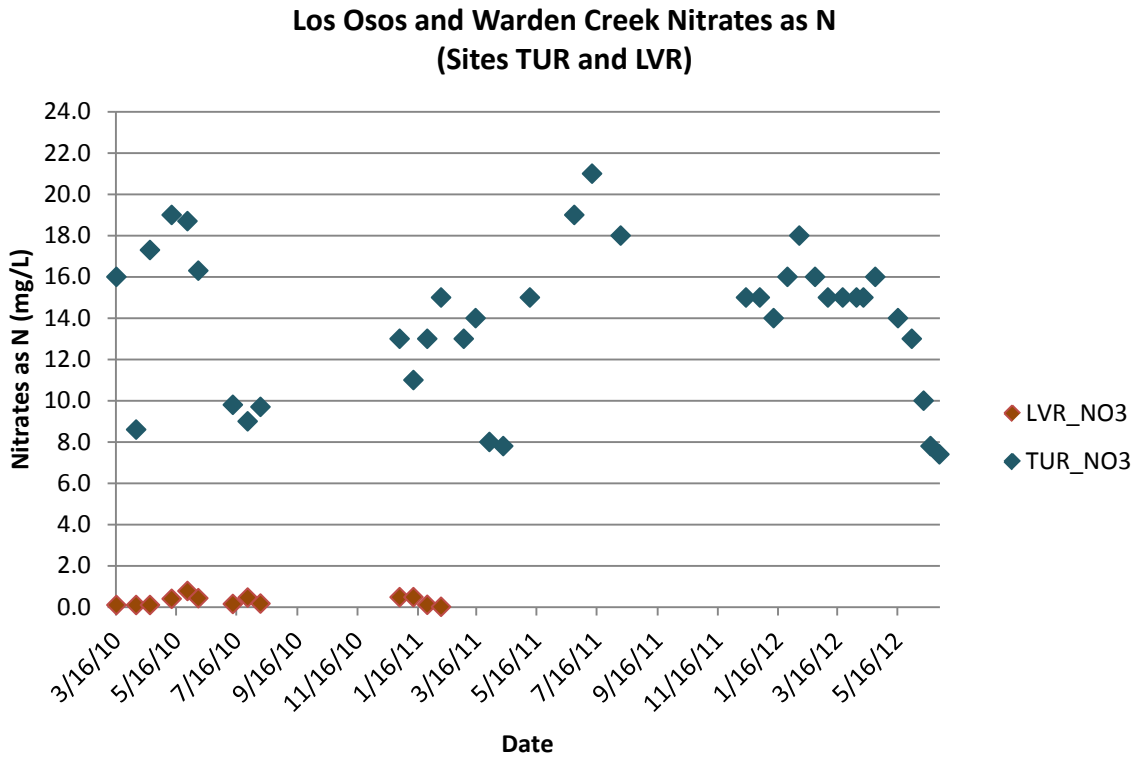
The following plot shows the number of nitrate as nitrogen samples in each of three categories: less than or equal to 1 mg/L (shown in green), between 1.1 to 4 mg/L (shown in yellow), and greater than or equal to 4.1 mg/L (shown in red). The data is lab-generated analysis for TUR on Warden Creek and LVR from 2010 through 2012. TUR is located within an area of extensive irrigated agriculture, and elevated nitrate concentrations are typical year-round, except following heavy rainfall. LVR, located at Los Osos Valley Road, had no nitrate exceedances of 1 mg/L during the monitoring period. This site is located upstream of established irrigated agricultural operations bordering Los Osos Creek.



The average nitrate concentrations for TUR and LVR from 2010 through 2012 are illustrated in the following graph.



The following graph provides the results from TUR and LVR of individual nitrate samples over time.



Algae Documenting

Algae data was analyzed through two data sets generated by 2012 assessments at the CLK site. The percent coverage of macroalgae at the site was determined by calculating algae presence at wetted points located on the transects and inter-transects. This calculated value is used to represent percent algal coverage throughout the 150 m reach. The monitoring site on Los Osos Creek is located at CLK, which is on private property in Clark Valley. CLK had a percent algal coverage of 6.6% in 2012.

Additionally, the qualitative spatial coverage of filamentous algae was scored for defined areas 5 m above and 5 m below each of ten transects assessed within each site. Each assessment area (10 m of wetted reach) was assigned a score between 0 to 4, with 0 indicating less than 5% algae coverage, 1 indicating < 10% coverage, 2 indicating 10 to 40% coverage, 3 indicating 40 to 75% coverage, and 4 indicating > 75% coverage. With this metric, CLK scored 10% of assessed area with scores of 3 or 4, the highest score of the six sites monitored in 2012.

Bacteria

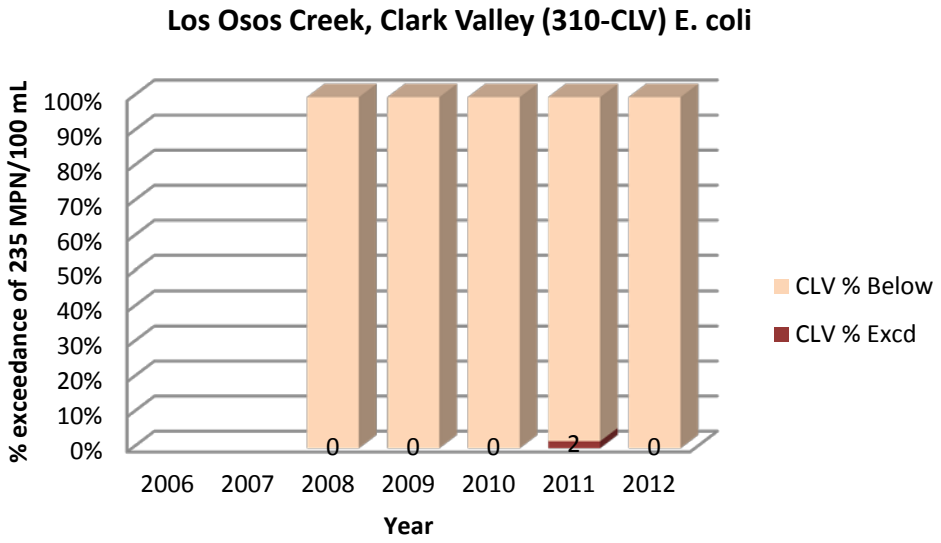
The following table contains the number of bacteria samples collected each year at the sites and the number of samples that exceeded the criteria.

