Quality Assurance Project Plan

Morro Bay National Estuary Program's
Monitoring Program

Prepared for
Central Coast Regional Water Quality Control Board
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401

and

United States Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105

Prepared by
Morro Bay National Estuary Program

February 27, 2024
Version 17.1

GROUP A ELEMENTS: PROJECT MANAGEMENT

1. TITLE AND APPROVAL SHEETS

Quality Assurance Project Plan

For

PROJECT NAME: Morro Bay National Estuary Program's Monitoring Program

Proposal Identification Number: __________________

Date: February 27, 2024

NAME OF RESPONSIBLE ORGANIZATION : Morro Bay National Estuary Program

APPROVAL SIGNATURES
(Add or delete signature lines as needed)

GRANT ORGANIZATION:

Title:	Name:	Signature:	Date:
MBNEP Program Director	Melodie Grubbs		1-31-2024
MBNEP Program Manager	Ann Kitajima		1-31-2024
QA Officer	Ann Kitajima		1-31-2024

REGIONAL BOARD:

Title:	Name:	Signature:	Date:
QA Officer	Mary Hamilton		

STATE WATER RESOURCES CONTROL BOARD:

Title:	Name:	Signature:	Date:
QA Officer	Andrew Hamilton		

U.S. ENVIORNMENTAL PROTECTION AGENCY:

Title:	Name:	Signature:	Date:
USEPA Project Manager	Suzanne Marr	SUZANNE MARR	Digitally signed by SUZANNE MARR Date: 2024.02.28 16:12:09 -08'00'
USEPA QA Manager	Audrey L. Johnson	Audrey L Johnson	Digitally signed by Audrey L Johnson Date: 2024.02.28 09:14:10 -08'00'

HISTORY OF REVISIONS

Version Number	Date	Revision Details
1.0	May 15, 2002	Final approval from EPA
1.1	June 30, 2003	See table with summary of revisions
	October 27, 2003	See table with summary of revisions. EPA approval of update.
1.2	October 1, 2004	See table with summary of revisions.
	January 25, 2005	EPA approval of update.
2.0	March 31, 2006	Updated to SWAMP compatible.
2.1	April 28, 2006	Incorporated SWAMP QA Team comments into this version.
2.2	July 9, 2006	Incorporated final revisions and comments into this version.
2.3	January 29, 2007	Incorporated EPA comments and awaiting approval before finalizing.
	March 30, 2007	EPA approval of response to comments. Document finalized to be submitted to EPA for signatures.
3.1	August 7, 2007	Annual update submitted to RWQCB for approval.
3.2	August 28, 2007	Responded to RWQCB comments and resubmitted for approval.
3.3	October 9, 2007	Received RWQCB approval of response to comments and generated final document.
4.1	March 26, 2008	Annual update to document for EPA approval.
4.2	October 10, 2008	Responded to EPA comments and resubmitted for approval.
4.3	October 30, 2008	Received final approval from EPA and finalized document for signatures.
5.1	October 30, 2009	Annual update submitted to EPA for approval.
5.2	January 12, 2010	Received conditional approval from EPA and finalized document for signatures, incorporating comments from Mark Kutnink in his email dated December 29, 2009.
6.1	January 12, 2011	Annual updates submitted to EPA for approval.
6.1	August 16, 2011	Received approval from EPA’s Office of Quality Assurance.
6.1	August 31, 2011	Received approval from the QA Officer of the CCRWQCB.
6.1	September 12, 2011	Finalized Version 6.1 of the document.
7.1	August 7, 2012	Annual updates submitted to EPA for approval.
7.1	August 21, 2012	Received approval from EPA's Office of Quality Assurance.
7.1	December 10, 2012	Received approval from the QA Officer of the CCRWQCB.

Version Number	Date	Revision Details
8.1	August 21, 2013	Annual updates submitted to EPA for approval.
8.2	September 18, 2013	Received approval from EPA's Office of Quality Assurance.
9.1	September 15, 2014	Annual updates submitted to EPA for approval
9.1	December 30, 2014	Received approval from EPA's Office of Quality Assurance
10.1	December 14, 2015	Annual updates submitted to EPA for approval
10.1	February 9, 2016	Received approval from EPA's office of Quality Assurance
11.1	February 7, 2017	Annual updates submitted to EPA for approval
11.1	February 14, 2017	Received approval from EPA's office of Quality Assurance
12.1	March 22, 2018	Annual updates submitted to EPA for approval
12.1	March 30, 2018	Received approval from EPA's office of Quality Assurance
12.2	September 26, 2018	Received approval from SWRCB Office of QA
13.1	March 22, 2019	Annual updates submitted to EPA for approval
13.1	April 30, 2019	Annual updated version revised with additional information for ocean acidification monitoring
13.1	June 17, 2019	Received approval from EPA's Office of Quality Assurance
13.1	July 10, 2019	Received approval from SWRCB Office of QA
14.1	August 4, 2020	Annual updates submitted to EPA for approval
14.1	September 24, 2020	Received approval from EPA's Office of Quality Assurance
14.1	December 7, 2020	Received approval from SWRCB Office of QA
15.1	September 14, 2021	Annual updates submitted to EPA for approval
15.1	October 26, 2021	Received approval from EPA's Office of Quality Assurance
15.1	November 17, 2021	Annual updates submitted to SWRCB Office of QA
16.1	December 21, 2022	Annual updates submitted to EPA for approval
16.1	January 31, 2023	Received approval from EPA's Office of Quality Assurance
17.1	January 31, 2024	Annual updates submitted to EPA for approval
17.1	February 27, 2024	Received approval from EPA's Office of Quality Assurance

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3. DISTRIBUTION LIST

Title:	Name (Affiliation):	Tel. No.:	QAPP No*:
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Contractor Program Manager/QA Officer /VMP staff	Ann Kitajima (MBNEP)	805-772-3834	ORIGINAL
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MBNEP Technical Working Group	Yarrow Nelson	805-756-1347	1

4. PROJECT/TASK ORGANIZATION

4.1 Involved parties and roles.

The Morro Bay National Estuary Program (MBNEP) is a collaborative organization that brings local citizens, local government, non-profits, agencies and landowners together to protect and restore the physical, biological, economic and recreational values of the Morro Bay estuary.

Melodie Grubbs is the program director of the MBNEP. She approves the contract invoices developed by the program manager. The program manager reports directly to the program director.

Ann Kitajima is the MBNEP's Assistant Director, as well as the MBNEP Volunteer Monitoring Program (VMP) manager and is referred to as the MBNEP Program Manager throughout this document. She also serves as the MBNEP Quality Assurance (QA) Officer for the project. She is responsible for all aspects of the project including organizing VMP staff, scheduling of monitoring, selection and maintenance of monitoring equipment, field and in-house analysis of samples, and contact with the labs used for quality assurance purposes. She is responsible for all contract submittals and for the activities of all VMP staff and volunteers.

The State Water Board QA Officer is responsible for ensuring that the Quality Assurance Project Plan (QAPP) adheres to the QA principles of the State Water Board. The EPA QA Officer is responsible for ensuring that the QAPP adheres to the QA principles of EPA. The Central Coast Regional Water Quality Control Board (CCRWQCB) QA Officer is responsible for ensuring that the QAPP adheres to the QA principles of the Regional Board.

Fruit Growers Laboratory, Inc. (FGL) is the lab that conducts nutrient and QA analysis for the MBNEP. Pace Analytical Services is the lab that conducts stormwater analysis for the MBNEP. The San Luis Obispo County Public Health Agency Laboratory occasionally conducts the analysis of *E. coli* and enterococcus samples. Contract laboratories are not directly responsible for delivery of any contract submittals. All labs will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP.

EcoAnalysts, Inc. conducts the analysis of macroinvertebrate samples. The lab will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP. This contract laboratory is not directly responsible for delivery of any contract submittals.

The University of California, Santa Barbara (UCSB) Marine Science Institute Laboratory is the lab that conducts nutrient analysis of bay waters for the MBNEP. This includes nitrates + nitrites, nitrites, orthophosphates, silicic acid, and ammonium. The lab will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP. This contract laboratory is not directly responsible for delivery of any project submittals.

The University of California, Davis Marine Pollution Studies Laboratory at Granite Canyon (UCD-GC) is the lab that conducts water and sediment toxicity analysis for the MBNEP. The lab will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP. This contract laboratory is not directly responsible for delivery of any contract submittals.

Table 4.1.1. Personnel responsibilities

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
Ann Kitajima	MBNEP Monitoring Program	Program Manager/Assistant	805-772-3834, annk@mbnep.org

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
		Director/QA Officer	
Melodie Grubbs	MBNEP	Program Director	805-772-3834, mgrubbs@mbnep.org
Stuart Buttram	Pace Analytical Services	Technical Director	800-878-4911, ex. 240, stuart@bclabs.com
David Terz	Fruit Growers Laboratory, Inc.	QA Director	805-392-2024, davidt@fglinc.com
Dr. Glen Miller	San Luis Obispo County Public Health Agency	Laboratory Director	805-781-5512, (f) 805-781-1023, gmmiller@co.slo.ca.us
Gary Lester	EcoAnalysts, Inc.	President	208-882-2588, glester@ecoanalysts.com
Karen Thorne	USGS Western Ecological Research Center	Project Manager for SET Project	(916) 502-2996, kthorne@usgs.gov
Ken Marchus	UCSB Marine Science Institute Laboratory	Lab Director	805-893-3802, k_a_m@ucsb.edu
Bryn Phillips	UC Davis Marine Pollution Studies Laboratory at Granite Canyon	Laboratory Director, QA Officer	831-624-0947, bmphillips@ucdavis.edu

4.2 Quality Assurance Officer role

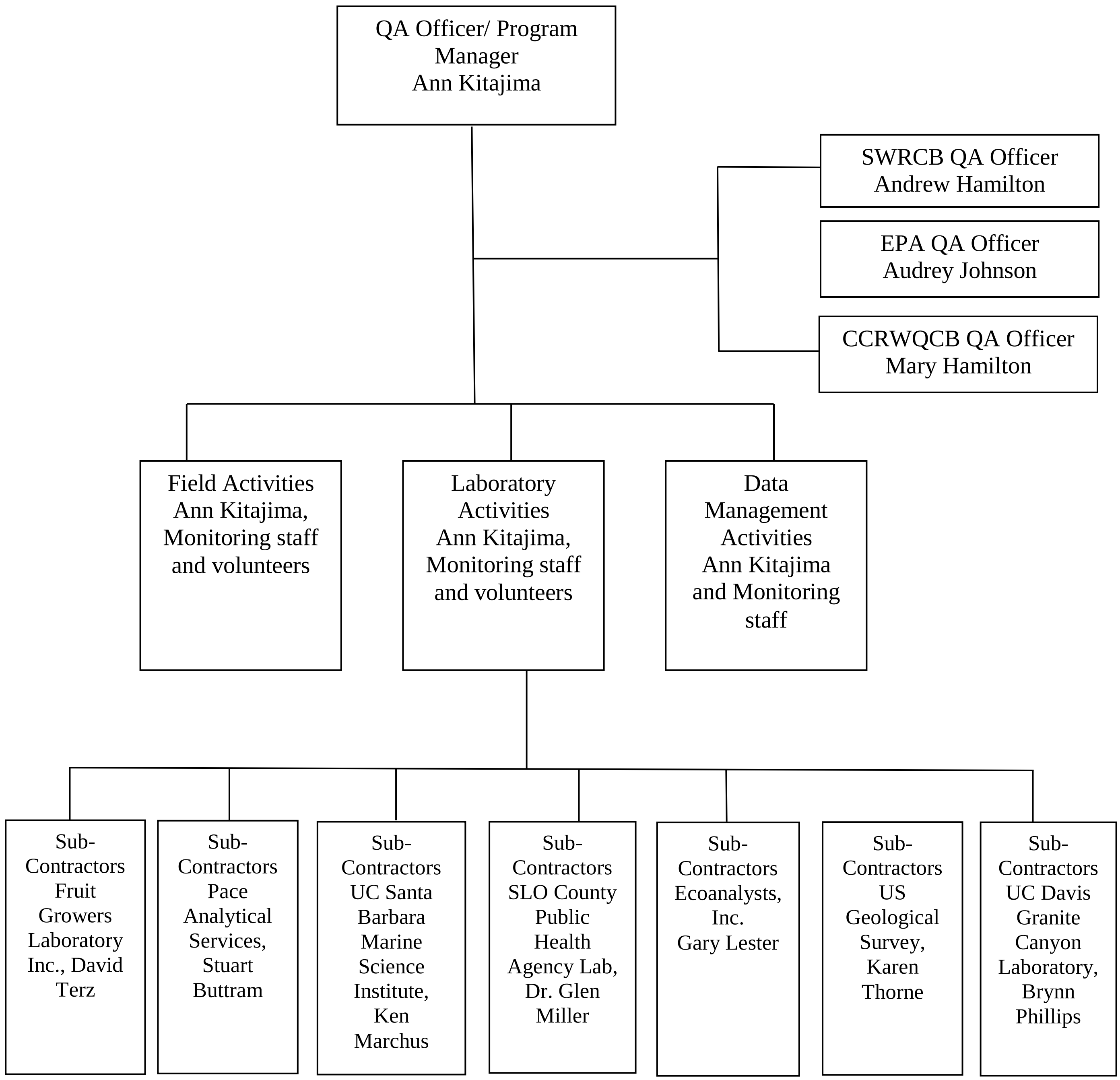
The MBNEP Program Manager is responsible for general oversight of the program including grant management, volunteer recruitment and training, protocol development, data management, data analysis and report writing. The Program Manager also serves as the MBNEP QA Officer for this small program. While the Program Manager oversees the operations of the program, this person is not actually generating the project data. Data collection is conducted by program volunteers and staff. While they receive training and oversight from the Program Manager, their data collection is conducted independent of the Program Manager. Data management and reporting, while overseen by the Program Manager, are conducted by a MBNEP staff member. So while both the MBNEP Program Manager and QA Officer roles are fulfilled by the same individual, there is no bias in the generating of project data.

4.3 Persons responsible for QAPP update and maintenance.

The MBNEP Program Manager is the person responsible for updates to this QAPP. Changes and updates may be made after a review of the changes by the MBNEP Program Manager and QA Officer. The MBNEP Program Manager will be responsible for making the changes, submitting the drafts for review, preparing a final copy, and submitting the final for signature. The plan will be reviewed annually.

4.4 Organizational chart and responsibilities

Figure 4.4. 1. MBNEP Organizational Chart and Responsibilities



5. PROBLEM DEFINITION/BACKGROUND

5.1 Problem statement

The National Estuary Program was established in 1987 under Section 320 of the Clean Water Act to address long-term planning and management in nationally significant estuaries. In 1995, Morro Bay was accepted into the program. As part of the formation of the Morro Bay National Estuary Program (MBNEP), seven priority problems were identified as major impacts to the estuary. These priority problems are:

1. Accelerated Sedimentation
2. Bacterial Contamination
3. Elevated Nutrients Concentrations
4. Scarce Freshwater Resources
5. Toxic Pollutants
6. Preserving Biodiversity
7. Environmentally Balanced Uses

The threats to the estuary as well as proposed actions to address these threats are outlined in a Comprehensive Conservation and Management Plan for Morro Bay (CCMP). Effectiveness of these implemented actions is tracked by monitoring. The data will help assess effectiveness of implementation actions and guide future actions. The MBNEP helped to establish the Morro Bay Volunteer Monitoring Program (VMP) in the early 1990s both to provide data to guide CCMP actions and to increase public involvement and stewardship in protection of a unique natural resource. The goal of the program is to track long-term trends in the Morro Bay estuary and its watershed, as well as understand the effectiveness of implementation efforts.

5.2 Decisions or outcomes

The MBNEP QAPP is based upon the following goal and seven objectives that are consistent with overall program goals. The objectives listed are in reference to evaluation and research needs of the CCMP. These public concerns, targets and methods of measurement are described in Chapters 5-13 of the MBNEP's Environmental Monitoring Plan (EMP). Further information on targets can be found in the CCRWQCB Basin Plan and in the Total Maximum Daily Load (TMDL) regulations for the Morro Bay watershed.

The primary goal of the program is to track the implementation of CCMP actions and monitor the health of the Morro Bay ecosystem.

In addition to identifying priority problems, the CCMP identified objectives for the program, as follows:

Geomorphological Objective

- ✓ Slow sedimentation by implementing management measures that address erosion and sediment transport

Human Use Objectives

- ✓ Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, and safe recreational uses
- ✓ Protect social, economic, and environmental benefits provided by the bay and watershed through comprehensive resource management planning
- ✓ Promote public awareness and involvement in estuarine management issues through education, outreach and use of volunteers

Water Quality (WQ) Objectives

- ✓ Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, safe recreational uses, healthy eelgrass beds, habitats for listed species, cold water aquatic habitat, and thriving fish and shellfish populations

Living Resources Objectives

- ✓ Ensure integrity of the broad diversity of natural habitats and associated native wildlife species in the bay and watershed
- ✓ Reestablish healthy steelhead trout habitat in Chorro and Los Osos Creeks

5.3 Water quality or regulatory criteria

Criteria for MBNEP monitoring include Basin Plan standards, Central Coast Ambient Monitoring Program (CCAMP) Attention Levels and other applicable regulatory criteria. Some monitoring methods do not have specific criteria for comparison including stream profiling, shorebird surveying, surface elevation tables (SETs), sediment deposition traps, stream flow, macroinvertebrates, macroalgae, and eelgrass monitoring.

Table 5.3.1 1. MBNEP screening levels for monitoring data

Parameter	**Criteria**[1]	**Source**	**Comments**
E. coli (freshwater)	Statistical Threshold Value: 320 MPN/100 mL (90th percentile of data) Geomean: 100 MPN/100 mL	SWRCB, Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries of California, Bacteria Provisions and a Water Quality Standards Variance Provision	REC-1 Bacteria Water Quality Objectives
Enterococcus spp. (estuarine)	Statistical Threshold Value: 110 MPN/100 mL (90th percentile of data) Geomean: 30 MPN/100 mL	SWRCB, Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries of California, Bacteria Provisions and a Water Quality Standards Variance Provision	REC-1 Bacteria Water Quality Objectives
Conductivity (for Water Quality)	> 3,000 uS/cm (AGR beneficial use)	CCRWQCB Basin Plan standard	Protects water for use as irrigation water
Dissolved oxygen (freshwater)	< 7.0 mg/L (COLD) < 5.0 mg/L (WARM)	CCRWQCB Basin Plan standards	Protection of aquatic life for cold and warm freshwater

[1] The criteria in this table indicate the range of concentrations that would be of concern. For example, for dissolved oxygen in freshwater, concentrations less than 7 mg/L are not protective of the COLD beneficial use. Thus, the criteria in the table is indicated as "< 7 mg/L."

Parameter	Criteria[1]	Source	Comments
Dissolved oxygen (estuarine)	< 7.0 mg/L, median % saturation < 85% (ocean waters) (COLD, SPWN)	CCRWQCB Basin Plan standard	Protection of cold water species in estuarine environment
Nitrate as nitrogen (for Water Quality)	> 1.0 mg/L with supporting evidence, > 10 mg/L (drinking water standard)	CCRWQCB 303(d) Listing Guidance Value	Evidence includes DO < 7.0 or > 13.0 mg/L, extensive algae, etc. (Black, 2010)
Orthophosphate as PO_4 (for Water Quality)	> 0.36 mg/L	Guideline value	Value developed specifically for Pajaro River but being used for Morro Bay (Williamson, 1994; Black, 2010).
pH (for Water Quality)	< 7.0 and > 8.5(COLD, WARM, estuarine)	CCRWQCB Basin Plan Standard	Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters (COLD, WARM)
Chlorophyll *a* (for Water Quality)	> 15 µg/L	CCRWQCB Basin Plan Guideline	Value developed for Lower Salinas River Watersheds but being used for Morro Bay (CCRWQCB Basin Plan, 2019).
Ammonia (for Water Quality)	> 0.025 mg/L NH_3-N as unionized ammonia	CCRWQCB Basin Plan Standard	General objectives, toxicity criteria
Temperature (for Water Quality)	> 21ºC	CCRWQCB 303(d) Listing Guidance Value	Optimum range for steelhead of 13 to 21 ºC (Moyle, 2002)
Turbidity (for Water Quality)	> 25 NTU (COLD) > 40 NTU (WARM)	CCRWQCB 303(d) Listing Guidance Value	COLD criteria (Sigler, 1984). WARM criteria (Shoup, 2009)
Aquatic Toxicity (for Water Toxicity)	< 6-day *Ceriodaphnia* survival and reproduction	CCRWQCB Basin Plan Guideline	Value developed for Santa Maria watershed but being used for Morro Bay (CCRWQCB Basin Plan, 2019).
Aquatic Toxicity (for Sediment Toxicity)	< 10-day *Hyalella azteca* survival	CCRWQCB Basin Plan Guideline	Guidance developed for Santa Maria watershed but being used for Morro Bay (CCRWQCB Basin Plan, 2019).
Dissolved copper (for Stormwater)	> 0.01 mg/L	CCRWQCB Basin Plan Standard	Standards apply to receiving waters

Parameter	Criteria[1]	Source	Comments
Dissolved lead (for Stormwater)	> 0.01 mg/L	CCRWQCB Basin Plan Standard	Standards apply to receiving waters
Dissolved zinc (for Stormwater)	> 0.02 mg/L	CCRWQCB Basin Plan Standard	Standards apply to receiving waters
Oil & grease (for stormwater)	> 75 mg/L	CCRWQCB NPDES General Permit	Discharge to ocean waters

6. PROJECT/TASK DESCRIPTION

6.1 Work statement and produced products

Bacteria monitoring conducted by program staff and volunteers includes monthly sampling at sites on local creeks and in Morro Bay. All freshwater samples are analyzed for total coliform and *E. coli*, and the marine samples are analyzed for enterococcus. Volunteers and staff analyze duplicate samples, run sterility blanks, and analyze certified reference materials. Occasionally samples are processed by the San Luis Obispo County Public Health Agency Lab due to logistics which do not allow them to be processed by MBNEP volunteers or staff. Each month, results are forwarded to various landowners and agencies so that any potential public health threats can be addressed. Data is stored in an MBNEP-maintained Access database. Deliverables include a consistent bacteria data set in electronic format and monthly notifications. All data is analyzed in monthly memos and in an annual data summary memo.