	2006	2007	2008	2009	2010	2011	2012†
CLV n	0	0	8	9	12	12	6
CLV % Exceed	-	-	0	0	0	2	0
TUR n	8	6	8	5	11	18	13
TUR % Exceed	25	0	13	*	36	44	31

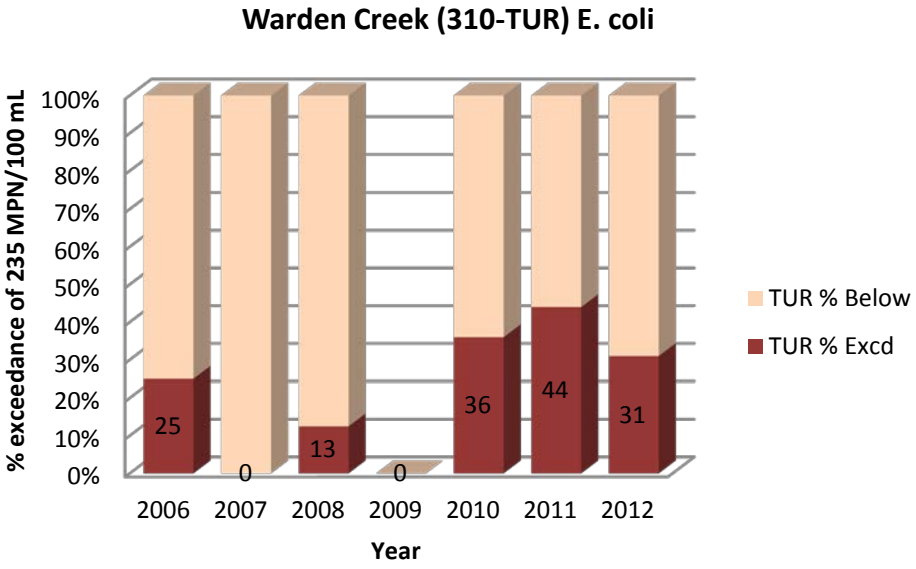
SYB n	11	13	13	12	12	12	6
SYB % Exceed	27	8	15	8	25	33	0

**The sample size n < 6 was deemed too small for inclusion in the analysis.*
†2011 values include January to June 2012.

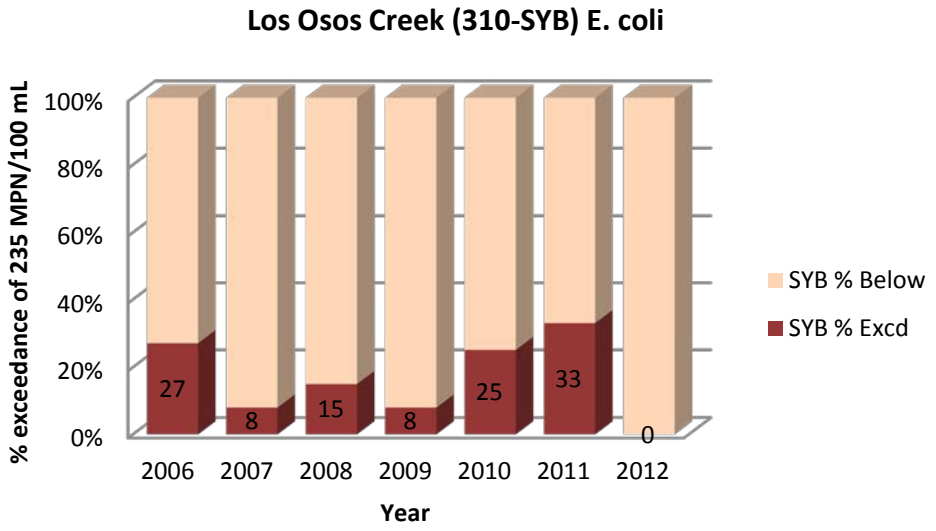
The following graphs depict the % of samples that exceeded the 235 MPN/100 mL recreational contact standard for *E. coli* each year. The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard. The data for 2012 is from January through June.



Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.

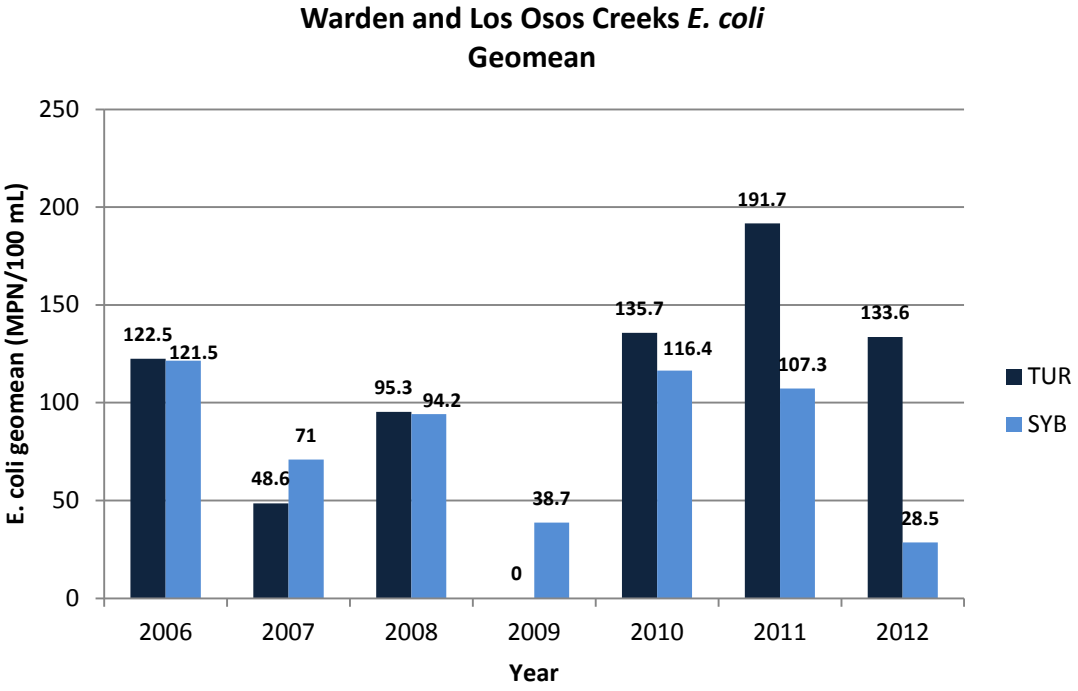


Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.



Note: The blank columns with zeroes in the graphs depict a sample size that was too small for inclusion in the analysis (n < 6), rather than a lack of exceedances of the standard.

The following graph is a plot of the geomean of *E. coli* data from January 2006 through June 2012 at the TUR and SYB sites.



MACROINVERTEBRATES

The metrics included in this report are taxa richness, EPT richness, EPT% and IBI score. Taxa richness is a measure of the number of different species of organisms in the sample. EPT richness is a measure of the total number of taxa within the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). Taxa richness and EPT richness typically decrease with poor water quality. EPT% is the total number of EPT individuals divided by the total number of individuals in the sample.

The Index of Biotic Integrity (IBI) score used in this report is the Southern California Coastal IBI developed by the Aquatic Bioassessment Laboratory of the California Department of Fish & Game. Seven uncorrelated biotic measurements were selected to be included in the calculation. They include collector-gatherer + collector-filterer individuals, percent non-insect taxa, percent tolerant taxa, coleoptera richness, predator richness, percent intolerant individuals and EPT richness. For the IBI scores, scores of 0 to 19 are considered to be very poor, 20 to 39 are poor, 40 to 59 are fair, 60 to 79 are good, and 80 to 100 are very good.