Water quality monitoring by program volunteers and staff includes monthly sampling at local creek and bay sites throughout the Morro Bay watershed. Samples are analyzed for temperature, turbidity, conductivity, dissolved oxygen (DO), and orthophosphates as PO_4. Split samples are sent to an Environmental Laboratory Accredited Program (ELAP) accredited laboratory for turbidity, pH and nutrient QA analysis. Three of the water quality monitoring sites have been designated as 'Agricultural Monitoring Sites'. All of the same analyses takes place at these sites as at the other water quality sites, with the addition of a field measurement for chlorophyll and total dissolved solids (TDS). Samples are analyzed by an ELAP accredited laboratory for the following analytes: nitrates as nitrogen, total nitrogen, organic nitrogen, Total Kjeldahl nitrogen, ammonia, nitrite, total phosphorus, orthophosphates as P, and total suspended solids (TSS). Monitoring takes place monthly. A subset of water quality monitoring sites are designated as ‘Bimonthly Nutrient Monitoring Sites.’ Every other month, samples are analyzed for nitrates as nitrogen and orthophosphate as phosphorus by an ELAP accredited laboratory. Data is stored in an MBNEP-maintained Access database. Deliverables include a consistent water quality data set in an electronic format. All data is analyzed in an annual data summary memo.

Seeps monitoring is conducted by program staff and includes every other month collection of samples at up to five freshwater seeps along the back bay shoreline. The flow varies depending on time of year and rainfall. Staff measures the conductivity and salinity of the seep and collects a sample for nitrate as nitrogen analysis by a certified laboratory. Data is stored in an MBNEP-maintained Access database. Deliverables include a consistent water quality data set in an electronic format. All data is analyzed in a data summary memo.

Flow monitoring by staff and program volunteers includes monthly monitoring at local creek sites throughout the watershed. Staff and volunteers measure creek depth and velocity, and an instantaneous flow rate is estimated from this information. Data is stored in an MBNEP-maintained Access database.

Deliverables include a consistent flow data set in an electronic format. Data is provided to partners upon request to support project implementation.

Continuous water quality data is collected by program staff on a monthly basis at local creek sites throughout the watershed. The continuous monitoring equipment is deployed for a week-long time period to collect temperature, DO (concentration and percent saturation), conductivity, pH, and chlorophyll concentrations at 30- minute intervals. Data is stored in an MBNEP-maintained Excel database. Temperature data is collected year-round with data collected at 30-minute intervals. Data is stored in an MBNEP-maintained Excel database. Deliverables include a consistent water quality data set in an electronic format. Data is analyzed in an annual data summary memo.

Continuous water depth measurements are collected by program staff at local creek sites throughout the watershed. The equipment is deployed permanently at the sites and collects stage height data on 15-minute increments. Data is downloaded from the equipment on a monthly basis and stored in an MBNEP-maintained Excel database. Deliverables include a consistent water depth data set in an electronic format. Data is provided to partners upon request to support project implementation.

For toxicity, samples are collected from four sites throughout the watershed and analyzed at a contract laboratory. Water samples are collected once during the dry season and once during the wet season. Sediment samples are collected once during the dry season. Deliverables include a toxicity data set in an electronic format. Data is stored in an MBNEP-maintained Excel database.
Continuous pH measurements in the estuary are collected by Cal Poly faculty and students at the Morro Bay T-pier and a back bay location. The equipment is deployed for approximately half of a year, with quarterly checks. Data is collected in 15-minute increments, with 10 measurements taken in a burst to be averaged into a single reading. Data is downloaded from the equipment on a quarterly basis and stored in a Cal Poly-maintained database. Deliverables include a consistent estuary pH data set in an electronic format. Data will be analyzed in a report after a year of data collection and will also be used to support other Cal Poly research efforts.

For bay nutrient monitoring, Cal Poly staff and volunteers collect discrete samples from six shoreline locations each month. Data is stored in a Cal Poly-maintained database. Deliverables include an estuarine water quality data set in an electronic format. Data will be analyzed in a report after a year of data collection and will also be used to support other Cal Poly research efforts.

For bioassessment monitoring, program staff and volunteers collect samples on local creeks each year. Algae documenting is conducted in conjunction with bioassessment monitoring. Macroinvertebrate samples are sent to a contract laboratory for analysis. The lab analyzes the sample according to SWAMP SAFIT Level 2 taxonomy protocols, with counts to at least 600. The lab provides the counts as well as various calculated metrics. Data is provided in Excel format. Deliverables include a consistent bioassessment data set in electronic format. All data is analyzed in an annual data summary memo.

For stream profiling, program staff and volunteers monitor sites as needed throughout the watershed. The data is maintained in an Excel spreadsheet and is shared periodically with CCRWQCB staff. Deliverables include a consistent stream profiling data set in electronic format. Data is included in sediment reports.

For sediment elevation monitoring, the MBNEP works with U.S. Geological Survey (USGS) to monitor surface elevation tables (SETs) and sediment deposition traps. For SET monitoring, sites are monitored at ten locations in the salt marsh, including four sites established by USGS and six historic sites established by the University of San Francisco, approximately every five years and more frequently if large storm events occur. For sediment deposition traps, eight transects are deployed throughout the bay. Traps are deployed for three months in the winter and three months in the summer. Data is stored in a USGS-maintained database. The results are presented in sediment monitoring reports.

For eelgrass monitoring, a contractor collects and analyzes bay-wide aerial imagery and creates a bay-wide map showing eelgrass location and density. The aerial imagery is typically collected approximately every other year with a drone or digital aerial sensor with four channels. For the aerial sensor, the spectral wavelength of each channel is customizable with the use of narrow-band interference filters. The digital image frames are used to generate a GIS-ready, georegistered, mosaiced false color imagery. For the drone, aerial RGB images taken at extreme low tides are georectified into orthomosaic images. A technician uses manual classification to distinguish eelgrass location and density. When flights take place, MBNEP staff conducts groundtruthing to collect data to support the classification conducted by the contractor. To track the health of eelgrass, MBNEP staff conducts separate monitoring efforts on eelgrass in the bay: 1) Permanent transect monitoring in six areas of the bay along transects to collect shoot density and other measurements; 2) Intertidal bed condition monitoring to determine eelgrass bed conditions through density, patchiness, and observational data; 3) Restoration bed monitoring to track the success of planting methods, locations, and seasonality; and 4) Biannual macroalgae and biomass monitoring to assess competition with eelgrass. The data is stored electronically in MBNEP-maintained Excel spreadsheets. An eelgrass report is created summarizing the effort and results for the year.

Periodically the MBNEP works with a contractor to conduct bay-wide bathymetry surveys. Interferometric side scan sonar will be used in the deeper waters of the bay and LiDAR measurements will be used for the shallower areas to collect topo-bathymetric elevation point data. The contractor will seam together the data sets and conduct the classification to create the bathymetry data layer. All standard accuracy validations will be conducted to ensure data quality. The results will be shared widely with project partners and researchers. The analysis is likely to be conducted at approximately a ten-year frequency.

For bird monitoring, volunteers participate in shorebird monitoring events each fall in partnership with the Morro Coast Audubon Society to conduct bay-wide counts. The data is shared with local birding organizations and stored in electronic Excel format. It is also entered into a data portal developed by Point Blue, who shares the survey results.

For stormwater monitoring, samples are collected from eight sites in the California State Park Marina parking lot at the onset of storms capable of generating flows that drain out of the parking lot. Samples are analyzed by an ELAP accredited laboratory for concentrations of oil and grease, dissolved copper, dissolved zinc, dissolved lead, total petroleum hydrocarbons from gasoline and diesel, and total suspended solids. Samples will be analyzed by the laboratory for *E. coli*. The results will be summarized in a memo that will be shared with project partners.

6.2. Constituents to be monitored and measurement techniques

Table 6.2.1 summarizes the constituents to be measured for each of the monitoring efforts described in Section 6.1.

Table 6.2.1. Constituents monitored and measurement techniques

Parameter	Laboratory / Organization	Monitoring Frequency	Primary or Secondary	Method
E. coli (freshwater)	MBNEP	Monthly	Primary	IDEXX Colilert-18 analysis
Enterococcus spp. (marine)	MBNEP	Monthly	Primary	IDEXX Enterolert analysis
Conductivity (freshwater)	MBNEP	Monthly	Primary	Meter
Dissolved oxygen (marine and freshwater)	MBNEP (freshwater), Cal Poly (marine)	Monthly	Primary	Meter
Orthophosphate as PO_4 (freshwater)[2]	MBNEP	Monthly	Primary	Meter
pH (freshwater)	MBNEP	Monthly	Primary	Meter
pH (marine)	Cal Poly	Continuously, for approximately six months of year	Primary	Meter
Flow (freshwater)	MBNEP	Monthly	Primary	Meter
Water depth (freshwater)	MBNEP	Continuously	Primary	Meter
Temperature (marine and freshwater)	MBNEP (freshwater), Cal Poly (marine)	Monthly	Primary	Meter
Turbidity (freshwater)[3]	MBNEP	Monthly	Primary	Meter
Chlorophyll (freshwater)	MBNEP	Monthly at Ag Monitoring Sites	Primary	Meter
Total dissolved solids (freshwater)	MBNEP	Monthly at Ag Monitoring Sites	Primary	Calculated
Laboratory analysis - Nitrate as nitrogen (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites and seeps, every other month for Water Quality (WQ) sites	Primary	EPA 300.0
Laboratory analysis - Orthophosphate as P (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites, every other month for WQ sites	Primary	EPA 300.0

[2] Orthophosphate as PO4 analysis is conducted in-house by staff and volunteers. Although analysis is conducted in the office, measurements are considered field measurements since they are analyzed using a field meter.
[3] Turbidity analysis is conducted in-house by staff and volunteers. Although analysis is conducted in the office, measurements are considered field measurements since they are analyzed using a field meter.

Parameter	Laboratory / Organization	Monitoring Frequency	Primary or Secondary	Method
Laboratory analysis - Total nitrogen (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	Calculated
Laboratory analysis - Organic nitrogen (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	Calculated
Laboratory analysis - Nitrite as N (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	EPA 300.0
Laboratory analysis – Total Ammonia (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	SM4500-NH_3D
Laboratory analysis - Total Kjeldahl Nitrogen (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	EPA 351.2
Laboratory analysis - Total Phosphorus (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	EPA 200.7
Laboratory analysis - Total Suspended Solids (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	SM2540D
Laboratory analysis - Total Alkalinity (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline locations	Primary	Dickson et al. 2009. Guide to Best Practices for Ocean CO_2 Measurements
Laboratory analysis - Dissolved Inorganic Carbon (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline locations	Primary	Dickson et al. 2009. Guide to Best Practices for Ocean CO_2 Measurements
Laboratory analysis - Nitrite + Nitrate (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-107-04-1-A
Laboratory analysis - Nitrite (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-107-05-1-A
Laboratory analysis - Orthophosphate (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-115-01-3-A
Laboratory analysis - Silicic Acid (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-114-27-1-B

Parameter	Laboratory / Organization	Monitoring Frequency	Primary or Secondary	Method
Laboratory analysis - Ammonium (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-107-06-5-A
Laboratory analysis - Macroinvertebrates	EcoAnalysts Inc.	Annually	Primary	SWAMP SAFIT Level 2 protocol
Stream profiling	MBNEP	As Needed	Primary	NA
SETs	MBNEP	As Needed	Primary	NA
Sediment deposition traps	MBNEP	As Needed	Primary	NA
Eelgrass monitoring	MBNEP	Annually	Primary	NA
Eelgrass – Baywide map	MBNEP	Biennially, approximately	Primary	NA
Bathymetry – Baywide data set	MBNEP	Approximately every ten years	Primary	NA
Algae documenting (freshwater)	MBNEP	Annually with bioassessment monitoring	Primary	NA
Bay algae and biomass monitoring	MBNEP	Biannually	Primary	NA
Bird surveys	MBNEP	Annually	Primary	NA
Laboratory analysis – Oil & grease	Pace Analytical Services	As needed, during storms	Primary	EPA 1664A HEM
Laboratory analysis – Dissolved copper, dissolved zinc, dissolved lead	Pace Analytical Services	As needed, during storms	Primary	EPA 200.8
Laboratory analysis – Total petroleum hydrocarbons – gasoline	Pace Analytical Services	As needed, during storms	Primary	EPA 8015B
Laboratory analysis – Total petroleum hydrocarbons – gasoline and diesel	Pace Analytical Services	As needed, during storms	Primary	EPA 8015B
Laboratory analysis – Total suspended solids	Pace Analytical Services	As needed, during storms	Primary	SM2540D
Laboratory analysis – Water toxicity	UC Davis Granite Canyon Laboratory	Once per year in the dry season Once per year in the wet season	Primary	<u>*Ceriodaphnia dubia*</u> (7-day), *Chironomus dilutus* (10-day), *Hyalella azteca* (96-hour) *Chironomus dilutus* (10-day), *Hyalella azteca* (96-hour)

Parameter	Laboratory / Organization	Monitoring Frequency	Primary or Secondary	Method
Laboratory analysis – Sediment toxicity	UC Davis Granite Canyon Laboratory	Once per year in the dry season	Primary	*Chironomus dilutus* (10-day), *Hyalella azteca* (10-day)

6.3 Project schedule

All monitoring efforts are ongoing with the goal of tracking long-term trends and assessing project effectiveness. For each monitoring effort, the results are summarized in memos and reports. This monitoring is expected to continue, assuming adequate funding is available, beyond the conclusion of the current funding source. The monitoring program is supported by Clean Water Act (CWA) Section 320 funding. Data analysis and review is conducted at a minimum on an annual basis.

Table 6.3.1. Project schedule timeline

Activity	Date (MM/DD/YY)[4]		Deliverable	Deliverable Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Water quality	Winter 2024	Summer 2025	Annual data summary memos	None
Bioassessment	Spring 2024	Fall 2024	Annual data summary memo	None
Eelgrass, bay algae monitoring	Winter 2024	Summer 2024	Annual data summary report	None
Sedimentation: SETs, sediment traps, stream profiling	Summer 2024	Fall 2024	Annual data summary report	None
Bacteria	Winter 2024	Spring 2024	Monthly memo, Annual data summary memo[5]	None
Estuarine pH and nutrients	Winter 2024	Fall 2024	Brief report summarizing data	December 2024
Toxicity	Winter 2024	Fall 2024	Annual data summary memo	None

6.4 Geographical setting

The Morro Bay estuary is a 2,300-acre semi-enclosed body of water where freshwater flowing from land mixes with the saltwater of the sea. Morro Bay opens into Estero Bay. Morro Bay is fed by a 48,000-acre watershed containing two major creeks, Chorro and Los Osos. Figure 6.4.1 shows the location of the bay, its watershed and the major creeks.

[4] These initiation and completion dates are estimated target dates. The timing of these activities depends on numerous factors beyond our control including staffing availability, seasonal factors (i.e., how much rain we received and when), and others.

[5] A monthly memo is issued containing the results of the monthly monitoring as well as summary statistics. The focus of the memo is on data that exceeds the SWRCB Bacteria Provisions. We also compile an annual memo summarizing data for the past water year.

This section includes maps showing monitoring sites as follows:

- Figure 6.4.1. Location of Morro Bay Watershed and Tributaries
- Figure 6.4.2. MBNEP Flow Monitoring Locations
- Figure 6.4.3. MBNEP Creek and Bay Bacteria Monitoring Locations
- Figure 6.4.4. MBNEP Monthly Creek Water Quality Monitoring Locations
- Figure 6.4.5. MBNEP Creek Bimonthly Nutrient Monitoring Locations
- Figure 6.4.6. MBNEP Bay Dissolved Oxygen Dawn Patrol Monitoring Locations
- Figure 6.4.7. MBNEP Stream Profiling Monitoring Locations
- Figure 6.4.8. MBNEP Sediment Elevation Monitoring Locations
- Figure 6.4.9. MBNEP Bioassessment and Algae Monitoring Locations
- Figure 6.4.10. MBNEP Eelgrass – Permanent Transect Monitoring Locations
- Figure 6.4.11. MBNEP Eelgrass – Bed Condition Monitoring Locations
- Figure 6.4.12. MBNEP Toxicity Monitoring Locations
- Figure 6.4.13. MBNEP Bay Macroalgae and Biomass Monitoring Locations
- Figure 6.5.14. MBNEP Shorebird Monitoring Locations
- Figure 6.4.15. MBNEP Pressure Transducer Monitoring Locations
- Figure 6.4.16. MBNEP Continuous Temperature Monitoring Locations
- Figure 6.4.17. MBNEP Seeps Monitoring Locations
- Figure 6.4.18. MBNEP Stormwater Monitoring
- Figure 6.4.19. Cal Poly Continuous pH Monitoring
- Figure 6.4.20. Cal Poly Shoreline Nutrient Monitoring Locations

Note that coordinates for each monitoring site in the maps are listed in Appendix W.