Los Osos Creek, Clark Valley (CLK)	Taxa Richness	EPT Richness	EPT %	IBI Score
2002	30	9	30	-
2003	35	14	40	-
2004	35	17	49	-
2005	25	12	48.0	-
2006	33	13	51.0	-
2007	*	*	*	*
2008	29	13	17.9	58.6
2009	*	*	*	*
2010	39	13	31.7	65.8
2011	41	15	58.7	52.9
2012	51	14	63.5	70.0

** No data collected this year.*
- Metric scores not currently available.

Los Osos Creek, Los Osos Valley Road (LVR)	Taxa Richness	EPT Richness	EPT %	IBI Score
2002	*	*	*	*
2003	*	*	*	*
2004	*	*	*	*
2005	15	6	40.0	-
2006	*	*	*	*
2007	*	*	*	*
2008	*	*	*	*
2009	*	*	*	*
2010	18	3	25.1	41.5
2011	46	13	53.0	48.6
2012	*	*	*	*

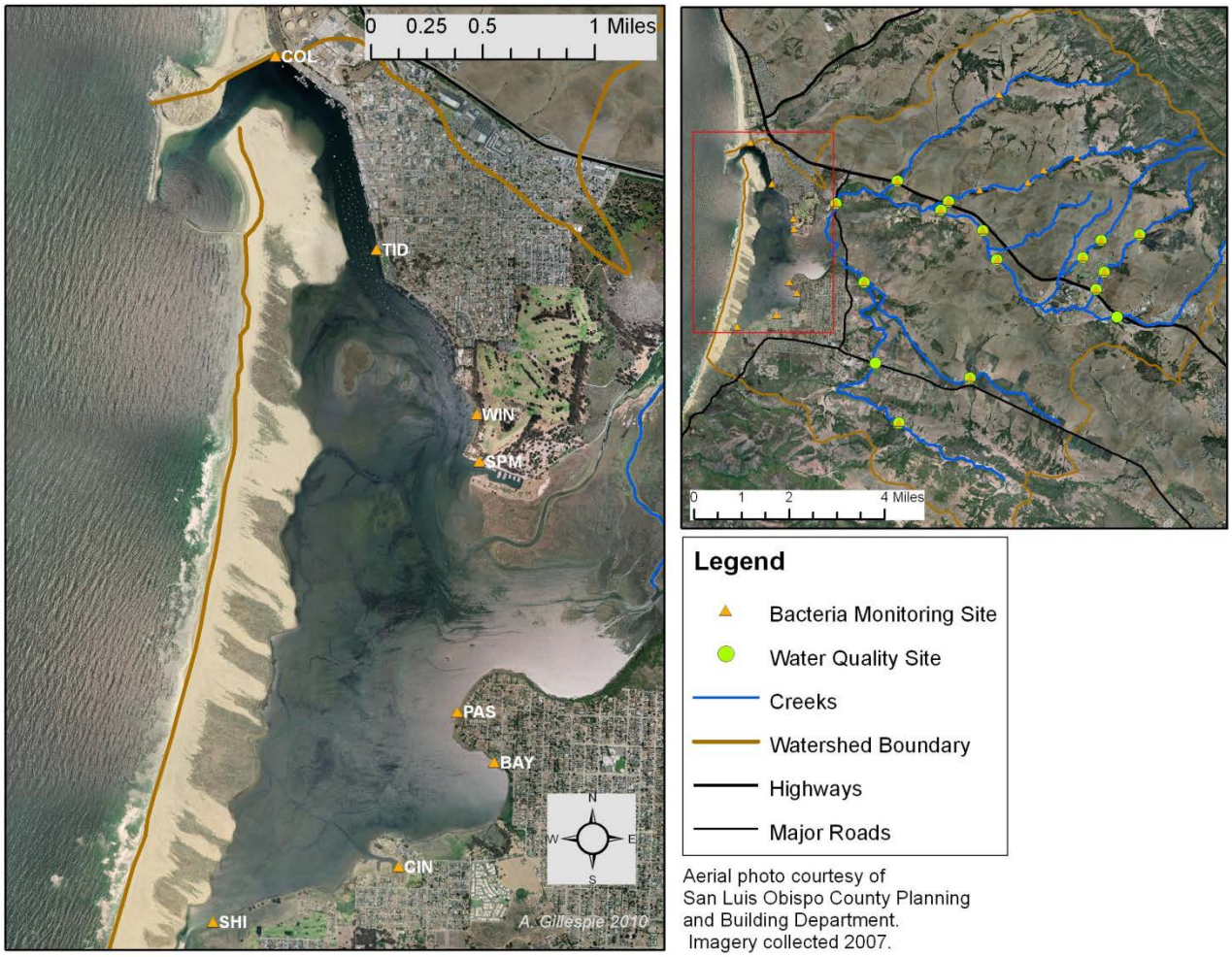
** No data collected this year*
- Metric scores not currently available

3.0 BAY DATA ANALYSIS

The following analysis includes data collected from the bay, including bacteria, dissolved oxygen, shorebirds and phytoplankton.

MORRO BAY BACTERIA

SITE MAP AND DESCRIPTION



The Morro Bay estuary is a 2,300-acre semi-enclosed body of water which supports recreational activities for residents and visitors alike. Kayaking, sailing, windsurfing, swimming and wading are common activities in the bay. Recreational use is particularly heavy at various designated access points around the bay. The VMP monitors eight commonly used bay access point on a monthly basis for *E. coli* and *Enterococcus spp*. concentrations. These sites were established between 2002 and 2004.

Monthly samples were collected by volunteers in the field and then analyzed with the IDEXX method using Colilert-18 reagent to obtain *E. coli* results and Enterolert reagent to obtain *Enteroccocus spp.* results. Samples were analyzed by volunteers using lab facilities in the Morro Bay-Cayucos Wastewater Treatment Plant Laboratory.

Although *Enterococcus spp*. is the preferred indicator for monitoring recreational contact safety in marine waters, the state of California continues to enforce regulations in shellfish growing waters using the fecal coliform indicator. In order to generate data comparable to the regulatory standards for fecal coliform, analysis tests for *E. coli* as well as *Enterococcus spp.* in the bay. The regulatory criteria for comparison are the recommended standards in EPA's 1986 guidance document *Ambient Water Quality Criteria for Bacteria*. For *E. coli* for a single grab sample, the water is considered to have an acceptable risk for swimming (REC-1 contact) if the concentration is below 235 MPN/100 mL in freshwater. Because no criteria exist for *E. coli* in marine waters, the freshwater criteria was adapted for comparison. For *Enterococcus spp.*, the EPA guidance cites 104 MPN/100 mL from a single grab sample in marine waters as safe for recreational contact (REC-1).