Figure 6.4.1. Location of Morro Bay Watershed and Tributaries

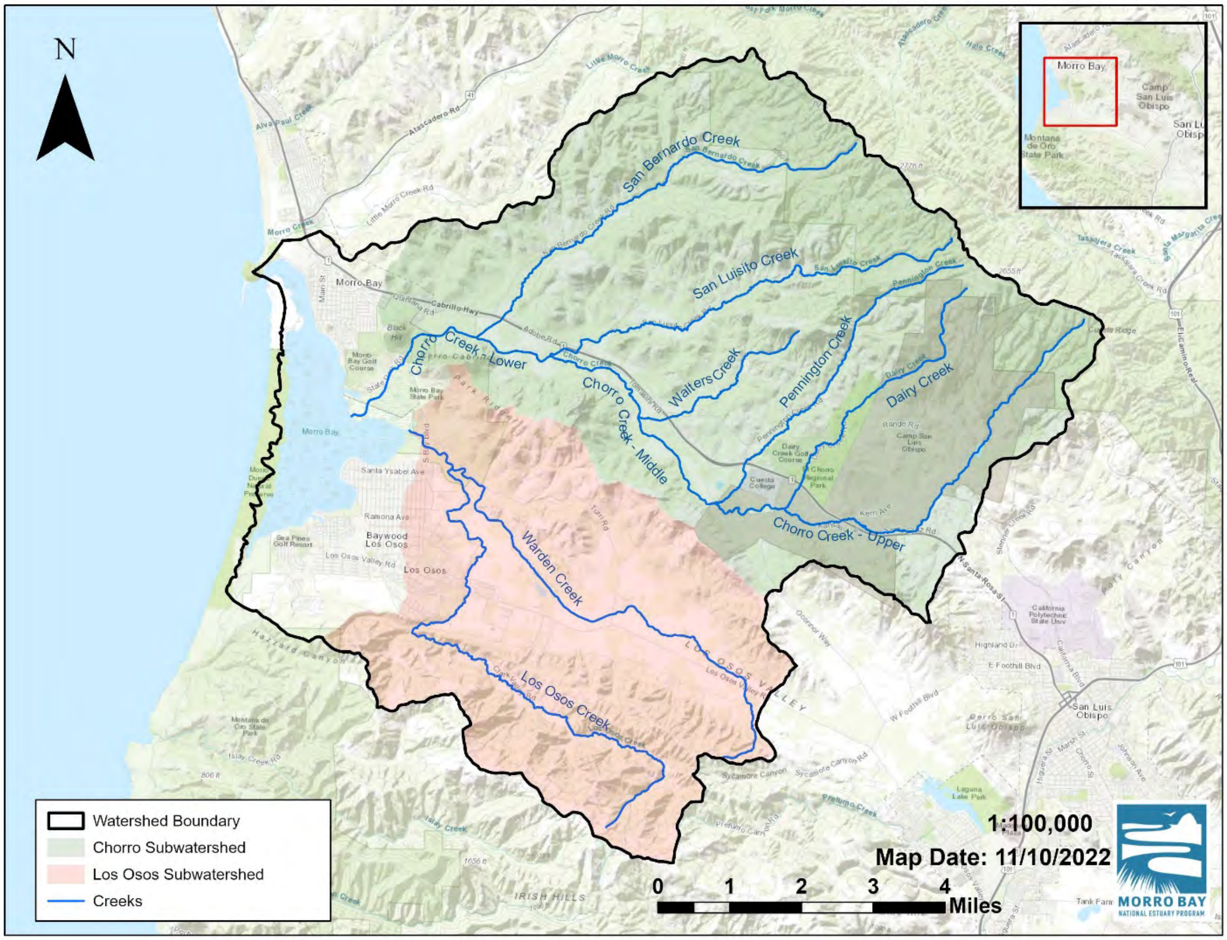


Figure 6.4.2. MBNEP Flow Monitoring Locations

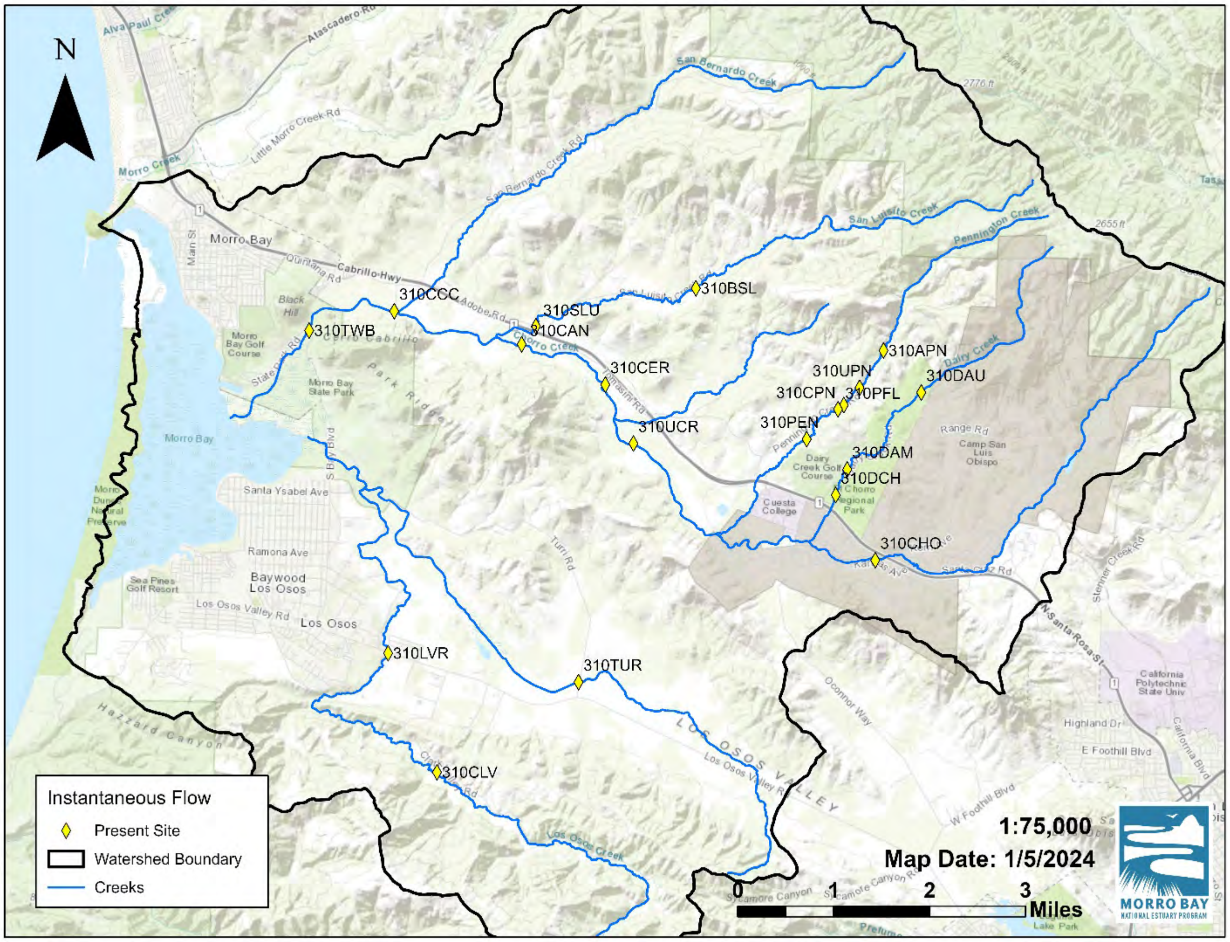


Figure 6.4.3. **MBNEP Creek and Bay Bacteria Monitoring Locations**

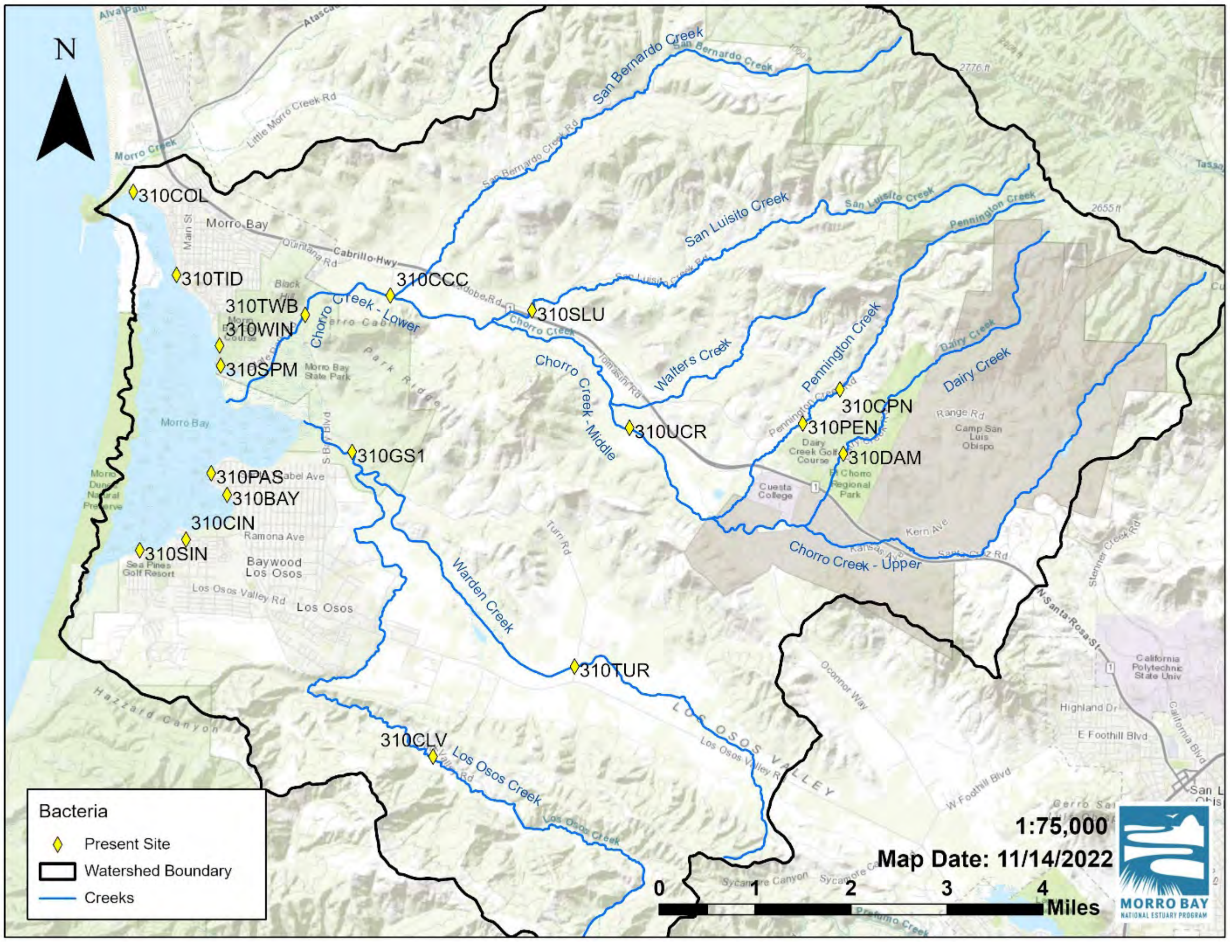


Figure 6.4.4. MBNEP Monthly Creek Water Quality Monitoring Locations

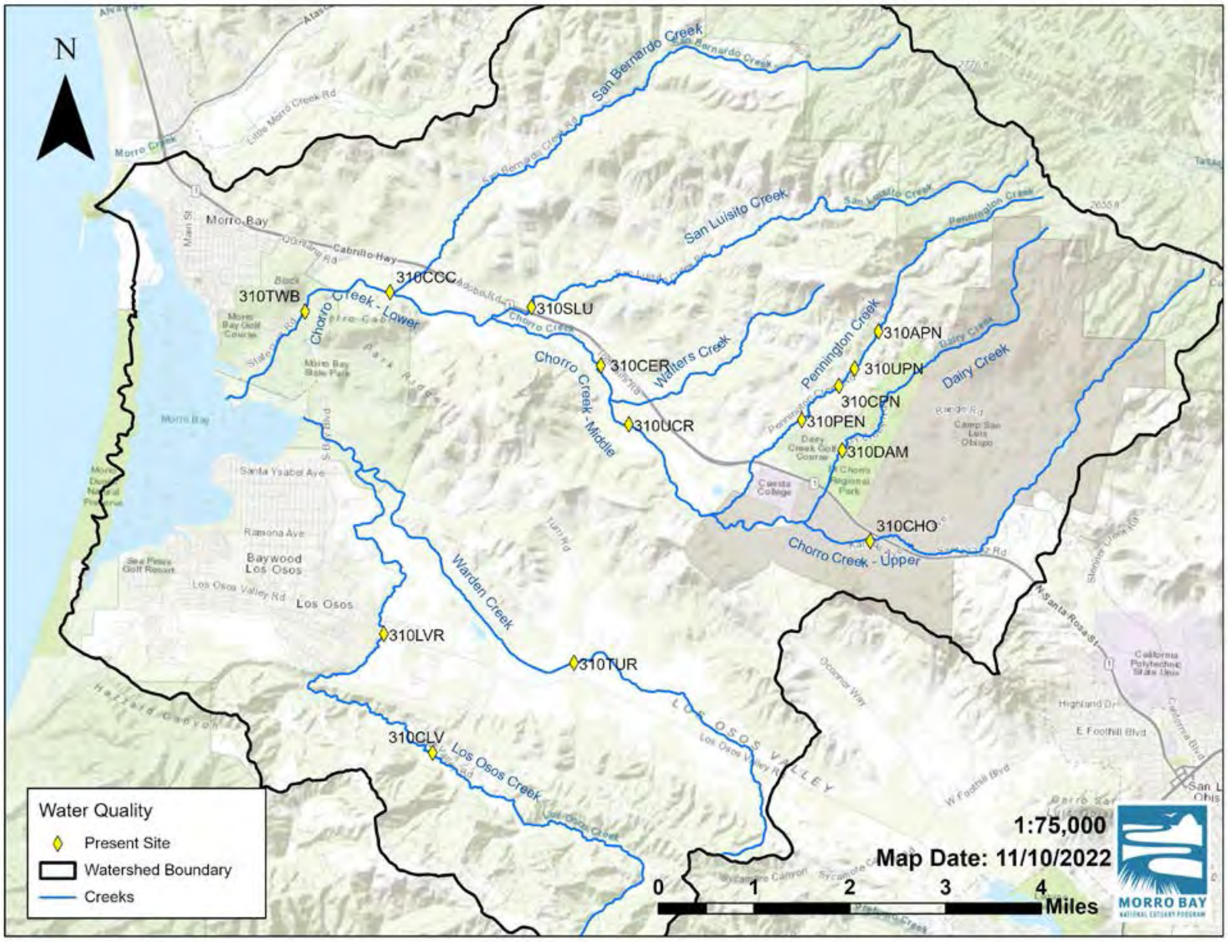


Figure 6.4.5. MBNEP Creek Bimonthly Nutrient Monitoring Locations

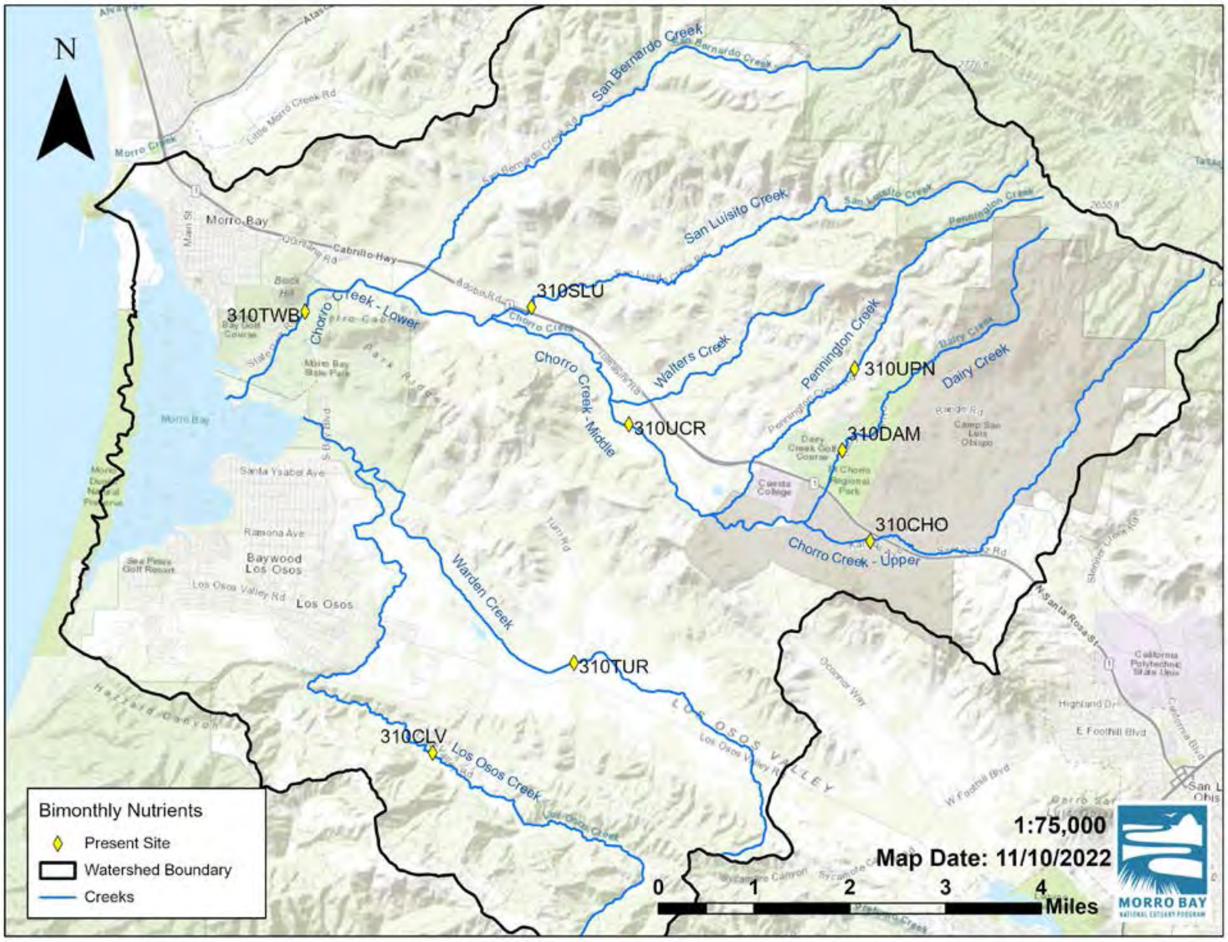


Figure 6.4.6. MBNEP Bay Dissolved Oxygen Dawn Patrol Monitoring Locations

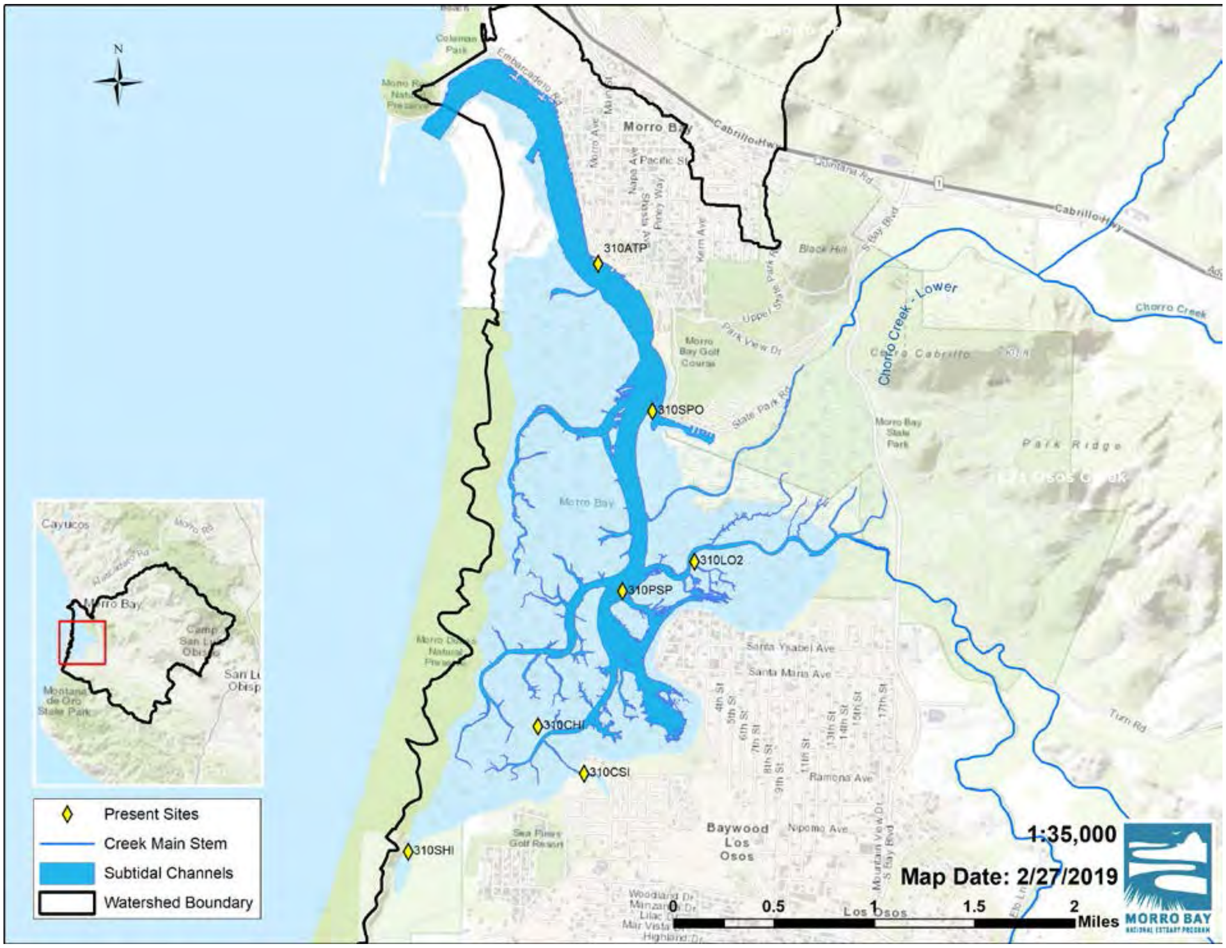


Figure 6.4.7. MBNEP Stream Profiling Monitoring Locations

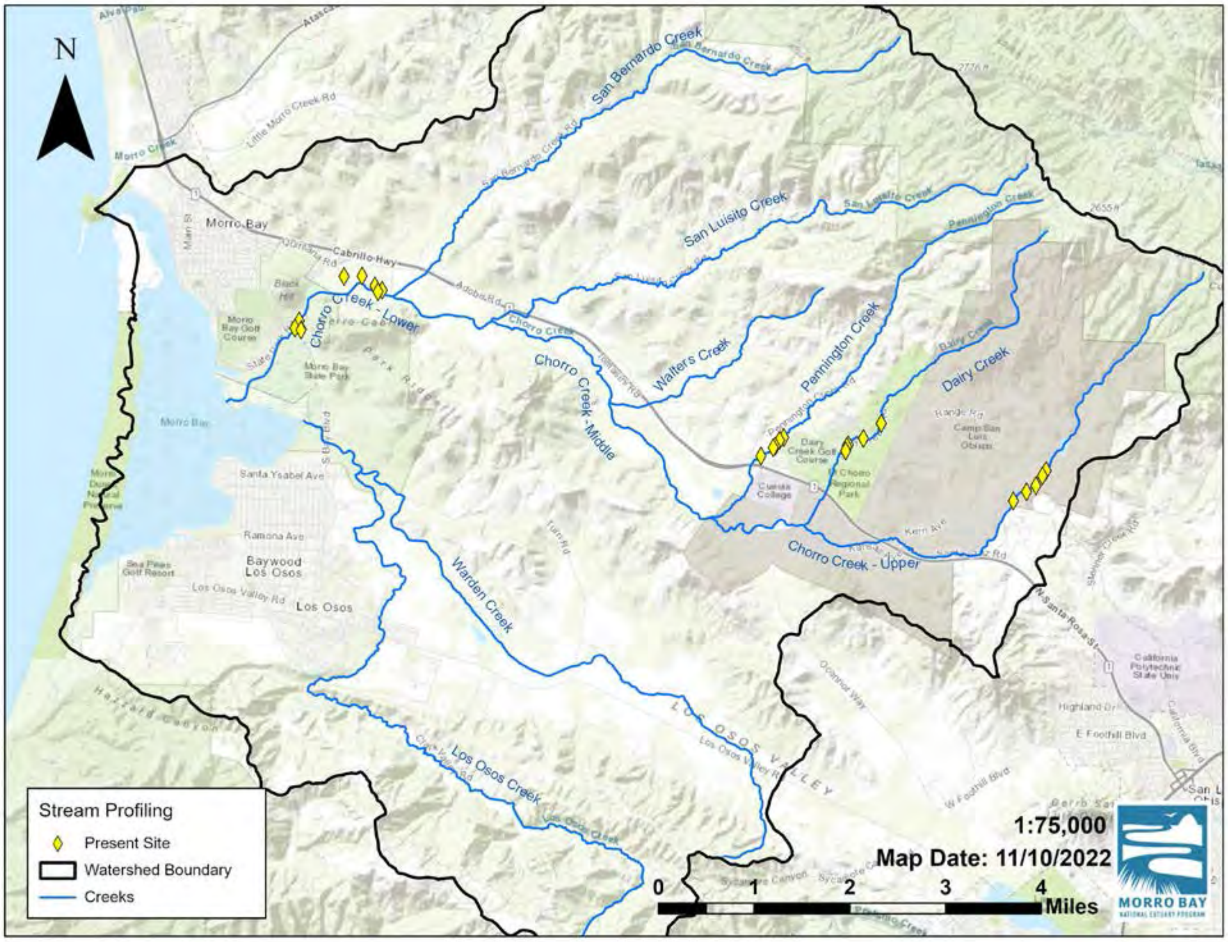


Figure 6.4.8. MBNEP Sediment Elevation Monitoring Locations

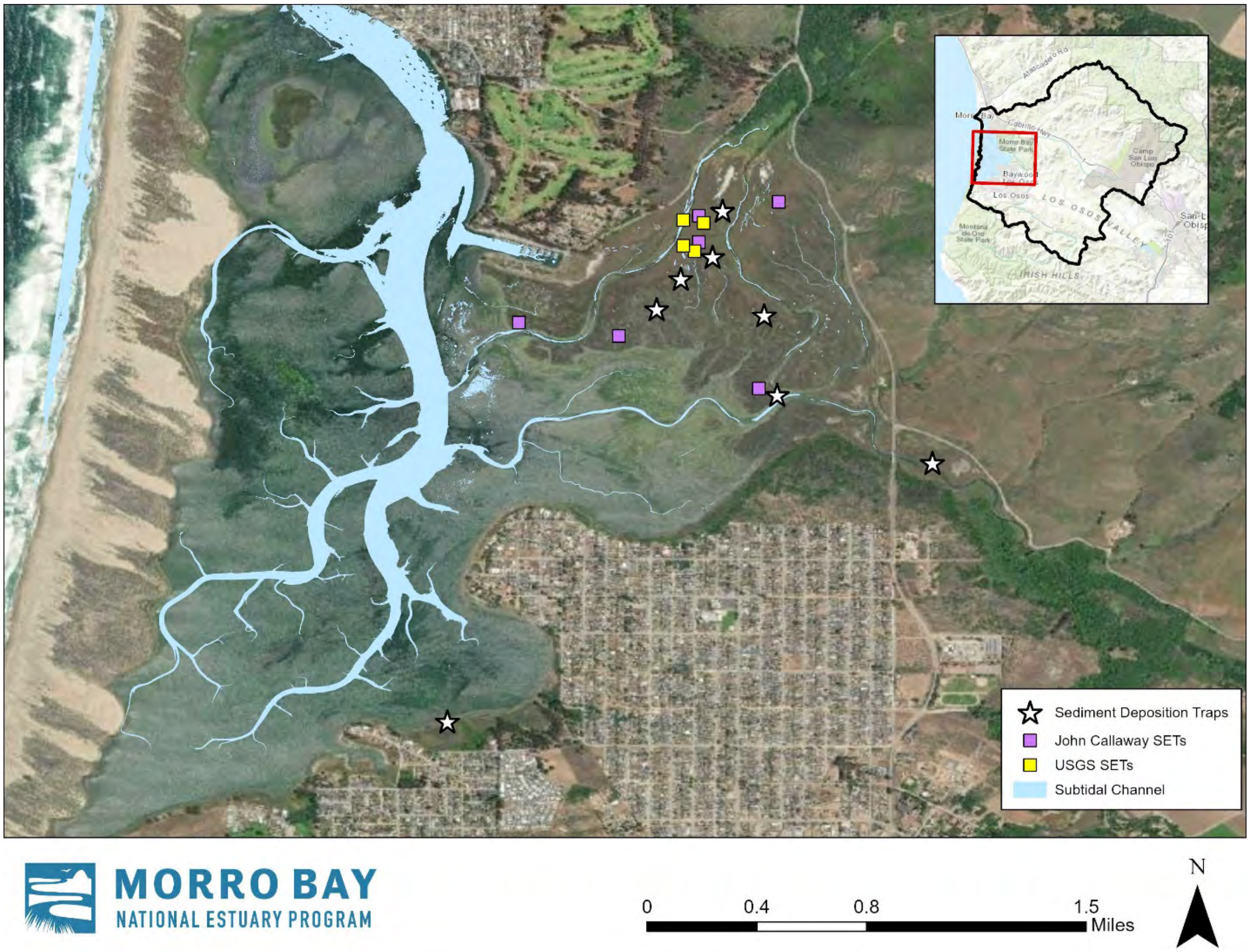


Figure 6.4.9. MBNEP Bioassessment and Algae Monitoring Locations

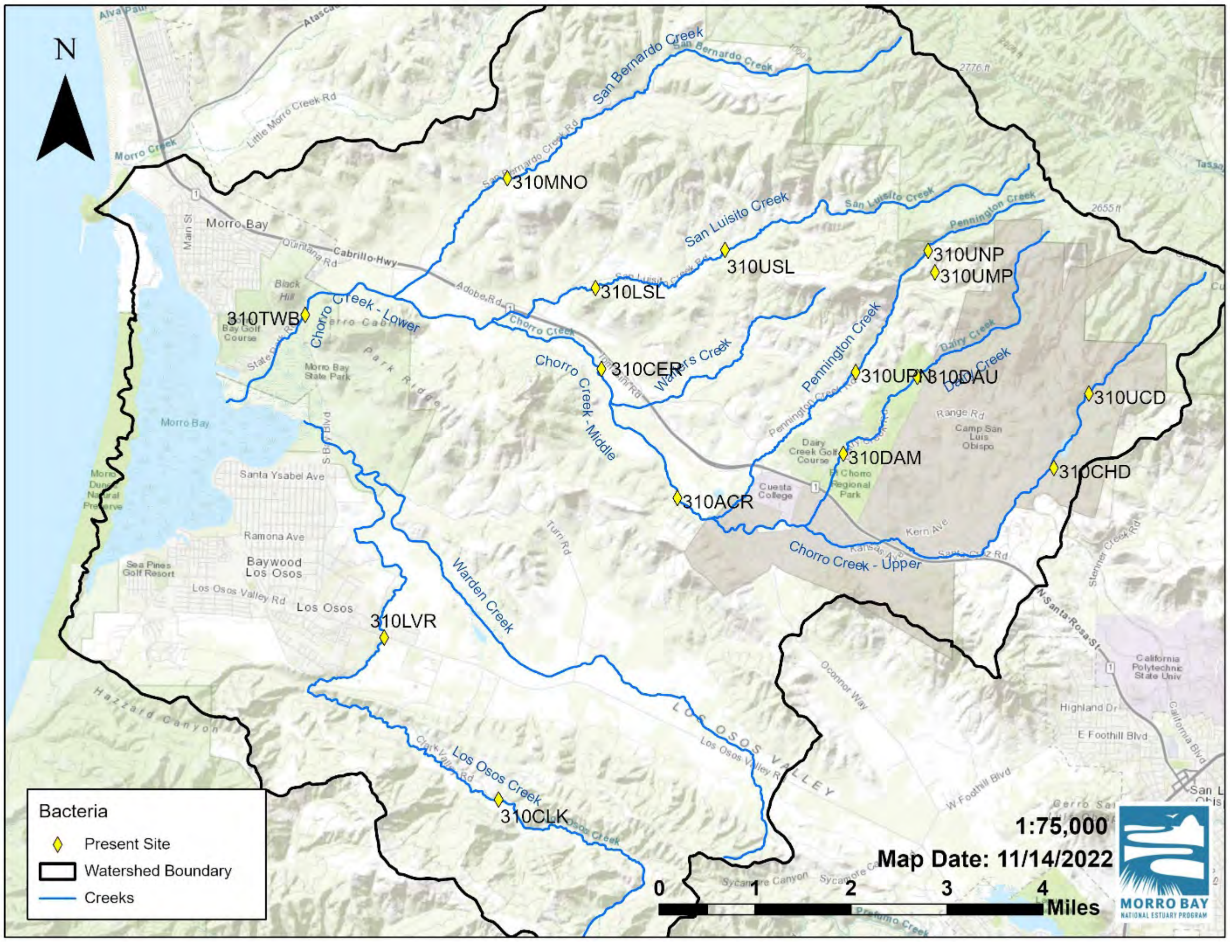


Figure 6.4.10. MBNEP Eelgrass - Permanent Transect Monitoring Locations

MORRO BAY NATIONAL ESTUARY PROGRAM

0 0.25 0.5 1 Miles

N

Figure 6.4.11. MBNEP Eelgrass - Bed Condition Monitoring Locations

Figure 6.4.12. MBNEP Toxicity Monitoring Locations

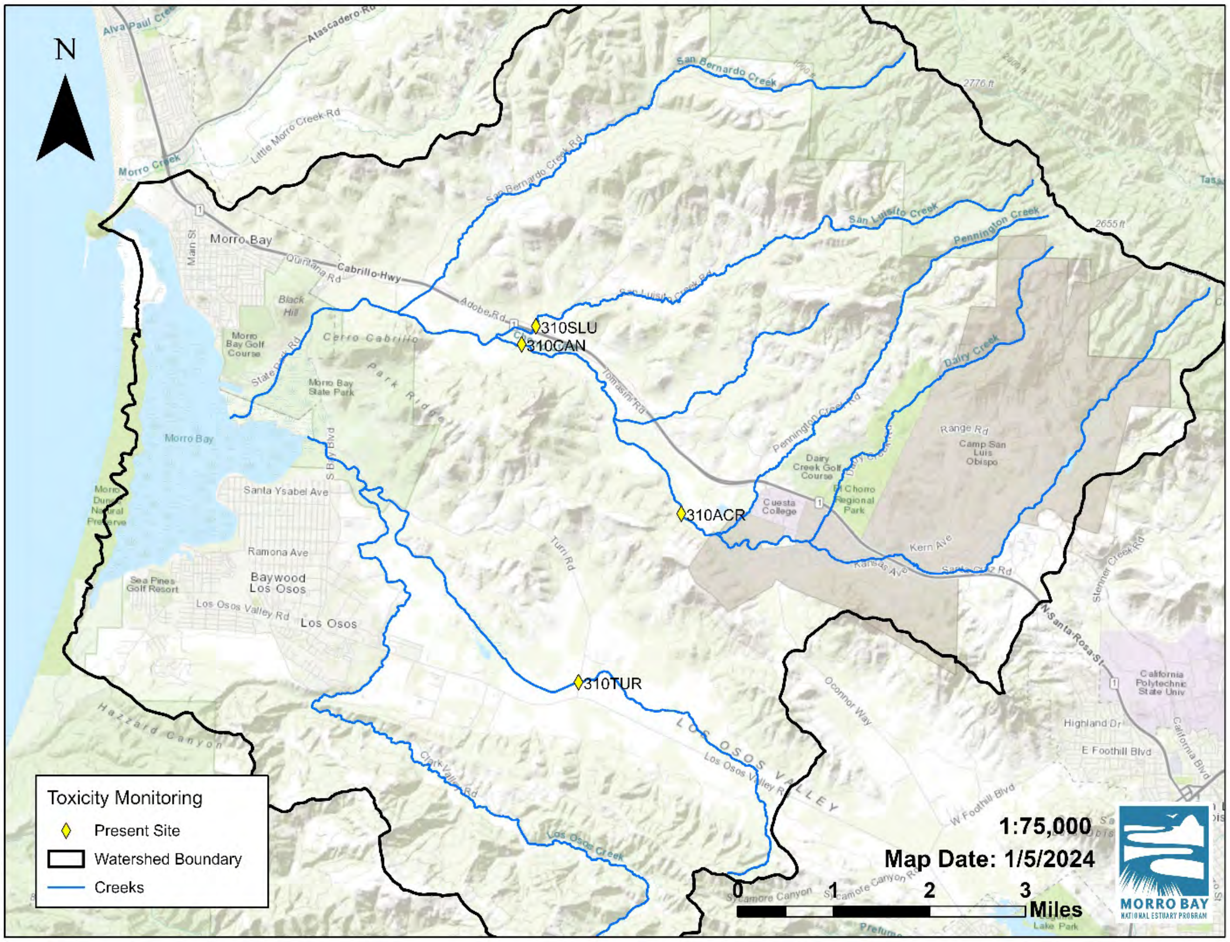


Figure 6.4.13. MBNEP Bay Macroalgae and Biomass Monitoring Locations

Figure 6.4.14. MBNEP Shorebird Monitoring Locations

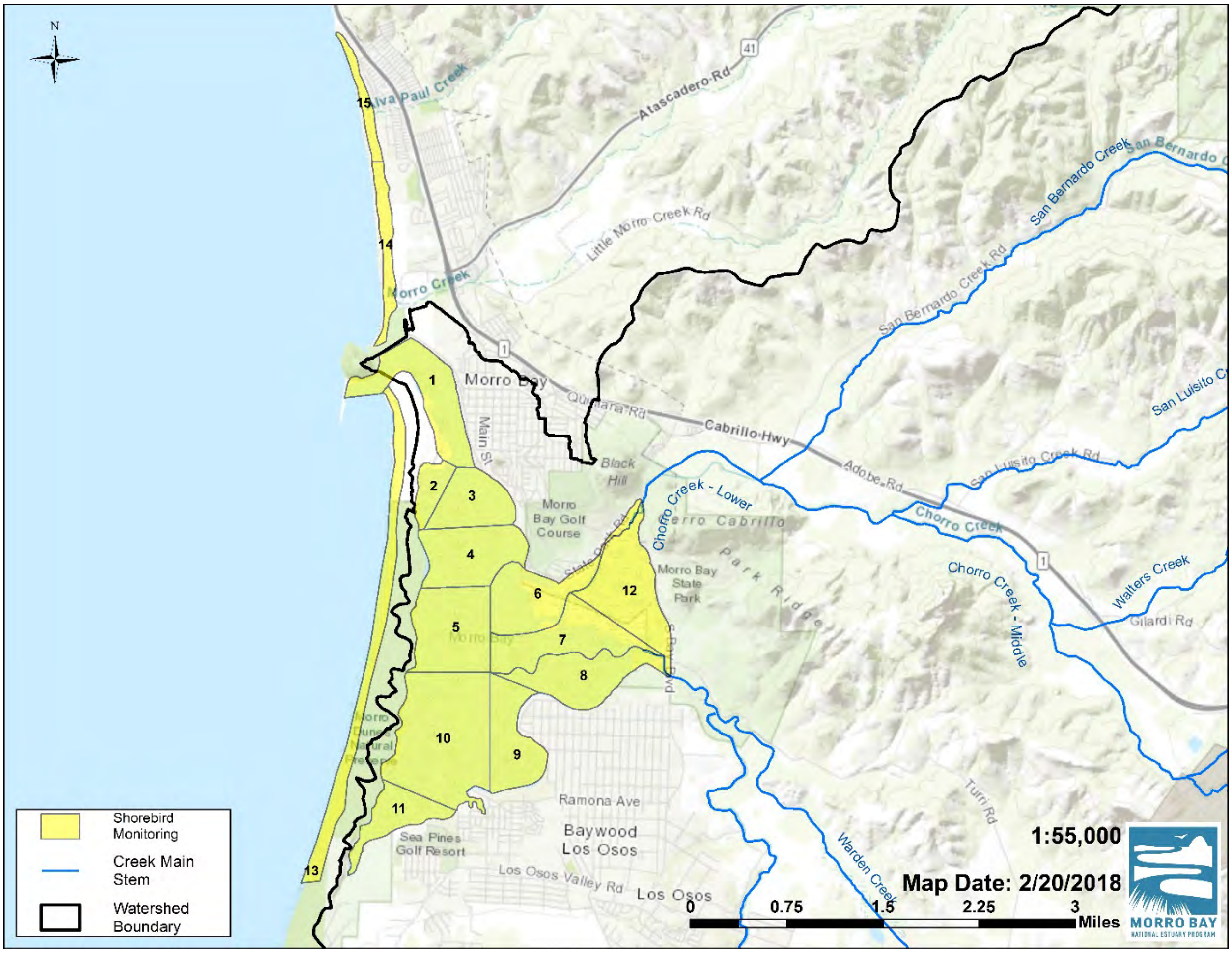


Figure 6.4.15. MBNEP Pressure Transducer Monitoring Locations

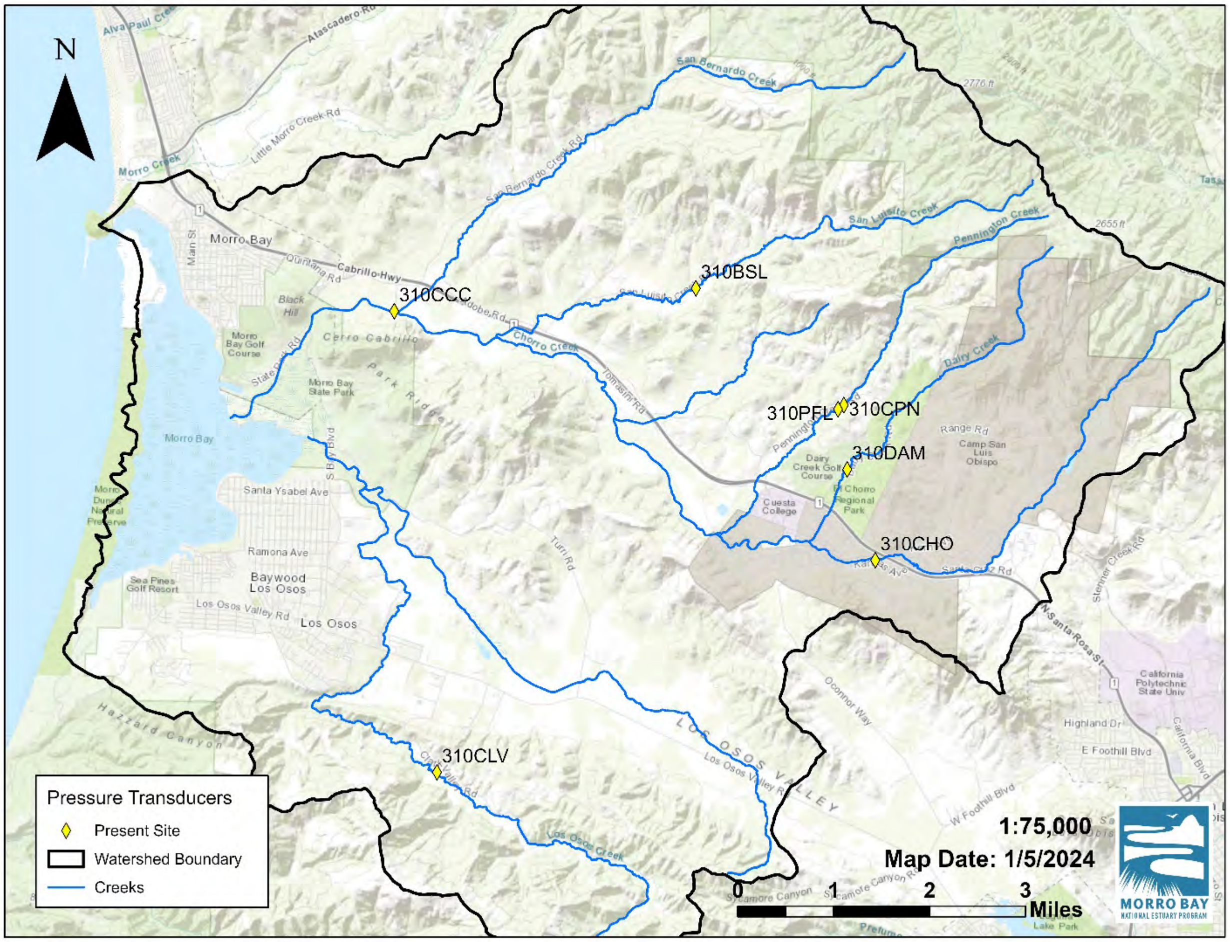


Figure 6.4.16. MBNEP Continuous Temperature Monitoring Locations

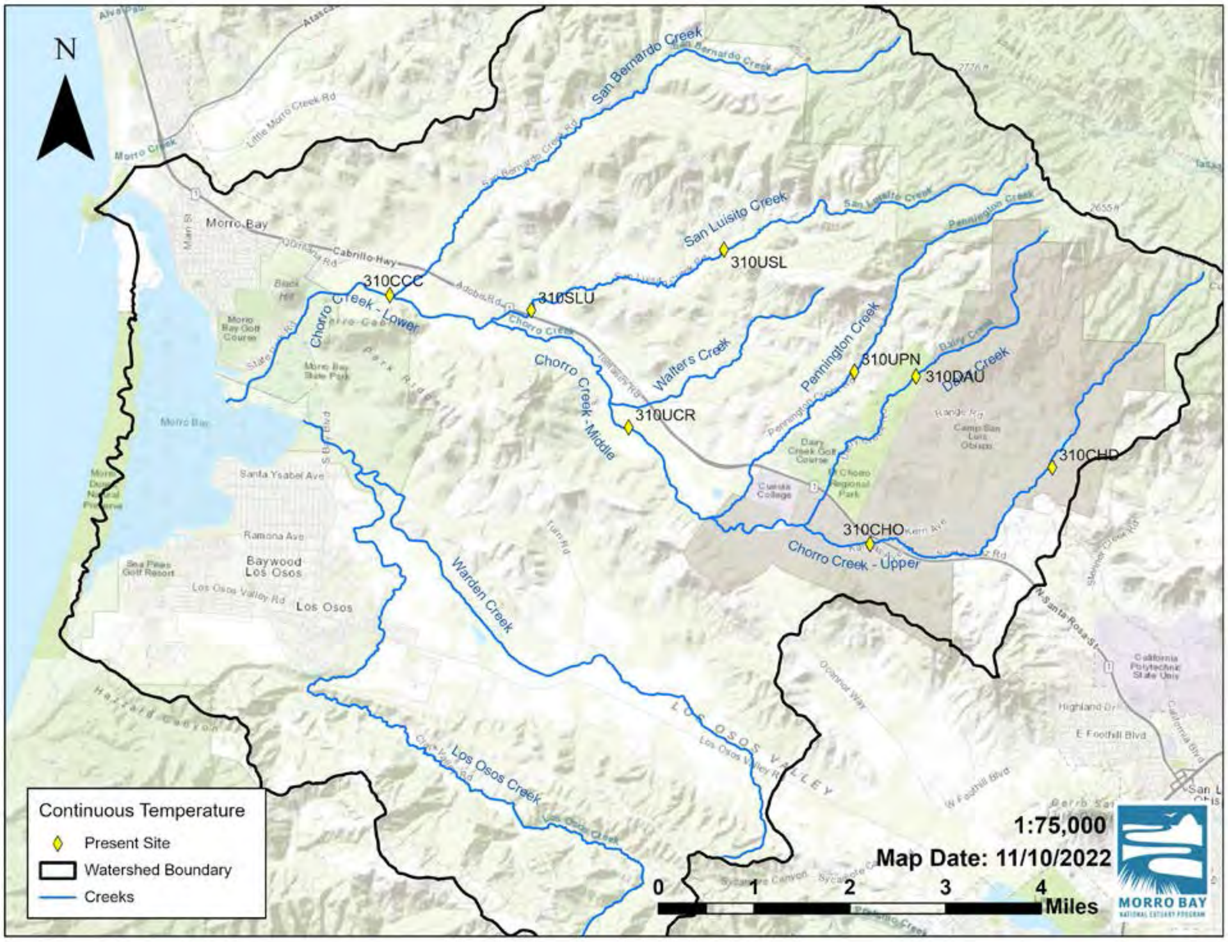


Figure 6.4.17. MBNEP Seeps Monitoring Locations

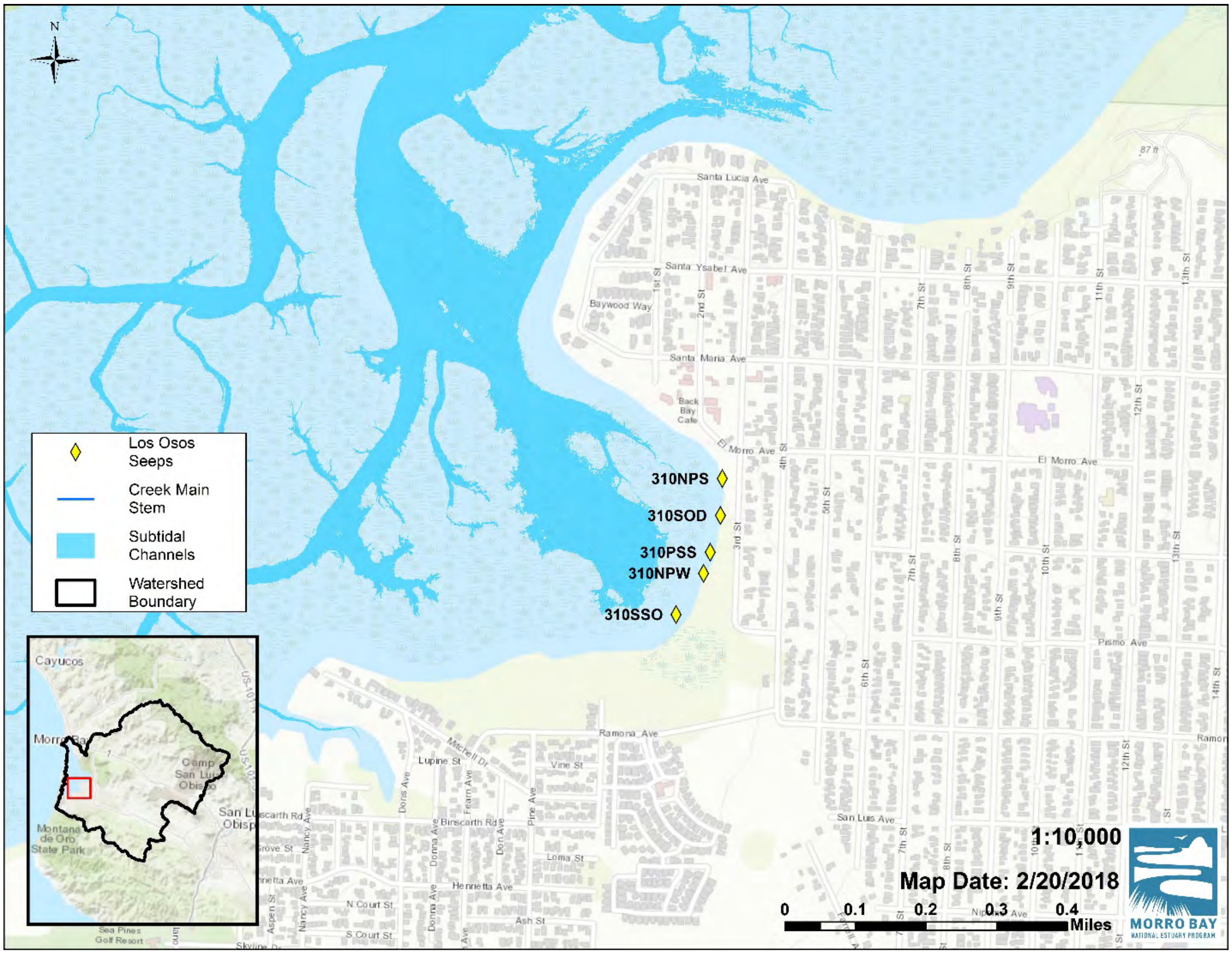


Figure 6.4.18. MBNEP Stormwater Monitoring

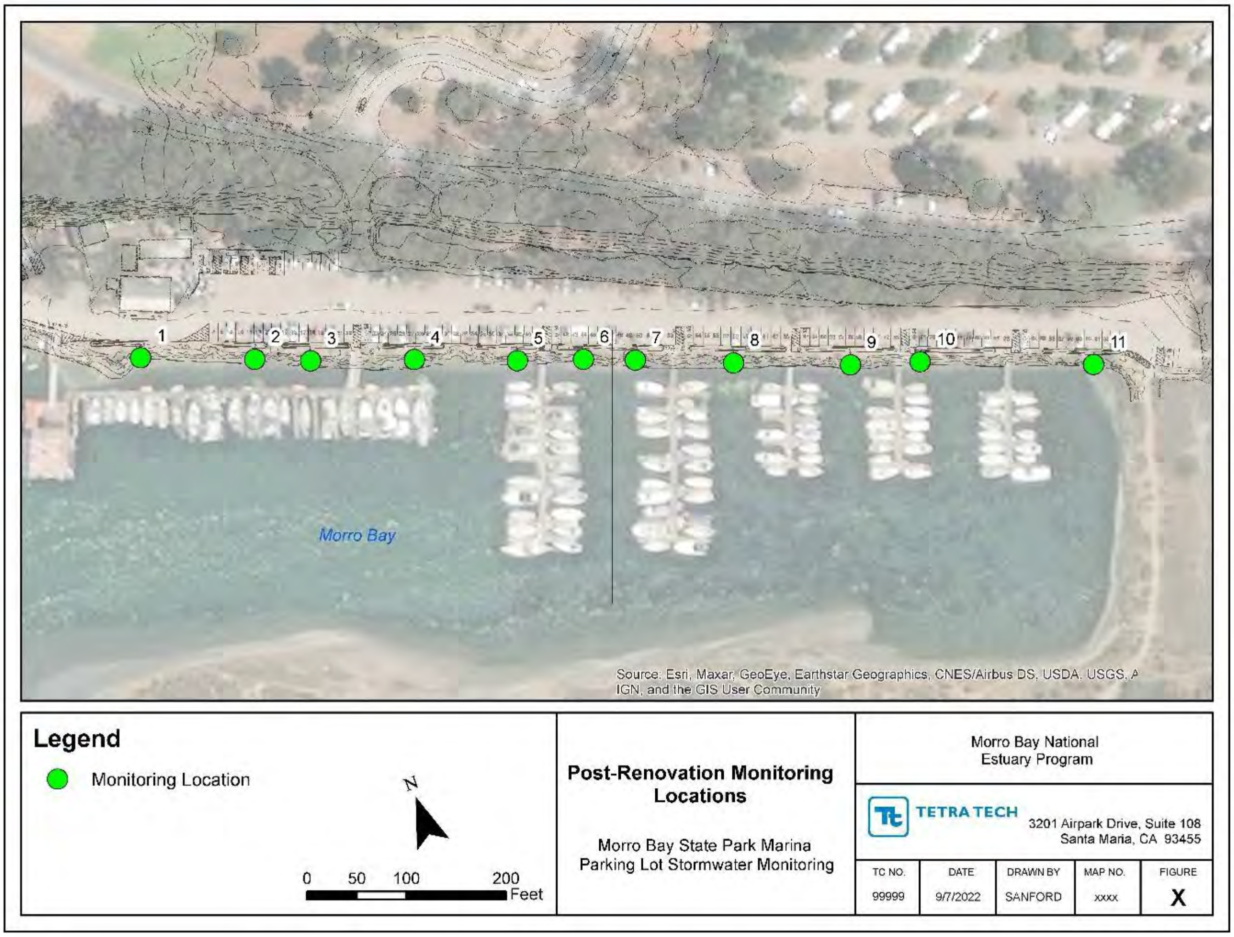


Figure 6.4.19. **Cal Poly Continuous pH Monitoring**

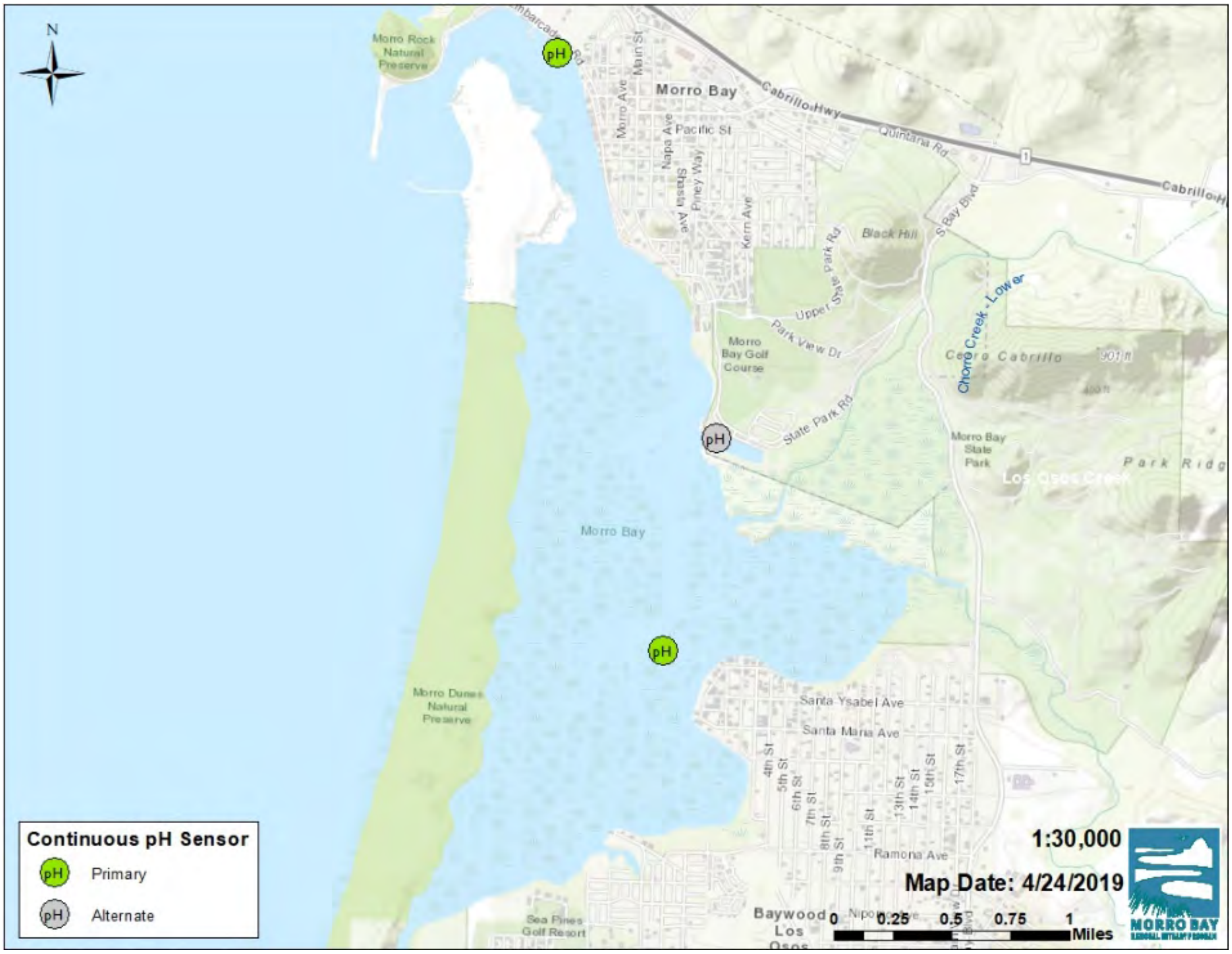


Figure 6.4.20. Cal Poly Shoreline Nutrient Monitoring Locations

6.5 Constraints

Low creek flow conditions can impact water quality, bacteria, flow and bioassessment monitoring. Lack of sediment of adequate grain size may be a limiting factor for sediment toxicity monitoring. For bay monitoring, tides must be high enough to avoid stranding in the soft mud. Possible constraints for monitoring include funding for SETs, sediment deposition traps, eelgrass mapping, bathymetry, toxicity, and macroinvertebrate monitoring, which involve costly consultants or laboratories. If funding is inadequate in the future, bay-wide aerial and sonar eelgrass maps, SETs, and detailed bioassessment sample analysis may not be conducted.

The timeline for creating the products listed in Table 6.2.1 are influenced by numerous factors, including organizational capacity, staff availability, the timing of rainfall, etc. If the proposed timelines in the table cannot be met, staff will assess capacity and reschedule the completion of these products.

7. Quality Objectives and Criteria for Measurement Data

Data Quality Objectives (DQOs) are essential because they set limits of allowable error to ensure that data are useable and support project goals. Data Quality Indicators (DQIs) are the quantitative statistics and qualitative descriptors used to interpret the degree of acceptability or utility of data to a user. Measurement Quality Objectives (MQOs) lay out the numeric targets associated with the DQIs that must be met in order to meet the project DQOs.

7.1 Data Quality Indicators

DQIs are the quantitative measures and qualitative descriptors used to set limits of acceptable levels of data error. The principal data quality indicators are representativeness, sensitivity, completeness, accuracy, precision, bias, and comparability.

Representativeness indicates how well the data represents environmental conditions. This is addressed through the overall sampling design. Sites were selected to maximize spatial variability and are typically located at the bottoms of tributaries. The sample schedule was designed to maximize representativeness by optimizing the sampling frequency and location. Often, data end users were involved in these decisions to ensure that the data generated would be adequate for their analytical needs.

Sensitivity for chemistry analysis is the lowest value an instrument or method can measure with reasonable statistical certainty. The contract laboratories selected for this project utilize analytical methods with laboratory-determined method detection limits (MDL) and reporting limits (RL) that meet the level of sensitivity required to meet the MQOs for this project.

Completeness is the percentage of data available for use versus the total amount of data collected. Data may be unavailable for use due to unavoidable circumstances such as laboratory error, samples lost or contaminated, etc. Because this monitoring program is a long-term program, any missed data at a specific site or time period can generally be collected during a later monitoring event. Completeness percentages were determined to help assess the effectiveness of this monitoring program and are provided in Tables 7.1.2 and 7.1.3.