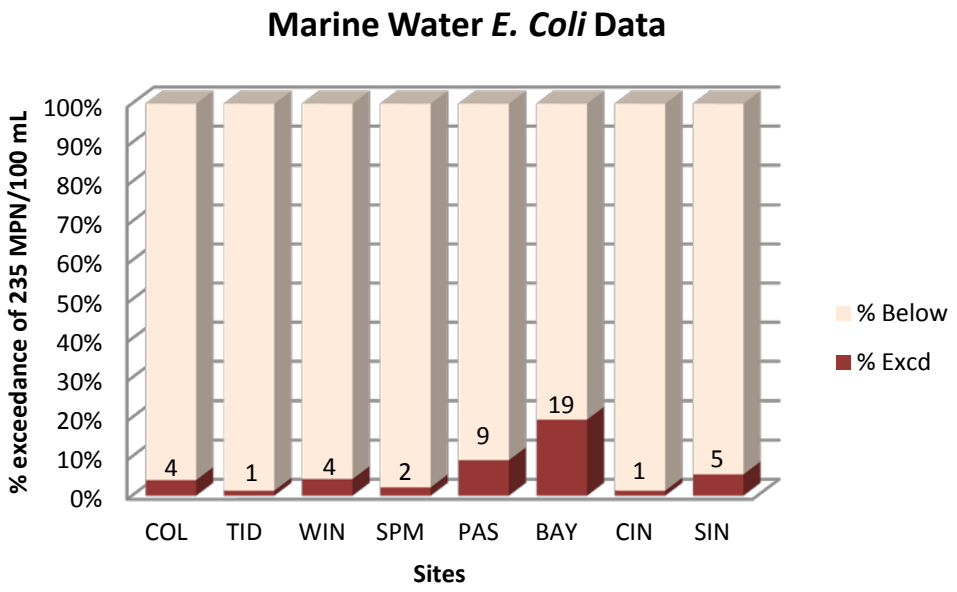
Based on typical sample dilutions, the range of detection for the *E. coli* and *Enterococcus spp*. testing is from < 10 MPN/100 mL to 24,196 MPN/100 mL.

E. COLI DATA

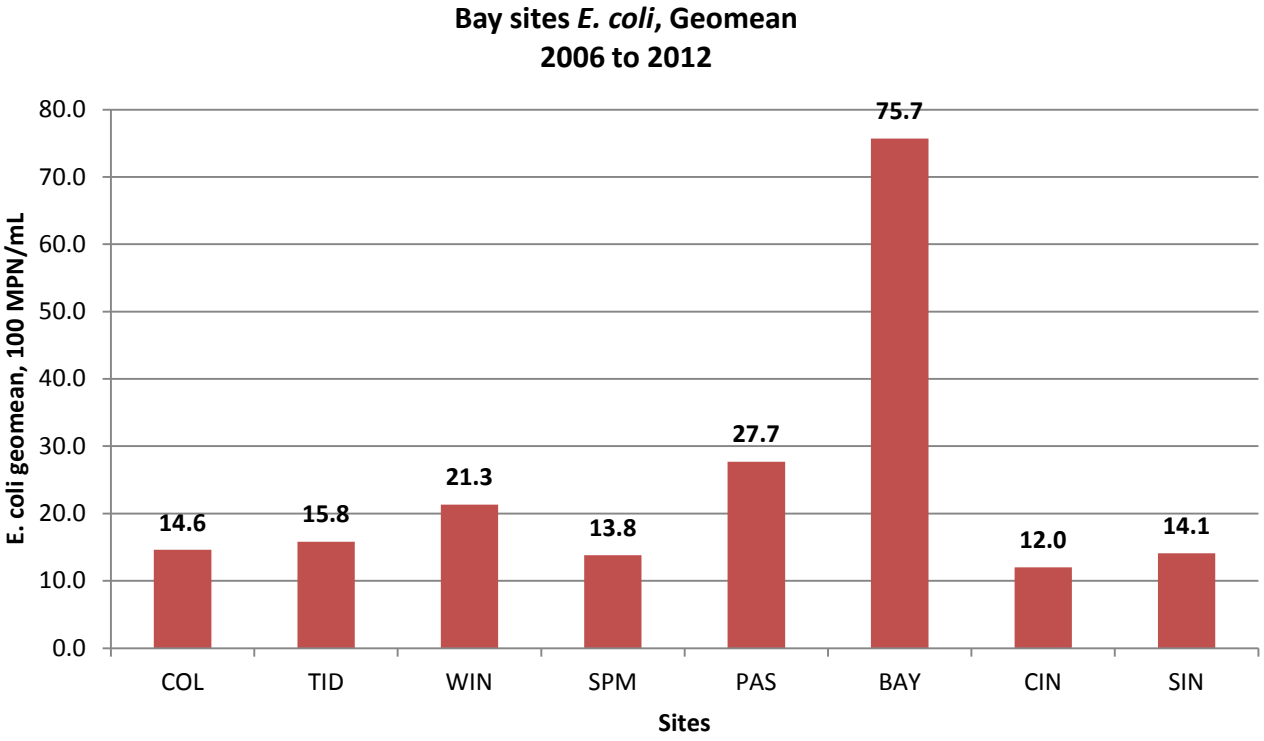
The following table contains the number of *E. coli* samples collected at the sites from January 2006 through June 2012.

Site Code	Site Description	Number of Samples (n)	Number of Exceedances	Percent of Samples Exceeding
COL	Coleman Beach	75	3	4%
TID	Tidelands Park	77	1	1%
WIN	Windy Cove	94	4	4%
SPM	State Park Marina	93	2	2%
PAS	Pasadena Point	77	7	9%
BAY	Baywood Pier	77	15	19%
CIN	Cuesta Inlet	77	1	1%
SIN	Sharks Inlet	55	3	5%

The following graph shows the % of samples that exceeded the *E. coli* regulatory standard of 235 MPN/100 mL for safe recreational contact that was adapted from EPA's criteria in freshwater. This analysis is for data from January 2006 through June 2012.



The following graph illustrates the geomean of the *E. coli* data from January 2006 through June 2012 for each site.