Accuracy is the closeness of agreement between a measured value and the true value. For field quality assurance, various methods are employed to measure data accuracy. For water quality field measurements, accuracy is ensured through regular calibration of monitoring equipment. See Table 16.1.1 for more details. For orthophosphates and turbidity field measurements, a monthly QA sample is collected at the time measurements are taken and sent to a contract laboratory as an accuracy check. Blanks are run monthly. Samples submitted to the contract laboratory for analysis are run for a spiked lab control sample, matrix spikes, matrix spike duplicates, blanks, and laboratory control samples. For bacteria analysis both internally and by contract laboratories, blanks and certified reference materials are run to ensure accuracy. Each year the MBNEP submits blank blind samples to the contract laboratories for analysis. Accuracy checks are conducted for 10% of the project's total samples, and each must have a relative percent difference (RPD) less than 25%.

The precision of a measurement describes how close the agreement is between multiple measurements. For field measurements, duplicate measurements are collected monthly and reviewed to ensure that they meet the MQOs. Analytical laboratories conduct duplicate and matrix spike duplicate analysis to ensure precision. Duplicates are run for 10% of the project's total samples, and each must have an RPD less than 25%. At least one laboratory duplicate per analytical batch (defined as 20 samples or less) is required. The RPD between the two replicate samples will be less than the MQOs defined in the QAPP. For bacteria replicates analysis, a single sample is collected in the field, mixed, and split into two samples for analysis. For the analysis method, the duplicate sample MPN must be within the 95% confidence interval. Each month, an analyst runs both portions of a split sample. To meet the precision criteria, the results must be within the 95% confidence interval criteria. Each year the MBNEP submits split samples blind to the contract laboratories for analysis.

Bias is a systemic error that can cause measurements to be skewed in one direction or the other. Bias can be unintentionally introduced through improper timing, reach selection, sample contamination, and site selection. These biases are controlled by ensuring field staff and volunteers are trained in proper site selection. Field blanks are also used to measure any contamination introduced during the process. QA samples are randomly distributed among all sites and samplers throughout the year to identify and eliminate bias.

Comparability is the measure of confidence that a dataset can be compared to and combined with another for decision-making purposes. MBNEP site selection and sampling design were developed in conjunction with the CCRWQCB and other local experts to ensure data comparability over the years.

Table 7.1.1 details the activities undertaken to ensure data quality, both for field and lab activities, as described generally above.