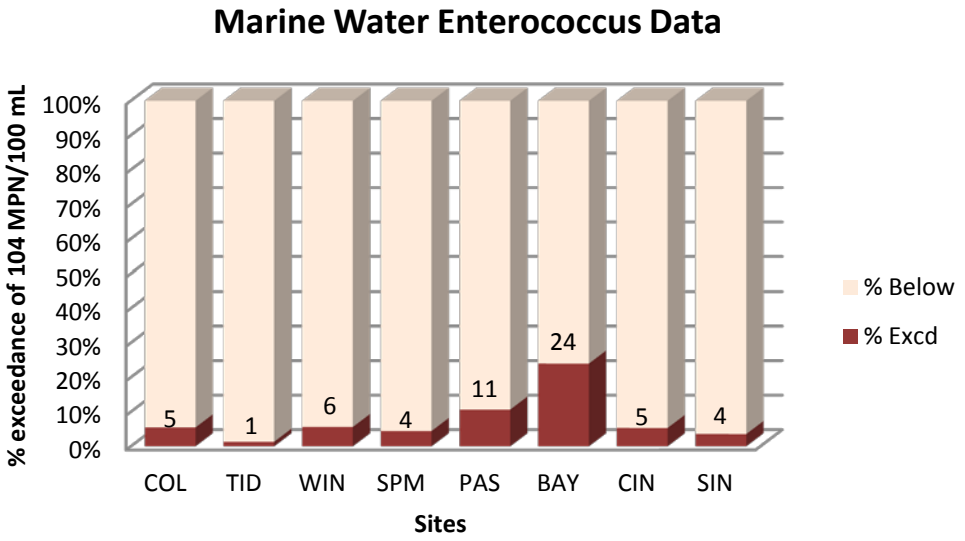


ENTEROCOCCUS SPP. DATA

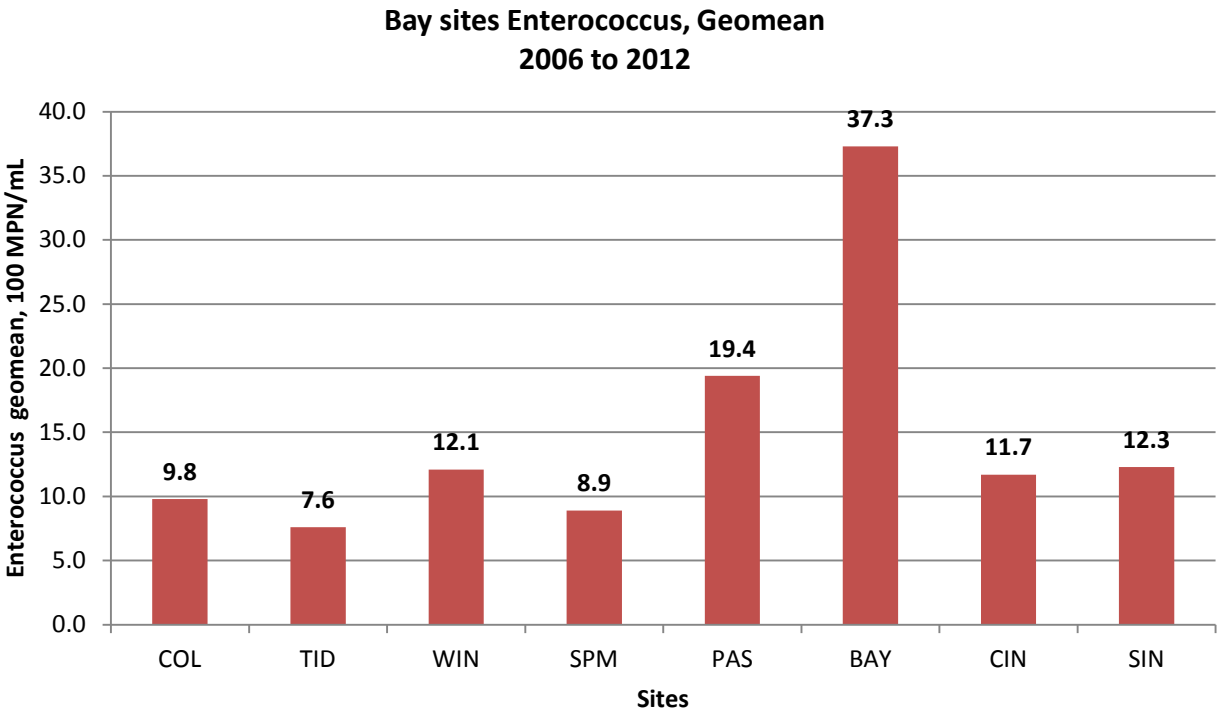
The following table contains the number of *Enterococcus spp*. samples collected at the sites from January 2006 through June 2012.

Site Code	Site Description	Number of Samples (n)	Number of Exceedances	Percent of Samples Exceeding
COL	Coleman Beach	73	4	5%
TID	Tidelands Park	75	1	1%
WIN	Windy Cove	89	5	6%
SPM	State Park Marina	90	4	4%
PAS	Pasadena Point	75	8	11%
BAY	Baywood Pier	75	18	24%
CIN	Cuesta Inlet	75	4	5%
SIN	Sharks Inlet	56	2	4%

The following graph shows the % of samples that exceeded the 104 MPN/100 mL regulatory standard for safe recreational contact for *Enterococcus spp*. in marine waters. This analysis is for data from January 2006 through June 2012.



The following graph illustrates the geomean of the *Enterococcus spp.* data from January 2006 through June 2012 for each site.



DAWN PATROL

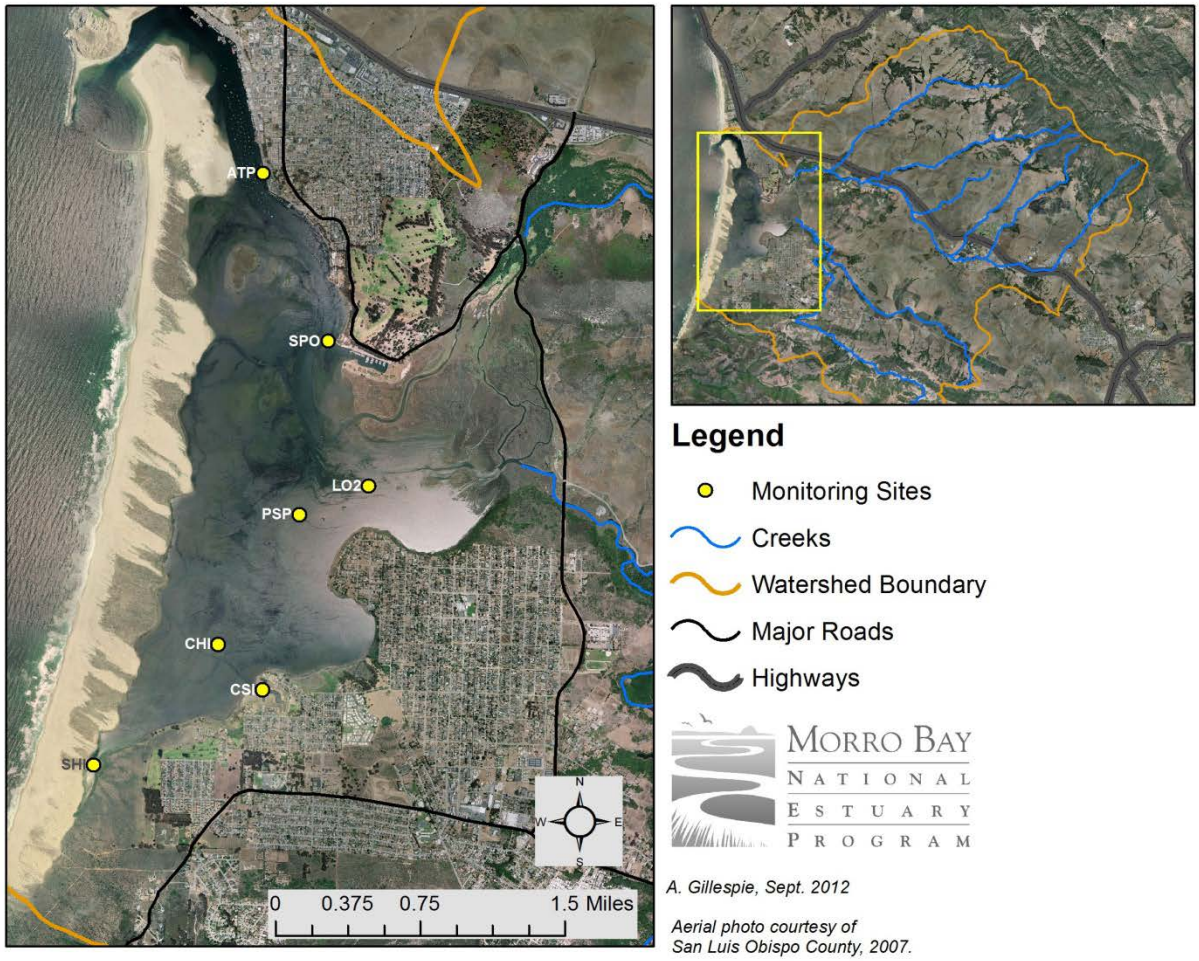
SITE MAP AND DESCRIPTION

Early morning dissolved oxygen (DO) readings in the bay were monitored starting in 2002. Seven sites are monitored on a monthly basis in the pre-dawn or early morning hours. Volunteers kayak to the sites and take surface measurements of temperature, salinity, and DO percent saturation and concentration. Measurements collected with continuous monitoring equipment demonstrated that depressed DO levels continued until approximately two hours after sunrise. Thus, rather than sending volunteers out in the pre-dawn hours, the monitoring schedule was revised for within two hours of sunrise, which still allowed volunteers to capture the desired data.