Table 7.1.1. Data quality indicators

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[6]
Field	Bacteria (sample collection in the field)	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly throughout the year, which was determined to be an adequate level of	Yes. Training in field techniques minimizes bias.	Yes. Monthly, a volunteer or staff member analyzes a split sample for comparison to precision criteria.	NA	Yes. See Table 7.1.3.	NA

[6] All analytical methods were selected to ensure that the results were of adequate sensitivity for comparison to the screening levels for monitoring data laid out in Table 5.3.1.

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[6]
		seasonality. End users of the data determined this frequency to be adequate for statistical analysis.					
Laboratory	Bacteria (sample analysis in the lab)	NA	Yes. Training in lab techniques minimizes bias.	Yes. Monthly, a volunteer or staff member analyzes a split sample for comparison to precision criteria.	Yes. Certified reference material.	Yes. See Table 7.1.3.	NA
Field	Water quality	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	NA	Yes. Monthly replicate readings taken for all meters and kits.	Yes. Pre and post-calibration of equipment.	Yes. See Table 7.1.2.	NA
Field	Water quality (Continuous Monitoring)	Yes. Monitoring sites were selected in areas where changes due to project implementation were of interest. All monitoring takes place monthly throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	NA	Yes. Side-by-side deployment of two units.	Yes. Pre and post-calibration of equipment with each deployment event.	Yes. See Table 7.1.2.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[6]
Laboratory	Water quality	NA	Yes. See Table 14.1.2.	Yes. See Table 7.1.3.	Yes. See Table 7.1.3.	Yes. See Table 7.1.3.	Yes. See Table 7.1.3.
Field	Flow	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	Yes. Training in field techniques minimizes bias.	Duplicate velocity measurements are collected at multiple points in the transect once a month.	NA	Yes. See Table 7.1.2.	NA
Field	Water depth	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place continuously throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	Yes. Advice and review by experts minimize bias. Comparison of water depth data with flow measurement.	Duplicate depth measurements are collected at multiple points in the transect once a month.	NA	NA	NA
Field	Continuous bay pH	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place continuously throughout the year to provide an adequate level of seasonality.	Yes. Advice and review by experts minimize bias.	<0.001 pH units	Yes. Collect a discrete sample for comparison. +/- 0.05 pH units	Yes. See Table 7.1.2.	NA
Field	Stream Profiling	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place approximately	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[6]
		every five years, during the dry season. It was determined to be an adequate frequency for statistical analysis.					
Field	SETs	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place periodically during the dry season. It was determined to be an adequate frequency.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Sediment deposition traps	Yes. Monitoring sites were selected to maximize spatial variability. Traps are deployed for three months during the winter and summer seasons. It was determined to be an adequate frequency.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Macroinverteb rates	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually each spring. This frequency provides an adequate level of seasonality. It was determined to be an adequate frequency for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.3.	NA
Laborat ory	Macroinverteb rates	NA	NA	Yes. Lab re-sorts 100% of all samples and 10% of the samples are re-identified by a	Yes. Lab re-sorts 100% of all samples and 10% of the samples are re-identified	Yes. See Table 7.1.3.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[6]
				second taxonomist.	by a second taxonomist.		
Field	Eelgrass mapping	Yes. Monitoring sites were selected to maximize spatial variability. Transect monitoring takes place annually each fall. Aerial mapping takes place biennially. This frequency provides an adequate level of seasonality. It is unknown if/when sonar mapping would be repeated.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Eelgrass monitoring	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place seasonally.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Bay Macroalgae Monitoring	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place biannually.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Laboratory	Bay Macroalgae Biomass (dry weights)	NA	NA	Yes. Replicate weights are taken. Results must be within +/- 1 mg.	Yes.	Yes. See Table 7.1.3.	NA
Field	Baywide Bathymetry	Decadal frequency was determined to be appropriate.	NA	NA	One cross line will be required within the survey. Position accuracy and classification accuracy will be verified.	NA	NA
Field	Algae (freshwater)	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes	Yes. Training in field techniques	NA	NA	Yes. See Table 7.1.2.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[6]
		place annually during bioassessment, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	minimizes bias.				
Field	Shorebird surveys	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually each fall. This frequency provides an adequate level of seasonality. It was determined to be an adequate frequency for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Laborat ory	Stormwater Monitoring	Yes. Monitoring sites were selected to cover the largest possible drainage area and includes outflows that are activated at varying rain intensities and depths.	Yes. Training in field techniques minimizes bias.	Yes. See table 7.1.3	Yes. See table 7.1.3	Yes. See table 7.1.3	Yes. See table 7.1.3
Field	Water toxicity	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place once during the dry season and once during the wet season.	Yes. Training in field techniques minimizes bias.	NA	NA	NA	NA
Field	Sediment toxicity	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place annually during the dry season.	Yes. Training in field techniques minimizes bias.	NA	NA	NA	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[6]
Laboratory	Water toxicity, sediment toxicity	NA	Yes. See SPoT QAPP (SWRCB, 2023).	Yes. See SPoT QAPP, (SWRCB, 2023).	Yes. See SPoT QAPP (SWRCB, 2023).	Yes. See SPoT QAPP (SWRCB, 2023).	Yes. See SPoT QAPP (SWRCB, 2023).

See Table 7.1.2 and 7.1.3 for descriptions of how each measurement quality objective will be determined.

Table 7.1.2. Measurement quality objectives for field measurements

Group	Parameter	Accuracy	Precision[7]	Target Reporting Limit	Completeness
Water quality	Dissolved oxygen (discrete) Dissolved oxygen (continuous)	± 0.2 mg/L ± 0.1 mg/L	± 0.75 mg/L or 25% ± 0.75 mg/L or 25%	0.01 mg/L 0.01 mg/L	90% 90%
Water quality	Temperature (discrete, continuous)	± 0.1°C	± 0.5 °C or 25%	0.1 °C	90%
Water quality	Conductivity (discrete, continuous)	± 1% of range	± 5 or 25%	0.1 uS for high range meter	90%
Water quality	pH (discrete, continuous)	± 0.05 pH units	< 0.001 pH units	0.0001 pH units	90%
Water quality	Turbidity	See below[8].	See below[8].	0.01 NTU	90%
Water quality	Orthophosphate as PO_4	± 25%	± 25%	0.33 mg/L	90%
Flow	Flow (cubic feet per second)	± 0.25 ft^3/sec	± 25%	NA	90%
Water quality	Chlorophyll (discrete, continuous)	± 0.1 µg/L of pigment	25%	0.1 µg/L	90%

[7] The precision criteria will be based on whichever value is greater.

[8] The acceptable difference between the two readings for turbidity are for ≤ 5 NTU (± 2 NTU), for ≤ 25 NTU (± 5 NTU), for ≤ 100 NTU (± 20 NTU), for ≤ 500 NTU (± 50 NTU), for ≤ 1,000 NTU (± 100 NTU), for ≤ 10,000 NTU (± 200 NTU), for ≤ 100,000 NTU (± 300 NTU).

Group	Parameter	Accuracy	Precision[7]	Target Reporting Limit	Completeness
Stream profiling	Elevation along profile	± 0.05 ft	NA	NA	90%
Water depth	Water depth	± 0.1% full scale	NA	NA	90%
SETs	Elevation change	± 1.5 mm	NA	NA	90%
Sediment deposition traps	Surface deposition	± 1 mg	NA	NA	90%
Eelgrass	Shoot density, blade length etc.	NA	NA	NA	90%
Algae documenting	Photo documenting	NA	NA	NA	90%
Shorebirds	Bird counts	NA	NA	NA	90%

Table 7.1.3. Measurement quality objectives for laboratory measurements

Group	Parameter	Laboratory / Organization	Accuracy[9]	Precision	Recovery[10]	Target Reporting Limits	Complete-ness
Bacteria	*E. coli*	MBNEP	Within range of CRM	Replicate must be within the 95% confidence interval.	NA	2 MPN/100 mL	90%
Bacteria	Entero-coccus	MBNEP	Within range of CRM	Replicate must be within the 95% confidence interval.	NA	2 MPN/100 mL	90%
Water	Nitrates as	Fruit Growers	90 - 110%	± 7%	90-110%	0.10 mg/L	90%

[9] Accuracy is measured by comparing the measured value to the true value. Accuracy is assessed with a matrix spike and matrix spike duplicate, using a known amount of a certified reference material (CRM). Accuracy is calculated within established limits.

[10] Recovery is measured by comparing the measured value to an expected value. Recovery is assessed with a blank spike and a blank spike duplicate, using a known amount of CRM. Recovery is calculated within established limits.

Group	Parameter	Laboratory / Organization	Accuracy[9]	Precision	Recovery[10]	Target Reporting Limits	Complete-ness
quality	N	Laboratory					
Water quality	Ortho-phosphate as P	Fruit Growers Laboratory	90-110%	+8%	90-110%	0.1 mg/L	90%
Water quality - Ag Monitoring	Ammonia-Nitrogen	Fruit Growers Laboratory	90 - 110%	+ 20%	90 - 110%	0.2 mg/L	90%
Water quality - Ag Monitoring	Total Kjeldahl Nitrogen	Fruit Growers Laboratory	90 - 110%	+ 20%	90 - 110%	0.50 mg/L	80%
Water quality - Ag Monitoring	Nitrite as N	Fruit Growers Laboratory	90 - 110%	+ 8%	90 - 110%	0.1 mg/L	90%
Water quality - Ag Monitoring	Total Phosphorus	Fruit Growers Laboratory	85 - 115%	+ 20%	85 – 115%	0.1 mg/L	80%
Water quality - Ag Monitoring	Total Suspended Solids	Fruit Growers Laboratory	60-109%	+ 20%	60-109%	1 mg/L	90%
Water quality	Turbidity	Fruit Growers Laboratory	NA	+ 10%	NA	0.1 NTU	90%
Bioassessment	Benthic invertebrates	EcoAnalysts Inc.	≤ 10% difference in sorting efficacy, differences in identification discussed between taxonomists until agreement is reached.	≤ 10% difference in sorting efficacy, differences in identification discussed between taxonomists until agreement is reached.	NA	NA	80%
Stormwater Monitoring	Oil & Grease	Pace Analytical Services	78 – 114%	+ 18%	78 – 114%	75 mg/L	80%

Group	Parameter	Laboratory / Organization	Accuracy[9]	Precision	Recovery[10]	Target Reporting Limits	Complete -ness
Stormwater Monitoring	Dissolved Copper	Pace Analytical Services	70-130%	± 20%	85-115%	0.01 mg/L	85%
Stormwater Monitoring	Dissolved Lead	Pace Analytical Services	70-130%	± 20%	85-115%	0.01 mg/L	85%
Stormwater Monitoring	Dissolved Zinc	Pace Analytical Services	70-130%	± 20%	85-115%	0.02 mg/L	85%
Stormwater Monitoring	Total Petroleum Hydrocarbons (TPH)-Gasoline	Pace Analytical Services	70-130%	± 20%	85-115%	NA	80%
Stormwater Monitoring	Total Petroleum Hydrocarbons (TPH)-Diesel	Pace Analytical Services	50-127%	± 24%	52-128%	NA	70%
Stormwater Monitoring	Total Suspended Solids	Pace Analytical Services	NA	± 10%	NA	NA	90%
Bay Nutrient Sampling (shoreline locations)	Nitrate + Nitrite	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	2.8 µg/L	90%
Bay Nutrient Sampling (shoreline locations)	Nitrite	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	1.4 µg/L	90%
Bay Nutrient Sampling (shoreline locations)	Phosphate	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	3.1 µg/L	90%

Group	Parameter	Laboratory / Organization	Accuracy[9]	Precision	Recovery[10]	Target Reporting Limits	Complete -ness
Bay Nutrient Sampling (shoreline locations)	Silicic Acid	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	28 µg/L	90%
Bay Nutrient Sampling (shoreline locations)	Ammonium	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	2.8 µg/L	90%
Toxicity	Water toxicity	UC Davis Granite Canyon Lab	NA	At least 5% of the total count. Each must have a RPD of <30%. One duplicate per batch of 20 samples.	NA	NA	90%
Toxicity	Sediment toxicity	UC Davis Granite Canyon Lab	NA	At least 5% of the total count. Each must have a RPD of <30%. One duplicate per batch of 20 samples.	NA	NA	90%

8. SPECIAL TRAINING NEEDS/CERTIFICATION

8.1 Specialized training or certifications

Training prepares program volunteers and staff for MBNEP monitoring efforts. Training is required for new staff and volunteers and is offered throughout the year on an as-needed basis. All trainees receive information on field equipment and safety. After training, volunteers will "shadow" a qualified volunteer monitor in that given protocol. Shadowing is defined as performing the given protocol, but with supervision to remind the trainee of safety and quality assurance guidelines. Bioassessment monitoring requires specialized training provided by the California Department of Fish and Wildlife Aquatic Bioassessment Laboratory (ABL) or CCRWQCB staff. Due to the infrequency of training opportunities, MBNEP staff attend bioassessment trainings whenever they are offered.

The MBNEP QA Officer is responsible for overseeing training of all MBNEP staff and volunteers. Volunteers are trained by MBNEP staff under supervision of the QA Officer.

Laboratory accreditation from the State Water Board's Environmental Lab Accreditation Program (ELAP) is not required because MBNEP data is not utilized for compliance assessment. However, to ensure data of known and documented quality, all laboratories are appropriately accredited. The water quality laboratories are ELAP certified or provide adequate information to assess lab performance and data quality. The bioassessment lab meets the certification requirements for taxonomy work.

Following is a brief discussion of training pertinent to each monitoring task. Staff and volunteer monitors will carry out all protocols in the field, except bacteriological and nutrient testing.

Water Quality Monitoring Training:

This training, conducted by MBNEP staff, emphasizes quality data collection and field safety protocols. Training includes instruction on how to properly operate field meters which collect temperature, dissolved oxygen, conductivity/salinity, and pH (freshwater meters only). Water quality training is split into estuarine and freshwater monitoring training. Volunteers for freshwater monitoring receive additional training by MBNEP staff that demonstrate the use of the flow meter and emphasize water safety precautions. Documentation of training attendees is recorded and maintained in a training log.

Continuous monitoring water quality meters and continuous water depth equipment are deployed by MBNEP staff. New staff receive training from MBNEP staff per the monitoring protocol. Estuarine pH sensors are deployed by Cal Poly staff, who handle all staff training per the monitoring protocol.

Bimonthly nutrient monitoring, Agricultural monitoring, seeps monitoring, and toxicity monitoring are carried out by MBNEP staff. New staff receive training from MBNEP staff per monitoring protocols (see Appendix).

Bioassessment and Algae Monitoring Training:

MBNEP staff train program volunteers in the techniques for collection of bioassessment samples. All samples are analyzed by a laboratory, and thus sample identification is not emphasized. All monitoring is conducted under the direct guidance of a MBNEP staff member. MBNEP staff receive training from CCRWQCB or California Department of Fish & Wildlife staff. Documentation of training attendees will be recorded and maintained in a training log.

Bacteria Monitoring Training:

MBNEP staff trains program volunteers in proper technique for sample collection in the field, including sterile technique. Volunteers are then trained in the lab by MBNEP staff in sample analysis techniques using IDEXX methodologies. The lab protocols include sample dilution, sample preparation, and reading and documenting lab results. Documentation of training attendees will be recorded and maintained in a training log.

Stream Profiling Training:

MBNEP staff train program volunteers in the techniques for plotting stream cross-sections at established points throughout the watershed. All monitoring is conducted under the direct guidance of a MBNEP staff member. Documentation of training attendees will be recorded and maintained in a training log.

Shorebird Monitoring Training:

Local birding experts train program volunteers in the protocol for conducting bay-wide shorebird counts. Bird identification is not included in the training because only birders of sufficient expertise participate in the effort.

Eelgrass and Macroalgae Training:

Eelgrass and macroalgae monitoring are completed primarily by MBNEP staff with occasional support by contractors. Prior to each field season, MBNEP staff hold a training session for new staff and contractors with guidance and oversight from an experienced staff member. Documentation of training attendees will be recorded and maintained in a training log.

8.2 Training and certification documentation

All training is documented in a training log where program staff record the volunteer trained, type of training, and staff conducting the training. When monitoring protocols are updated, volunteers are re-trained, and this is also documented in the training log. Upon starting with the program, MBNEP staff receive training in all areas of the program as part of their basic orientation. All training documentation is overseen by the MBNEP QA Officer.

8.3 Training personnel

All MBNEP staff training is provided by the MBNEP QA Officer and/or experienced staff who ensure that all necessary training has been completed. Training for Cal Poly students is provided by Cal Poly staff with support from experienced MBNEP staff. All volunteer training is overseen by the MBNEP QA Officer and provided by MBNEP staff who ensure that all appropriate volunteer training has been completed. Analytical laboratories are responsible for providing training to their own personnel.

9. Documents And Records

The MBNEP will maintain records for sample collection and laboratory testing. Samples sent to a laboratory for analysis will include a chain of custody form. The laboratories generate records for sample receipt and storage, analyses, and reporting. Sampling collection records contain a unique site ID, date, time, monitor's name, equipment used, data recorded, weather and rainfall information, and tidal information (if applicable).

The MBNEP has an existing database of field measurements. The program uses an Access database and Excel spreadsheets to store all program data. The Data Manager, an MBNEP staff member, maintains this electronic data with oversight by the MBNEP QA Officer. The files are saved to MBNEP's cloud storage with regular backup on an external hard drive.

Cal Poly will store files (typically in Excel and MATLAB format) in the Cal Poly OneDrive, which is backed up via cloud storage.

All monitoring records generated are stored at the MBNEP office, both paper and electronic copies. The analytical laboratories records pertinent to this project will be maintained at the lab locations. Copies of all laboratory results will be sent to the MBNEP via mail, email or electronic data retrieval system and stored in the project file. All records contain the unique sample ID, date of sample receipt, date of analysis, analytical methods, method detection limit (if applicable), reporting limit (if applicable) and measured value.

All data records, both volunteer-generated and laboratory-generated, that do not meet the objectives outlined in the approved QAPP will be flagged as acceptable or unacceptable and excluded from any future analysis or reporting. QA Officer will work with staff, volunteers, or contract laboratories to develop corrective actions. Any necessary retraining will be conducted.

Copies of this QAPP will be distributed to all parties involved with the project and made available to MBNEP staff. Copies of relevant sections will be sent to the analytical laboratories for distribution within the labs. Any future amended QAPPs will be held and distributed in the same fashion. All originals of subsequent amended QAPPs will be held at the MBNEP. Copies of versions, other than the most current, will be labeled as such so as not to create confusion.

Persons responsible for maintaining records for this project are as follows. MBNEP staff will maintain all sample collection, sample transport, chain of custody, and laboratory analyses forms at the MBNEP office. MBNEP staff will also maintain at the MBNEP office all records associated with the receipt and analysis of samples, and all records submitted by the laboratory. MBNEP staff will maintain the database permanently. Each individual laboratory will maintain records in accordance with its own QAPP requirements. The MBNEP Program Manager will oversee the actions of these persons and will arbitrate any issues relative to records retention and any decisions to discard records.

Copies of the records will be maintained at the MBNEP office and the analytical laboratories for at least five years after project completion. The database will be maintained without discarding. The QAPP will be maintained without discarding.

Other documents generated during the course of this project include monthly status reports, annual data summary memos, an annual training log, and quarterly database submittals.

GROUP B: DATA GENERATION AND ACQUISITION

10. SAMPLING PROCESS DESIGN

10.1 Size of study area

Water quality, bacteria, flow, stream profiling, water depth, toxicity, and bioassessment monitoring sites were selected to monitor as much of the watershed as possible. Thus, sites tend to be at the downstream locations of tributaries or near potential significant impacts. Additionally, many sites were selected based on historical monitoring efforts in the area such as the National Monitoring Program. Safe access and landowner permission are other major factors in site selection. Sites for continuous monitoring of water quality parameters are selected to be upstream and downstream of features of interest such as point sources or past, present, or future enhancement projects. The eelgrass transects and bay algae monitoring locations were distributed throughout the bay to look at the influence from different factors present in each region of the bay. Eelgrass mapping and bathymetry mapping covers the entire bay. The shorebird study area follows the historical sites established in historical studies. The SETs and sediment deposition traps were established in portions of the bay where the most change due to sedimentation could be expected. Continuous water depth measurement sites were established to help characterize surface flows in order to develop a water balance for the Chorro Valley, to track the impact of water conservation efforts, and to identify future project locations. The bay pH sensors are deployed in locations with other water quality sensor infrastructure already in place so that the data supports ongoing monitoring efforts. Bay nutrient sampling is conducted at easily accessible shoreline sites located throughout the bay.

10.2 Volume or time period represented by a sample

Monitoring efforts occur at various times of the year at frequencies that were determined to be adequate for analysis. For monitoring frequencies, see Table 6.2.1.

10.3 Type and total number of samples needed

- ❖ Water quality monitoring is conducted at 16 creek sites and seven bay sites. Bimonthly nutrient monitoring for nitrates and orthophosphates takes place at nine sites when flows are adequate. For in-house turbidity and orthophosphate analysis, water samples are collected in sterile 4 oz. Whirl-pak bags. If a sample analyzed by a contract laboratory, water samples are collected in vessels provided by the lab (see Table 12.1.1).
- ❖ Water samples for bacteria analysis are collected at eight creek sites and eight bay sites. For bay sites that require a 1:10 dilution, one 100-mL water sample is collected. At creek sites, a 250-mL sample is collected and homogenized. The sample is then split into two 100-mL samples and are analyzed as undiluted (1:1) and as diluted (1:10). If quality assurance analysis is being conducted, a larger volume of is sampled, homogenized, and split accordingly.
- ❖ Flow data is collected at 17 creek sites during times of measurable flow.

- Bioassessment samples are collected from 10 sites each year, although the number monitored varies from year to year based on water levels, funding, and staff availability. Samples consist of approximately 1L of preserved insects and debris collected from creek beds.
- For sediment deposition traps, pre-weighed glass filter pads are deployed and retrieved. Pads are dried in an oven and weighed using a fine scale.
- Bay pH sensors are visited quarterly and discrete samples will be collected for sensor calibration. These 500-mL discrete samples are collected using a Niskin sampler either from a dock, a boat, or diving.
- For bay nutrient monitoring, 500-mL samples are collected from six shoreline locations using a trigger-deployed water sampler.
- Water toxicity is assessed at four sites during the dry and wet seasons. Sediment toxicity is assessed at four sites during the wet season only. Water samples are collected in four 2.25-L amber glass bottles. Sediment samples are collected from the top 2 cm from a pre-cleaned polyethylene scoop and placed in a 4-L amber glass compositing/homogenizing container.

No samples are collected for continuous monitoring of water quality, continuous water depth monitoring, stream profiling, SETs, algae documenting, or bird surveys. For more information, see Tables 11.1.1 and 12.1.1.

10.4 Where samples are taken

See Section 6.4.

Sites are identified using landmarks, maps, and GPS coordinates. For monitoring of eelgrass, SETs, sediment traps, continuous water depth and stream profiling, permanent benchmarks are established at each of the monitoring sites, and they are located with the aid of GPS. Either MBNEP staff or contractors conduct these monitoring efforts and are trained in the use of GPS. Bay pH monitoring occurs at existing water quality sensor array stations. If one of those locations is unavailable for some reason, then the alternative is located at the State Park Marina.

10.5 If sites become inaccessible

Samples can be collected within the same reach or immediate area at a more accessible location. Staff and volunteers are trained in site selection so they have the knowledge to identify a new site location if a new one becomes inaccessible. If conditions are unsafe, staff and volunteers will delay sample collection until access becomes safe.

10.6 Project activity schedules

Monitoring for water quality, agricultural monitoring, bacteria, and flow is conducted on a monthly basis, year-round. A subset of water quality sites are monitored every other month for nitrates and orthophosphates with analysis conducted by the laboratory. Continuous water temperature and depth monitoring take place year-round. Creek algae documenting takes place once a year in the spring during bioassessment monitoring. Bay samples must be collected at the appropriate tidal cycle and thus this monitoring schedule is dictated by the tides. In-bay monitoring for DO must be conducted within two hours after sunrise on a tide to allow safe access via kayak. This allows the volunteers to capture the lowest DO levels of the diurnal cycle. All QA samples will be delivered to the lab by MBNEP staff or courier. Staff will make every effort to deliver the bacteria samples to the lab in time for them to be analyzed within eight hours of collection. If this is not possible, they will be delivered for analysis within 24 hours of collection. Bay pH monitoring will be conducted in month-long deployments for approximately six months of the year. Bay nutrient samples are sampled monthly at shoreline locations throughout the year. Eelgrass monitoring and bay macroalgae monitoring take place annually during negative tides. Bioassessment occurs once a year during the spring, and samples are typically delivered to the lab within two months, although they can be held for up to five years. Eelgrass aerial imagery and/or sonar is collected biennially, depending on funding availability and the amount of rainfall. In heavy rainfall years, more frequent monitoring may take place. Bathymetry monitoring is conducted on a decadal timeframe. Water toxicity monitoring occurs annually during the dry and wet seasons. Sediment toxicity monitoring occurs once per year during the wet season. Stream profiling and SET monitoring takes place on a frequency of several years since the monitoring is intended for long-term tracking of sedimentation in the bay. Tidally-influenced monitoring such as bay water quality, bacteria, eelgrass, SETs, sediment traps, macroalgae monitoring, and shorebirds are scheduled upon review of a tide table to ensure adequate access and optimal conditions.

For more information, see Table 6.2.1 and Section 10.2

10.7 Critical vs. informational data

All data collected for this effort is considered to be critical data.

10.8 Sources and reconciliation of variability

For water quality and bacteria monitoring, potential sources of variability include improper sample handling or lab techniques and environmental variability. Samples are split for 10% of samples collected. If split samples sent to the laboratory for analysis differ consistently from volunteer conducted analysis, additional quality assurance will be conducted and training refreshers will be conducted to remedy the problem and minimize operator-introduced sources of variability. Data should be within the measurement quality objectives listed in Table 7.1.3. If these objectives are not met, the data are flagged in the database and are not included in any data analysis. Other measures to address variability include wearing gloves during sample collection and analysis, use of clean or sterile containers for sample collection and analysis, and intense training for volunteers in proper sampling technique. For bay pH and bay nutrient monitoring, sources of variability include improper sample handling. Duplicate discrete samples are collected monthly for analysis and differences will be assessed. Any variability will be reconciled through additional training. For flow monitoring, continuous water depth monitoring, and bioassessment sampling, proper site selection is the largest source of variability and is addressed through volunteer and staff training. For algae documenting, eelgrass, and shorebird monitoring, the greatest sources of variability are the individual making the assessment, and this can only be addressed through training. For stream profiling, proper site identification is likely the greatest source of variability and can only be addressed through training. For toxicity, sources of variability include improper sample handling or lab techniques as well as environmental variability. To assess improper sample handling, field blanks will be collected. Field blanks must meet the minimum number required by SPoT and must not produce a statistically different result from that of the controls.

10.9 Sources of bias or misrepresentation

For bacteria, a potential source of bias is in the interpretation of testing results. Volunteers and staff must interpret sample fluorescence to read the results. This bias is addressed for bacteria monitoring by periodically splitting samples for all analysis and comparing the results from the split samples to the R_{log} criteria. Volunteers and staff also analyze a certified reference material of known bacteria concentration to check their accuracy. For water quality monitoring nutrient analysis, detailed procedures must be followed as related to reaction times, sample temperatures, etc. Volunteers and staff analyze a split sample while the other half is sent to a QA lab for analysis. The compared results must be within the measurement quality objectives outlined in Table 7.1.3. If they are not, then the sample collection and laboratory techniques will be reviewed to eliminate any potential source of bias and the data will be flagged in the database. For continuous water depth monitoring, flow monitoring and macroinvertebrate sampling, proper site selection is the largest source of bias and is addressed through volunteer and staff training. For algae documenting, eelgrass, and shorebird monitoring, the greatest sources of bias are the individual making the assessment and this can only be addressed through training. For stream profiling, a potential source of bias is improper use of the monitoring equipment, which can only be addressed through training. For bay algae biomass, the largest source of bias would be improper laboratory techniques such as inadequate drying of algae and improperly calibrated lab equipment such as scales. This is addressed through training in lab techniques as well as calibration procedures. For bay pH, the largest sources of bias would be calibration errors, which can only be addressed through training. For toxicity, bias can be unintentionally introduced through improper timing, reach selection, sample contamination, and depositional area selection for the surveys. These biases are controlled by ensuring field crews sample in the lowest gradient (i.e., calmest) reaches, and during the base flows that follow the high flow season (i.e., late spring through fall).

11. SAMPLING METHODS

All bacteria samples are aquatic samples. They will be collected as grab samples using sterile containers from approximately mid-stream and from just below the water's surface. The sterile sample containers hold 120-mL and are made from high density plastic. They are purchased from IDEXX Laboratories for use with the IDEXX testing system. The sealed, sterile containers contain sodium thiosulfate to neutralize chlorine which may be present at some sites. These bottles are used once and then disposed of. When samples are collected, the collector makes sure to leave some headspace in the jar. To collect samples to be split, a larger volume of water is required. Larger, 250-mL autoclavable bottles are used for sample collection. The bottles are autoclaved between uses to ensure that they are sterile. Samples are inverted 25 times and then 100 mL is decanted into each of two IDEXX 120-mL jars prior to analysis. Excess sample can be disposed of down the drain. Bacteria monitoring requires a wet lab with an autoclave, incubators and a source of sterile distilled water. MBNEP bacterial analysis by program staff and volunteers is conducted at Cuesta College. MBNEP and Cuesta College staff operate the facility's autoclave to provide the sterilized glassware and distilled water needed for analysis. If it is determined that the sample collection method is introducing error into the results, the MBNEP QA Officer will reassess both the monitoring protocol and how the volunteers follow the protocol. If a source of error is identified, the protocol will be revised and volunteers and staff will be re-trained.

For water quality monitoring, measurements are taken from approximately mid-stream and from just below the water's surface. All sampling equipment is rinsed with deionized water upon completion of the monitoring. All monitoring is conducted in the field using field meters. Water samples for quality assurance purposes are collected from mid-stream, just below the water's surface. A large, clean container is used to collect a single sample. The sample is gently mixed and then split. A portion is used to fill a sterile 16 oz. Whirl-pak bag for the volunteer's analysis and a portion is used to triple rinse and then fill a clean container provided by the laboratory for one-time use. For Bimonthly Nutrient Monitoring and Agricultural Monitoring, water samples are collected in one-time use bottles provided by the contract laboratory. All samples are aqueous samples. Excess sample is disposed of by the lab. Other than the field equipment, no special equipment or facilities are required for analysis. If it is determined that the sample collection method is introducing error into the results, the MBNEP QA Officer will reassess both the monitoring protocol and how the volunteers and staff follow the protocol. If a source of error is identified, the protocol will be revised and volunteers and staff will be re-trained.

Macroinvertebrate samples for bioassessment are stored in clean 16-oz plastic containers. The samples contain creek substrate and macroinvertebrates. Every attempt is made to remove all plant matter. The D-ring sampling net, bucket and sieves are rinsed between monitoring sites to minimize contamination. Excess samples are disposed of by the lab. No additional equipment or facilities are required for the sampling. All analysis is conducted by the laboratory. If samples are too large to fit in the 16-oz collection jar, larger debris is rinsed and removed until the sample is small enough. A 95% isopropyl alcohol preservative is added to each jar as soon as possible after collection. If it is determined that the sample collection method is introducing error into the results, the MBNEP QA Officer will reassess both the monitoring protocol and how the volunteers and staff follow the protocol. If a source of error is identified, the protocol will be revised and volunteers and staff will be re-trained.

For continuous water depth monitoring, flow, SETs, stream profiling, algae documenting, and shorebird monitoring, no samples are collected.

For sediment deposition traps, pre-weighed glass filter pads are attached to a ceramic tile. Pads are retrieved and replaced after one month. Collected filters are transported to a laboratory and oven-dried at 60°C for 2 hours, then cooled in a dehumidifying chamber. The samples are then heated in a muffle furnace for 5 hours at 500°C before cooling in a dehumidifying chamber before weighing.

For bay pH, discrete samples are collected quarterly and preserved with mercury chloride to be a pH calibrant for the field sensors. Samples of 500 mL are collected with a trigger-deployed Niskin sampler. They are analyzed using a Dissolved Inorganic Carbon instrument with a Licor 7000 NDIR analyzer, a Total Alkalinity titrator, or a custom automated spectrophotometric pH instrument using m-cresol purple indicator dye. The preserved samples may be stored in the laboratory for up to six months before analyzing. For bay nutrient monitoring, a 500-mL sample is collected with a trigger-deployed Niskin sampler and decanted into 50-mL Falcon tubes of plastic HDPE with a plastic-lined cap. Samples are stored on ice and immediately transported to a lab to be frozen. Samples can be held for up to a year before analysis.

For sediment toxicity, samples will be taken from depositional areas with low hydrologic energy, such as the inner side of bends or eddies where the water movement may be slower. Samples are collected along a 100-meter reach, with subsamples collected from up to 10 depositional areas, depending on the location of fine sediment deposits. Subsamples are homogenized to address variability and create a sample representative of depositional sediment mobilized within the watershed. Care is taken to sample recent sediment deposits in active areas of the streambed by avoiding banks, beaches, and other areas where sediment may have been deposited more than one year previously. Sediment is sampled to a depth of up to five centimeters and placed in a 4-L amber glass compositing/homogenizing container. This container is filled approximately 75% full with depositional sediment.

For water toxicity, samples will be taken from the centroid of the stream, where a 2.25-L bottle can be submerged. If there is no sampling point deep enough to submerge the 2.25-L bottle, a clean 1-L glass amber bottle will be used. In all of these monitoring efforts, any problems are identified by MBNEP staff in conjunction with the MBNEP QA Officer. Protocols will be revisited and any appropriate volunteer re-training will take place to correct the problem. These corrections will be documented in the updated monitoring SOPs as well as the volunteer training log.

See Appendices for copies of all monitoring SOPs.

Table 11.1.1. Sampling locations and sampling methods.

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #
Bacteria (all creek sites, stormwater run-off sites)	See Fig 6.4.3, Fig 6.4.18	Water	Below surface	*E. coli*	1 per month at each site plus one split per month	MBVMP Bacteria Monitoring Protocol
Bacteria (all bay sites)	See Fig 6.4.3	Water	Below surface	Entero-coccus	1 per month at each site plus one split per month	MBVMP Bacteria Monitoring Protocol
Water Quality (all creek sites)	See Fig 6.4.4	Water	Below surface	Orthophos phates as PO_4, Turbidity	1 per site per month	MBVMP Water Quality Monitoring Protocol
Water Quality (all creek sites)	See Fig 6.4.4	Water	Below surface	Orthophos phates as P, Nitrate as N, Turbidity	For QA, split samples at 10% of sites per month, sent to lab for analysis.	MBVMP Water Quality Monitoring Protocol
Water Quality – Bimonthly Nutrient Monitoring Sites	See Fig 6.4.5	Water	Below surface	Nitrates as N, Orthophos phates as P	For Bimonthly Nutrient sites, samples sent to lab four times per year.	MBVMP Water Quality Monitoring Protocol
Water Quality - Ag Monitoring Sites	See Fig 6.4.4	Water	Below surface	Nitrates as N, Orthophos phates as P	For Ag Sites, 1 set per month sent to lab.	MBVMP Water Quality Monitoring Protocol
Water Quality - Ag Monitoring Sites	See Fig. 6.4.4	Water	Surface	Total Nitrogen, Nitrite as N, Organic N	1 per site, once a month	MBNEP Ag Monitoring Protocol

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #
Water Quality - Ag Monitoring Sites	See Fig. 6.4.4	Water	Surface	Ammonia as Nitrogen	1 per site, once a month	MBNEP Ag Monitoring Protocol
Water Quality - Ag Monitoring Sites	See Fig. 6.4.4	Water	Surface	Total Kjeldahl Nitrogen	1 per site, once a month	MBNEP Ag Monitoring Protocol
Water Quality - Ag Monitoring Sites	See Fig. 6.4.4	Water	Surface	Total Phosphorus	1 per site, once a month	MBNEP Ag Monitoring Protocol
Water Quality - Ag Monitoring Sites	See Fig. 6.4.4	Water	Surface	Total Suspended Solids	1 per site, once a month	MBNEP Ag Monitoring Protocol
Toxicity Monitoring Sites	See Fig. 6.4.12	Water	Below Surface	Freshwater Water Toxicity	1 sample per site, once during the dry season. 1sample per site, once during the wet season.	Stream Pollution Trends (SPoT) Monitoring Program QAPP (SWRCB, 2023)
Toxicity Monitoring Sites	See Fig. 6.4.12	Sediment	1-5 cm (depositional sediment)	Freshwater Sediment Toxicity	1 sample per site, once during the dry season	Stream Pollution Trends (SPoT) Monitoring Program QAPP (SWRCB, 2023)
Bay pH (calibration for sensors)	See Fig 6.4.19	Water	1 m below the surface	pH	1 sample per sensor per deployment	SeaBird SeaFET pH Sensor Deployment and Calibration Procedures

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #
Bay Nutrient Monitoring Sites	See Fig 6.4.20	Water	1 m below the surface	Nitrate + Nitrite, Nitrite, Orthophos phate, Silicic Acid, Ammoniu m	1 sample per site, once a month	Cal Poly Nutrient Monitoring Sample Collection Protocol
Bay Macroalga e Biomass Sites	See Fig 6.4.13	Algae	Surface	Algae biomass dry weight	9 unique samples per transect	MBNEP Bay Macroalgae Monitoring Protocol
Bioassessm ent Monitoring Sites	See Fig 6.4.9	Macroinver tebrate samples	Creek bottom	Benthic invertebrat es	1 composited sample per site	MBVMP Bioassessment Protocol
Stormwater Monitoring Sites	See Fig 6.4.18	Water	Surface	Total Suspended Solids	1 sample per site, frequency variable	MBNEP Stormwater Monitoring Protocol
Stormwater Monitoring Sites	See Fig 6.4.18	Water	Surface	Oil & Grease	1 sample per site, frequency variable	MBNEP Stormwater Monitoring Protocol
Stormwater Monitoring Sites	See Fig 6.4.18	Water	Surface	Dissolved metals: Pb, Zn, Cu	1 per site, frequency variable	MBNEP Stormwater Monitoring Protocol
Stormwater Monitoring Sites	See Fig 6.4.18	Water	Surface	Total Petroleum Hydrocarb ons (TPH)-Gasoline	1 per site, frequency variable	MBNEP Stormwater Monitoring Protocol
Stormwater Monitoring	See Fig 6.4.18	Water	Surface	Total Petroleum	1 per site, frequency variable	MBNEP Stormwater

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #
Sites				Hydrocarbons (TPH)-Diesel		Monitoring Protocol

12. SAMPLE HANDLING AND CUSTODY

12.1 Sample handling and transport

The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or dispatched properly. Samples should include the date and time of collection, sample location, sampler name, and analysis to be performed. Collected samples will be kept in an ice chest with ice or ice packs. Volunteers conducting the sample collection and analysis are required to complete field datasheets. These include the following information: time of sample collection; sample ID numbers, including unique IDs for any replicate or blank samples; the results of any field measurements (e.g., temperature, DO, conductivity, turbidity) and the time that measurements were made; qualitative descriptions of relevant water conditions (e.g., color, flow level, clarity) or weather (e.g., wind, rain) at the time of sample collection; and a description of any unusual occurrences associated with the sampling event, particularly those that may affect sample or data quality. Samples will be clearly labeled with an indelible marker and include the site ID, sampling date and time, sampler name, and parameter to be analyzed for.

After returning from the field, all water samples for water quality and bacteria analysis will be analyzed immediately, transferred to the laboratory refrigerator, or delivered to the analytical laboratory or its courier.

For bioassessment samples, 95% isopropyl alcohol is added immediately after collection. Samples are stored in a refrigerator for approximately one month. Prior to overnight shipment to a contract laboratory, samples are drained of alcohol preservative, double-bagged, and packed in a shipping container. Lab personnel immediately refill the samples with alcohol upon sample arrival.

For discrete grab samples for calibrating bay pH equipment, the sample is transferred into a 500-mL glass sample bottle through tubing and allowed to overflow to remove all bubbles and headspace. Use syringe to remove water to create headspace. Add 120 uL of 100% saturated Mercury II Chloride via pipette. Insert the greased glass stopper, and use band and clip to secure stopper. Invert bottle several times to fix thoroughly. Sample can be stored for up to six months in the laboratory. For bay nutrient monitoring, samples are filtered using a 0.5 um polycarbonate filter then stored on ice. Upon returning to the lab, samples are frozen. Frozen samples are stored for six months.

All bacteria samples are hand delivered to the labs. Water quality samples to be analyzed by the lab are picked up by a lab courier for delivery to the lab or shipped via an overnight courier service. Pick-ups and deliveries are scheduled to comply with all hold time requirements.

Contract laboratories will follow sample custody procedures outlined in their QA plans. Contract laboratory QA plans are on file with the respective laboratory.

All samples remaining after successful completion of analyses will be disposed of properly. It is the responsibility of the personnel of each analytical laboratory to ensure that all applicable regulations are followed in the disposal of samples or related chemicals.

Laboratories shall maintain custody logs sufficient to track each sample submitted and to analyze or preserve each sample within specified holding times.