The Central Coast Region Basin Plan states that bay DO concentrations must remain above 5.0 mg/L to be protective of marine aquatic life.

The monitoring sites were selected to provide a wide spatial distribution throughout the bay. The sites are divided into two regions which are covered by two separate monitoring teams each month. The front bay sites include Tidelands Park (ATP), State Park Marina (SPO), near the Los Osos Creek tributary in the mudflat area (LO2), and Pasadena Point (PSP) in the channel. The back bay sites include the main channel off of Cuesta Inlet (CHI), Cuesta Inlet (CSI), and Sharks Inlet (SHI). The two sets of sites were not necessarily monitored on the same day.

The State Park Marina site was formerly listed under code SPM. To differentiate this site from the shoreline bacteria monitoring site, the Dawn Patrol site was re-coded as SPO.



DAWN PATROL DO N VALUE SUMMARY

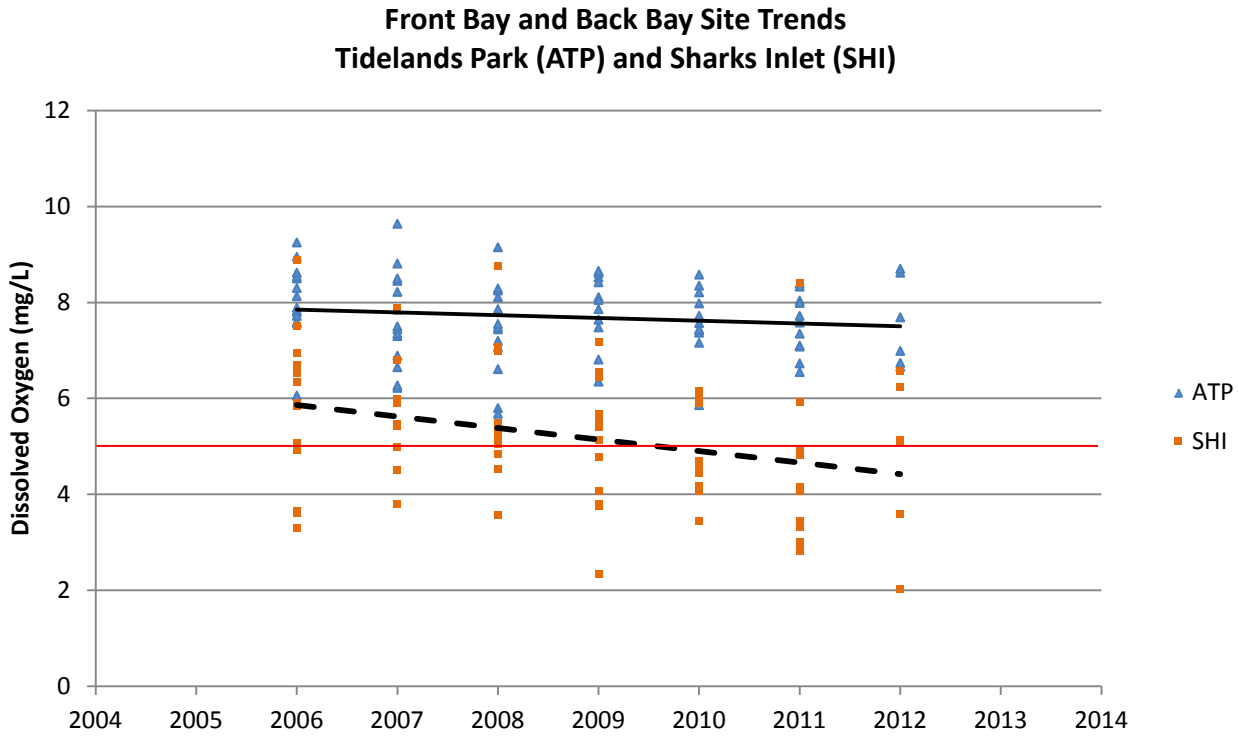
The following table shows the number of readings taken at each site by year. The table also shows the number and percent of samples that exceeded the 5.0 mg/L regulatory standard that is protective of marine habitat.

Sites	2006	2007	2008	2009	2010	2011	2012*	Sample Size	# of Exceed-ances	% of Exceed-ances
ATP	13	15	13	12	12	11	6	82	0	0
SPO	7	12	13	12	12	12	6	75	1	1.3
LO2	8	12	13	12	12	11	6	74	2	2.7
PSP	8	12	13	12	12	12	6	75	0	0
CHI	12	12	11	12	10	11	6	75	7	9.3
CSI	13	12	11	12	10	11	6	76	31	40.8

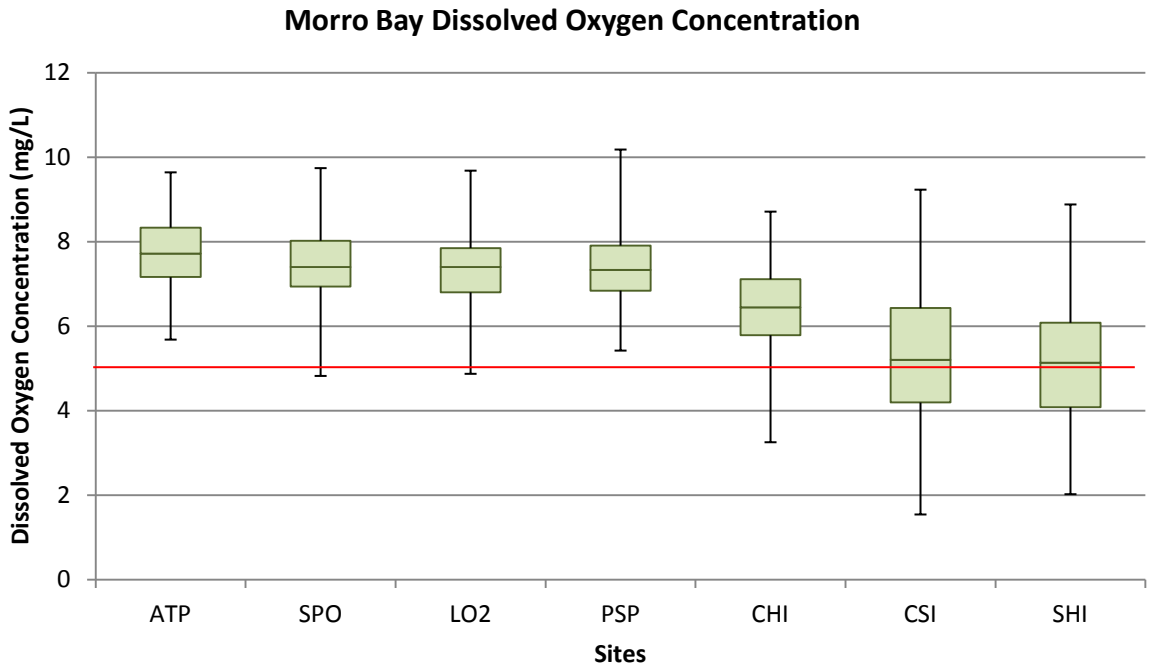
Sites	2006	2007	2008	2009	2010	2011	2012*	Sample Size	# of Exceed-ances	% of Exceed-ances
SHI	13	9	11	12	10	12	6	72	32	44.4

**2012 data includes January through June.*

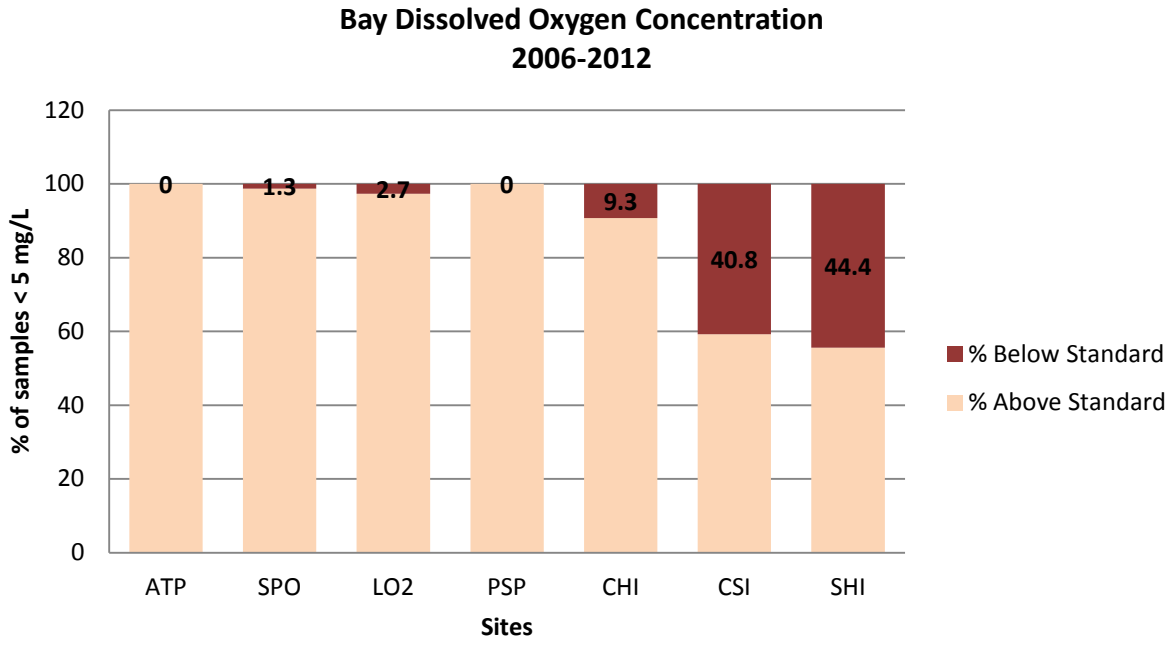
The following figure is a scatter plot of surface level DO levels at two sites, Tidelands Park (ATP) and Sharks Inlet (SHI). The red line indicates the Basin Plan DO standard of 5.0 mg/L that is protective of marine life. The southernmost site of Sharks Inlet (shown in orange) exhibits DO levels that tended to remain in the 5 to 6 mg/L range. The dashed black line represents the trend line for the data, indicating a downward trend in DO levels between 2006 and 2012. In comparison, the front bay site at Tidelands Park (shown in blue) consistently had levels above 5.0 mg/L. The trend line is represented by the solid black line, which is exhibiting a slight decrease in DO over time.



The next figure indicates the median DO levels at each of the sites. The centerline of the box plots indicates the median DO concentration for each site, and the interquartile range is shown in the box (Q1 to Q3, the middle 50% of the data). The upper whisker extends to the highest data value within the upper limit. The upper limit = Q3 + 1.5 (Q3 – Q1). The lower whisker extends to the lowest value within the lower limit. The lower limit = Q1 – 1.5 (Q3-Q1). The red line indicates the Basin Plan DO standard of 5.0 mg/L that is protective of marine life. The data show the expected trend of higher DO levels along the main channel where more tidal flushing occurs (sites ATP, SPO, LO2 and PSP) and lower DO levels in the shallow back bay areas (sites CHI, CSI, SHI). Concentrations below 5.0 mg/L were regularly observed in the summer time. The low DO levels in the back bay could be a naturally-occurring phenomenon due to a lack of tidal flushing.



The following bar graph shows the percent of monitoring events where the DO concentration was below 5.0 mg/L for each site.



SHOREBIRD MONITORING

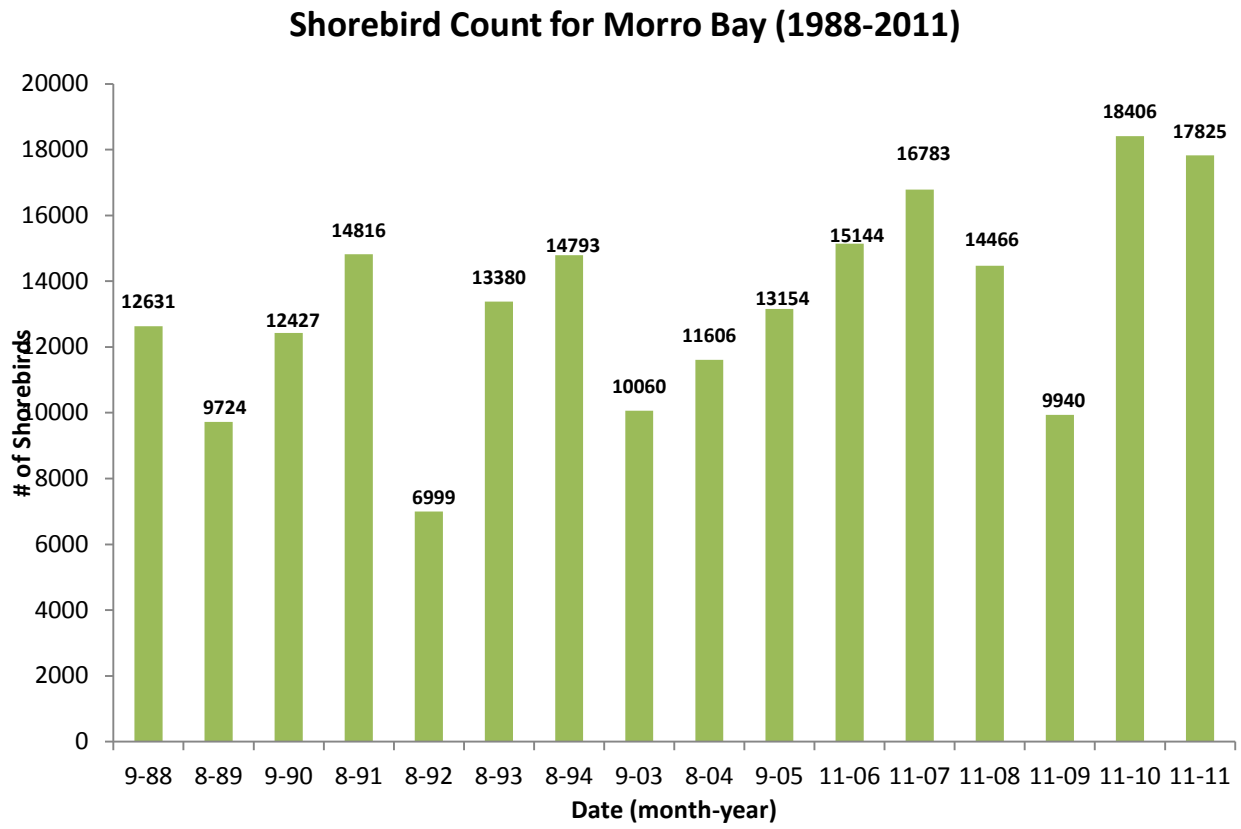
A Morro Bay shorebird survey has been conducted each fall since the late 1990s. The bay, sand spit and Morro strand beach are divided into 15 distinct regions. One to two birders occupy each region and conduct a count during a two-hour period. Depending on the conditions of the region, birders conduct counts from boats or at specified lookouts on land. They conduct species counts of shorebirds

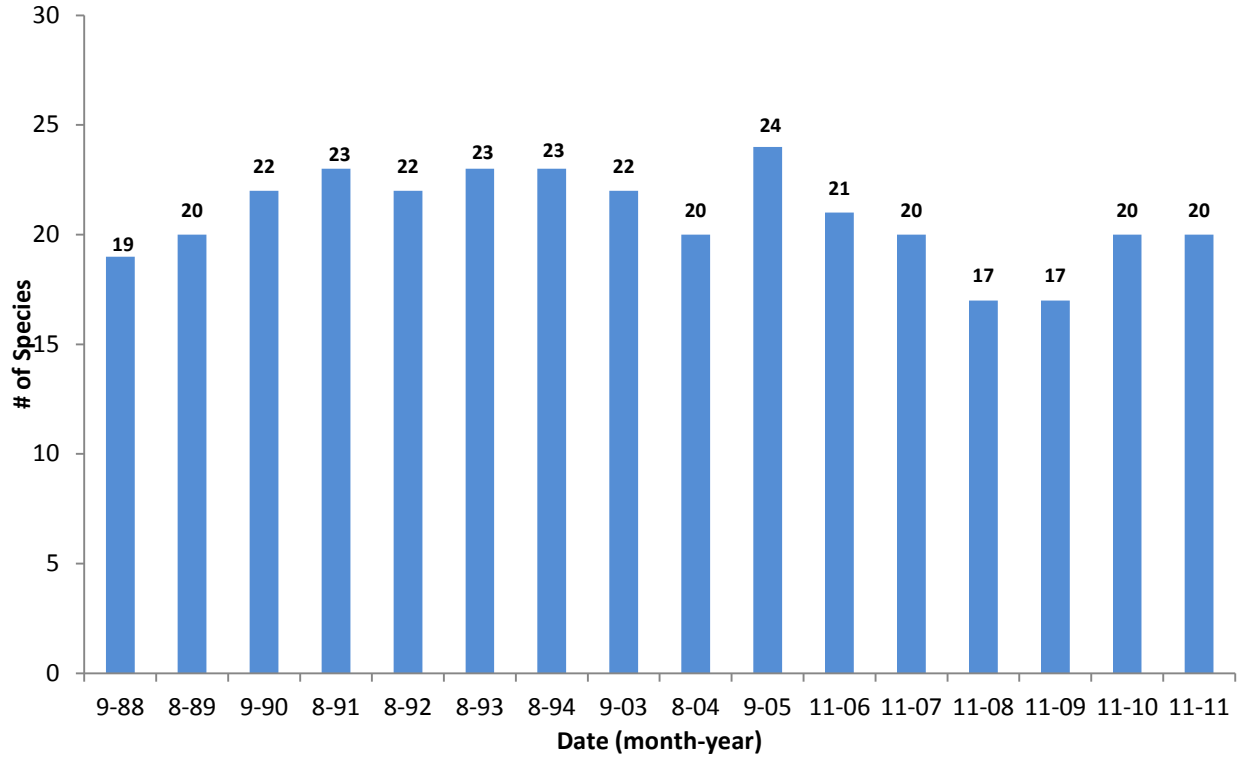
in their region while trying not to double count birds leaving one region and traveling to another. The protocol was developed by the Pt. Reyes Bird Observatory (PRBO) to monitor activity along the Pacific Flyway, and surveys were coordinated for Morro Bay by local birder Marlin Harms from the mid-1980s through the mid-1990s. When the MBNEP restarted this monitoring effort in 2003, the PRBO methodologies were adopted so that the recent trends could be compared with the historical data.

The following maps show the areas covered by the survey and the 15 regions.

In the fall of 2006, PRBO restarted its flyway monitoring effort. Volunteers in San Francisco, Humboldt, San Diego, Bolsa Chica, Newport Beach, Elkhorn Slough and a few other pockets in the Santa Barbara and San Diego areas conducted their counts during a one-week period. A longer survey period was allowed due to the varying tidal conditions required by each individual survey area.

The following figure shows the shorebird count and number of species counted for Morro Bay.


Shorebird Count for Morro Bay (1988-2011)
# of Shorebirds
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
12631
9724
12427
14816
6999
13380
14793
10060
11606
13154
15144
16783
14466
9940
18406
17825
9-88
8-89
9-90
8-91
8-92
8-93
8-94
9-03
8-04
9-05
11-06
11-07
11-08
11-09
11-10
11-11
Date (month-year)


Shorebird Species Count for Morro Bay (1988-2011)
# of Species
30
25
20
15
10
5
0
19
20
22
23
22
23
23
22
20
24
21
20
17
17
20
20
9-88
8-89
9-90
8-91
8-92
8-93
8-94
9-03
8-04
9-05
11-06
11-07
11-08
11-09
11-10
11-11
Date (month-year)

The average number of shorebirds for fall surveys was 13,260 birds and the average species counted was 21. In 2012, the most abundant shorebird was the Least Sandpiper and the least abundant was the Spotted Sandpiper.

The reason for the elevated fall counts in 2006 and 2007 was likely a shifting of the survey date. While fall surveys had historically been conducted in August or September, the survey date was shifted back to November when coordination began with PRBO.

PHYTOPLANKTON

Volunteers collect samples once a month throughout the year. Samples are collected by lowering a 20 um net into the water to collect a sample at the north T-Pier near the Coast Guard/Harbor Patrol station in Morro Bay. Volunteers then conduct taxa counts under the microscope and identify plankton down to the genus level. The datasheet and a preserved sample are sent to the California Department of Public Health (CDPH) to assist with biotoxin monitoring to ensure the safety of farmed and sport harvested shellfish for human consumption. This effort was started in conjunction with CDPH in 2002.

Since the data is not used as a bioindicator for the watershed, it will not be summarized in this report. As far as toxic organisms present, monitoring since May 2002 has yielded 138 pulls containing species known to produce domoic acid and 23 pulls with species potentially containing paralytic shellfish poison toxins, out of a total of 219 pulls.