Table 12.1.1. Sample handling and custody

Parameter	Container	Volume	Initial Preservation	Holding Time
E. coli, enterococcus	Sterile, sealed plastic jar purchased from IDEXX Laboratories	120 mL	Sodium thiosulfate, cool to 4°C; dark.	24-hour hold time, but 8 hour if conditions allow, at 4°C, dark.
Orthophosphate as P, analysis by volunteer	Whirl-pak bag	4 oz.	None	48 hour at $\leq$ 6 °C, dark.
Orthophosphate as P, analysis by laboratory	Glass cuvette and filter provided by laboratory	40 mL	None.	48 hour at $\leq$ 6 °C, dark.
Nitrates as N, Nitrite as N, Total Nitrogen, Organic Nitrogen, analysis by laboratory	Plastic jar provided by laboratory	16 oz.	None	48 hour at $\leq$ 6 °C, dark.
Turbidity, analysis by lab for QA purposes	Plastic bottle provided by laboratory	16 oz.	None	48 hours at $\leq$ 6 °C, dark.
Ammonia-nitrogen, Total Kjeldahl Nitrogen, , analysis by lab	Plastic bottle provided by laboratory	16 oz.	H_2SO_4 preservative	28 days, at $\leq$ 6 °C, dark.
Total Phosphorus, analysis by laboratory	Plastic bottle provided by laboratory	250 mL	HNO_3 preservative	28 days, at $\leq$ 6 °C, dark
Bay pH	Glass bottle	500 mL	100% saturated Mercury II Chloride	6 months after being fixed
Benthic invertebrates	Wide mouth plastic jar	16 oz.	95% isopropyl alcohol	5 years

Parameter	Container	Volume	Initial Preservation	Holding Time
Sediment deposition traps	Glass filter	NA	None	Unlimited hold time in a dark, cool location
Bay Nutrient Monitoring	Plastic HDPE Falcon flask with plastic lined cap	17 mL	Store on ice. Upon return to the lab, filter through a 0.4 um polycarbonate filter and freeze.	6 months, samples frozen
Oil & Grease: analysis by lab	Glass amber jar with cap provided by laboratory	32 oz.	HCl preservative	28 days
Dissolved Copper, Dissolved Zinc, Dissolved Lead, analysis by lab	Plastic bottle with cap provided by laboratory	16 oz.	Lab filters, preserves with HNO_3 to pH < 2	6 months
Total Petroleum Hydrocarbons (TPH)-Gasoline, analysis by lab	Glass vial provided by laboratory	(3) 40 mL	HCl preservative, cool to ≤ 6°C	14 days
Total Petroleum Hydrocarbons (TPH)-Diesel, analysis by lab	Glass amber jar with cap provided by laboratory	32 oz.	Cool to ≤ 6°C	14 days
Total Suspended Solids, analysis by lab	Plastic bottle with cap provided by laboratory	32 oz.	Cool to ≤ 6	7 days at < 6°C in the dark.
Freshwater Water Toxicity	Amber glass bottle provided by laboratory	500 mL	None	48 hours at 4°C in dark.
Freshwater Sediment Toxicity	Amber glass bottle provided by laboratory	500 mL	None	56 days at ≤ 6°C in the dark.

12.2 Chain of custody procedure

Chain of custody forms will accompany all samples during transport to contract laboratories. These are completed by MBNEP staff. Forms are signed by the lab and the person relinquishing the sample. Copies of these forms are maintained by MBNEP staff. All bacteria and water quality samples will be transported to the analytical laboratory directly by volunteers, MBNEP staff or by laboratory or overnight courier.

See Appendix for a sample chain of custody forms.

13. ANALYTICAL METHODS

13.1 Analytical methods

The data in Table 13.1.1 and 13.1.3 do not apply to stream profiling, SETs, sediment deposition traps, eelgrass, algae, bathymetry, or shorebird monitoring. In the following tables, the term MDL refers to the Method Detection Limit which is the lowest concentration an instrument can distinguish from zero but cannot quantify. This is established by the lab conducting the analysis. These terms do not apply to the activities listed in Table 13.1.1, which covers field analysis.

Table 13.1.1. Field analytical methods

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Target Reporting Limit (units, wet or dry weight)	Analytical Method/ SOP
Flow	Field monitoring by MBNEP staff and volunteers	NA	Depth = 0.15 ft, Velocity = 0.01 ft/sec	MBVMP Water Quality Monitoring Protocols
Conduct-ivity (Water Quality)	Field monitoring by MBNEP staff and volunteers, Continuous monitoring deployment by MBNEP staff	> 3,000 uS (for Water Quality only)	0.10 uS for high range meter	MBVMP Water Quality Monitoring Protocols, MBVMP EXO3 Sonde Protocol
Dissolved oxygen (Water Quality and Dawn Patrol)	Field monitoring by MBNEP staff and volunteers, Continuous monitoring deployment by MBNEP staff	< 7.0 mg/L	0.01 mg/L	MBVMP Water Quality Monitoring Protocols, MBVMP EXO3 Sonde Protocol
pH (Water Quality)	Field monitoring by MBNEP staff and volunteers, Continuous monitoring deployment by MBNEP staff	< 7.0 or > 8.5 pH units	1.0 pH	MBVMP Water Quality Monitoring Protocols, MBVMP EXO3 Sonde Protocol
Chlorophyll (Water Quality, Ag)	Field monitoring and continuous deployment by MBNEP staff	NA	NA	MBNEP Agricultural Monitoring Protocol, MBVMP EXO3 Sonde Protocol
Total Dissolved Solids (Water	Field monitoring by MBNEP staff	NA	NA	MBNEP Agricultural Monitoring Protocol, MBVMP EXO3 Sonde Protocol

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Target Reporting Limit (units, wet or dry weight)	Analytical Method/ SOP
Quality, Ag)				
Bay pH (continuous)	Field monitoring by Cal Poly	< 7.5 pH units	6.5 pH units	SeaBird SeaFET pH Sensor Deployment and Calibration Procedure
Temperature (Water Quality and Dawn Patrol)	Field monitoring by MBNEP staff and volunteers, Continuous monitoring deployment by MBNEP staff	> 21°C	0.1°C	MBVMP Water Quality Monitoring Protocols, MBNEP Continuous Temperature Logger Protocol, MBVMP EXO3 Sonde Protocol
Turbidity (Water Quality)	Field monitoring by MBNEP staff and volunteers	> 25 NTU	0.01 NTU	MBVMP Water Quality Monitoring Protocols
Orthophosphates as PO_4 (Water Quality)	Field monitoring by MBNEP staff and volunteers	> 0.36 mg/L	0.33 mg/L	MBVMP Water Quality Monitoring Protocols
Sediment deposition traps	Sample collection and analysis by MBNEP staff and USGS	NA	NA	USGS Sediment Deposition Trap Protocol
Macroalgae Biomass – dry weights	Sample collection and analysis by MBNEP staff and contractor	NA	NA	MBNEP Bay Macroalgae Monitoring Protocol

Table 13.1.2. Field equipment features

Monitoring Effort	Equipment Description	Measurement Principle	Major Attributes
Flow	HACH FH950	Electromagnetic	Velocity averaging
Water depth	In-Situ Inc., Level TROLL 500, Level TROLL 700	Piezoresistive transducer	Automatic barometric pressure compensation
Conductivity (Water Quality, Water Quality	YSI ProQuatro. YSI Pro 2030, YSI EXO3 Multi-	Voltage drop	Temperature correction

Monitoring Effort	Equipment Description	Measurement Principle	Major Attributes
Continuous)	Parameter Water Quality Sonde		
Dissolved oxygen (Water Quality, Dawn Patrol, Ag)	YSI ProQuatro, YSI Pro 2030	Membrane covered polarographic	Self-calibrating
Temperature (Water Quality and Dawn Patrol)	YSI ProQuatro, YSI Pro 2030	Thermistor	
pH (Water Quality)	YSI ProQuatro, YSI EXO3 Multi-Parameter Water Quality Sonde	Glass combination electrode	Temperature compensation
Turbidity (Water Quality)	HACH 2100Q Turbidimeters	Nephelometric	Auto ranging
Orthophosphates as PO_4 (Water Quality)	HACH DR/890, HACH DR/900	Ascorbic acid reduction reaction, colorimeter	
Chlorophyll (Water Quality, Ag)	YSI EXO3 Multi-Parameter Water Quality Sonde	Optical (fluorescence)	
Total Dissolved Solids (Ag)	YSI EXO3 Multi-Parameter Water Quality Sonde	Voltage drop	Calculated
Dissolved Oxygen (Water Quality Continuous)	YSI EXO3 Multi-Parameter Water Quality Sonde	Optical (dynamic luminescence quenching)	No flow required
Temperature (Water Quality Continuous)	YSI EXO3 Multi-Parameter Water Quality Sonde	Thermocouple	
Temperature (Water Quality Continuous)	HOBO MX2203 TidbiT	Thermistor	Detects when water is present, Bluetooth connectivity for download
Bay pH (Continuous)	SeaBird SeaFET V2 pH sensor	Ion sensitive field effect transistor	
Drone-based Eelgrass Monitoring	DJI Phantom 4 Pro	True color imagery collection	20-megapixel camera

Table 13.1.3 Laboratory analytical methods

Analyte/ Instru-mentation	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Target Reporting Limit (units, wet or dry weight)	Analytical Method/ SOP	MDLs (1)
Total coliform (IDEXX Colilert-18)	MBNEP In-house laboratory	> 10,000 MPN/100mL	2 MPN/100mL for an undiluted sample	MBVMP Bacteria Monitoring Protocols	1 MPN/100 mL for an undiluted sample
E. coli (IDEXX Colilert-18)	MBNEP In-house laboratory, County of San Luis Obispo Public Health Laboratory	Statistical Threshold Value: 320 MPN/100 mL (90^{th} percentile of data) Geomean: 100 MPN/100 mL	2 MPN/100mL for an undiluted sample	MBVMP Bacteria Monitoring Protocols	1 MPN/100 mL for an undiluted sample
Enterococcus (IDEXX Enterolert)	MBNEP In-house laboratory, County of San Luis Obispo Public Health Laboratory	Statistical Threshold Value: 110 MPN/100 mL (90^{th} percentile of data) Geomean: 30 MPN/100 mL	2 MPN/100mL for an undiluted sample	MBVMP Bacteria Monitoring Protocols	1 MPN/100 mL for an undiluted sample
Bay pH (spectrophotometer)	Cal Poly	< 7.5 pH units	6.5 pH units	Carter et al. 2013 DOI 10.4319/lom.2013.11.16	NA
Bay Nitrates + Nitrites	UCSB Marine Science Institute Lab	NA	2.8 µg/L	31-107-04-1-A	0.13 µg/L
Bay Nitrite	UCSB Marine Science Institute Lab	NA	1.4 µg/L	31-107-05-1-A	0.30 µg/L
Bay Phosphate	UCSB Marine Science Institute Lab	0.13 mg/L	3.1 µg/L	31-115-01-3-A	0.31 µg/L
Bay Silicic	UCSB Marine Science Institute	NA	28 µg/L	31-114-27-1-	0.84 µg/L

Analyte/ Instru-mentation	**Laboratory / Organization**	**Project Action Limit (units, wet or dry weight)**	**Target Reporting Limit (units, wet or dry weight)**	**Analytical Method/ SOP**	**MDLs (1)**
Acid	Lab			B	
Bay Ammonium	UCSB Marine Science Institute Lab	0.1 mg/L as ammonia	2.8 µg/L	31-107-06-5-A	0.10 µg/L
Nitrate as N	Fruit Growers Laboratory	10 mg/L for Water Quality	0.1 mg/L	EPA 300.0	0.04 mg/L
Orthophosphate as P	Fruit Growers Laboratory	> 0.12 mg/L for Water Quality	0.05 mg/L	EPA 300.0	0.009 mg/L
Total Kjeldahl Nitrogen	Fruit Growers Laboratory	NA	0.5 mg/L	EPA 351.2	0.41 mg/L
Nitrite as N	Fruit Growers Laboratory	NA	0.17 mg/L	EPA 300.0	0.001 mg/L
Total Phosphorus	Fruit Growers Laboratory	NA	0.05 mg/L	EPA 200.7	0.061 mg/L
Ammonia as N	Fruit Growers Laboratory	NA	0.8 mg/L	SM 4500-NH3 G	0.093 mg/L
Turbidity for Water Quality (for QA)	Fruit Growers Laboratory	> 25 NTU	0.1 NTU	SM 2130B	0.06 NTU
Fecal/thermotolerant coliform (multiple tube fermentation – MTF)	County of San Luis Obispo Public Health Laboratory	> 43 MPN/100 mL	2 MPN/100 mL for an undiluted sample	Standard Methods 9221E+C	Lower: 1.8 MPN/100 mL Upper: >1600 MPN/100 mL Upper with extra dilution: >16000 MPN/100 mL
Benthic macroin-	EcoAnalysts, Inc.	NA	600 minimum individuals	EcoAnalysts Laboratory SOP/QA Plan 2007*	NA

Analyte/ Instru-mentation	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Target Reporting Limit (units, wet or dry weight)	Analytical Method/ SOP	MDLs (1)
vertebrates[11]					
Oil & Grease	Pace Analytical Services	75 mg/L	6.7 mg/L	EPA-1664 HEM	0.74 mg/L
Dissolved Copper	Pace Analytical Services	0.01 mg/L	0.002 mg/L	EPA 200.8	0.00032 mg/L
Dissolved Lead	Pace Analytical Services	0.01 mg/L	0.001 mg/L	EPA 200.8	0.000021 mg/L
Dissolved Zinc	Pace Analytical Services	0.02 mg/L (for receiving waters, not for runoff)	0.005 mg/L	EPA 200.8	0.0057 mg/L
Total Petroleum Hydrocarbons (TPH)-Gasoline[2]	Pace Analytical Services	NA	0.05 mg/L	EPA 8015B	0.011 mg/L
Total Petroleum Hydrocarbons (TPH)-Diesel[12]	Pace Analytical Services	NA	0.23 mg/L	EPA 8015B-TPHd	0.049 mg/L
Total Suspended Solids	Fruit Growers Laboratory, Pace Analytical Services	NA	3.2 mg/L	SM2540D	0.55 mg/L
Freshwater Sediment Toxicity	UC Davis Granite Canyon	NA	NA	EPA 600/R-99/064; *Hyalella azteca* - SOP	NA

[11] Bioassessment sample analysis is conducted per the following SWAMP SOP, with customization or modifications per the QA Officer's request:
http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/bmi_lab_sop_final.pdf

[12] Regulatory criteria do not exist for TPH, and no value will be adopted as a Project Action Limit. This TPH data is considered to be a baseline screening level data to determine the impacts of stormwater runoff from a parking lot into nearby Morro Bay.

Analyte/ Instru-mentation	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Target Reporting Limit (units, wet or dry weight)	Analytical Method/ SOP	MDLs (1)
				2.7	
Freshwater Sediment Toxicity	UC Davis Granite Canyon	NA	NA	EPA 600/R-99/064; *Chironomus dilutus* - SOP 2.8	NA
Freshwater Water Toxicity	UC Davis Granite Canyon	NA	NA	EPA 821/R-02/012M; *Hyalella azteca* - SOP 2.20	NA
Freshwater Water Toxicity	UC Davis Granite Canyon	NA	NA	Ingersoll et al. 2013; Kunz et al. 2017; *Chironomus dilutus* - SOP 2.26	NA
Freshwater Water Toxicity	UC Davis Granite Canyon	NA	NA	EPA /R-02/013; *Ceriodaphnia dubia*	NA

If failures occur, the appropriate laboratory personnel will address the problem and contact the MBNEP QA Officer with any proposed solutions or resolutions.

All excess samples will be disposed of properly by laboratory personnel following their own documented SOPs.

Analytical results are typically available for bacteria and water quality samples within two weeks. If a rush is needed on the analysis, results can be transmitted via phone or email in a more timely manner. Macroinvertebrate samples for bioassessment typically take three months for analysis and reporting by the analytical lab.

14. QUALITY CONTROL

14.1 Water quality monitoring

Quality assurance and quality control activities for sampling processes include the collection of field splits for nutrient testing and the preparation of field blanks. For field splits, the volunteers collect a sample and split it. Half is analyzed by the volunteer and half is sent to the laboratory for analysis. The laboratory will analyze the split samples to assess the accuracy and bias criteria.

Blanks will be prepared by pouring deionized water into a clean sample collection container provided by the laboratory. This blank is carried in the field in a cooler with ice packs, to simulate as closely as possible how the nutrient samples are handled. The laboratory will analyze the field blanks submitted.

In order to monitor the sampling process, the MBNEP QA Officer will randomly observe sampling processes and compare the actual actions against the sampling SOP.

Volunteers will split water quality samples and analyze both samples to determine precision. The relative percent difference (RPD) between the two results should be within 25%. This analysis is conducted for 10% of samples analyzed by volunteers.

The RPD is calculated as follows:

$$RPD = (X1 - X2)*100/[(X1 + X2)/2]$$ where X1 is the larger value

The volunteers will periodically analyze deionized water using the water quality nutrient field test kits to assess their sample handling and laboratory techniques. The result should be less than the method detection limit. This analysis is conducted for 10% of samples analyzed by volunteers. This also ensures the quality of each batch of reagents. The results are analyzed as follows:

$X1 < MDL$ where X1 is the analysis result by the volunteers and the MDL is the method detection limit for the method of analysis.

Water quality data will also be tested for outliers. During data reviews, data is plotted and any values that are out of range with the majority of the data at a given site are revisited and checked for possible equipment malfunction, operator error and other possible explanations for out of range results. If the results appear to be valid given the circumstances (i.e., weather-related) then the data remains in the database as valid. If a determination cannot be made as to whether or not the data is valid, then when the data is analyzed with Minitab box plots, the outliers are identified and are not included in the calculation of medians, interquartile ranges, etc. The Minitab criterion for an outlier is values that are at least 1.5 times the interquartile range (Q3 – Q1) from the edge of the box. Contract laboratories, Pace Analytical Services and Fruit Growers Laboratory, are ELAP-certified (FGL Certification #1573; Pace Certification #1186). These laboratories undergo annual inspection and recertification processes. Any data that fails to meet the lab's own measurement quality objectives will be addressed by the laboratory following its own SOPs. The accuracy, precision, completeness, and recovery criteria are laid out in Table 7.1.3. Precision is determined by calculating the RPD (as shown above). Accuracy, recovery, and completeness are calculated as follows:

$$\text{Accuracy \% difference} = [(X1 - X2) * 100]/ (X1)$$ where X1 is the known value

$$\text{\% Recovery} = [(\text{matrix plus spike result} - \text{matrix result}) / (\text{expected matrix plus spike result})] * 100$$

$$\text{\% Completeness} = [\text{\# valid samples} / \text{\# total planned samples}] * 100$$

Data that fails to meet the data quality objective will be flagged as such in the database and will not be used in subsequent analysis. If this occurs, volunteer protocols and technique will be reviewed. If necessary, protocols will be revised and volunteers will be re-trained.

In the following tables, TRL stands for Target Reporting Limit.

Table 14.1.1 Field QC for water quality monitoring

Matrix: Water	
Sampling SOP: MBVMP Water Quality Monitoring Protocols, YSI EXO3 Sonde Protocol, SeaBird SeaFET pH Sensor Deployment and Calibration Procedure, MBNEP Continuous Temperature Logger Protocol, MBNEP Agricultural Monitoring Protocol	
Analytical Parameter(s): orthophosphates, turbidity, pH, temperature, dissolved oxygen	
Analytical Method/SOP Reference: See Table 14.1.2.	
# Sample locations: Various. (See Section 6.4).	
Field QC	**Frequency/Number per sampling event**
Equipment Blanks: continuous bay pH	Prior to deployment
Field Blanks: nutrients	One sample per year for water quality monitoring
Field Duplicate Pairs: nutrients	10% of total samples for water quality nutrient analysis
Field Duplicate Pairs: turbidity	One sample per month analyzed both by MBNEP equipment and a certified lab.
Field Duplicate Pairs: pH	One sample per month analyzed by MBNEP equipment and a certified lab.
Field Duplicate Pairs: continuous bay pH	One sample per sensor per month
Field Duplicate Pairs: DO	One sample per month analyzed both by MBNEP equipment and Winkler titration
Other: continuous water temperature	At time of deployment and retrieval, take a second reading with a calibrated temperature meter

Table 14.1.2. Analytical QC for water quality monitoring

Matrix: Water	
Sampling SOP: FGL 2D0900137	
Analytical Parameter(s): Nitrates as N, Orthophosphates as P, TKN, Nitrite as N, Total Phosphorus, Turbidity, Total Ammonia-Nitrogen, Total Suspended Solids	
Analytical Method/SOP Reference: Nitrates (EPA 300.0), Orthophosphates (EPA 300.0), Turbidity (SM 2130B), Ammonia-Nitrogen (SM 4500-NH_3G), TKN (EPA 351.2), Total Phosphorus (EPA 200.7), Nitrite as N (EPA 300.0), Total suspended solids (SM2540D)	
# Sample locations: Various (See Section 6.4)	
Laboratory QC	**Frequency/Number**
Method Blank	One per batch
Instrument Blank	One per day of analysis
Lab. Duplicate	One per batch
Lab. Matrix Spike	One per batch
Matrix Spike Duplicate	One per batch
Lab. Control sample	One per batch

14.2 Bacteria monitoring

Quality assurance and quality control activities for sampling processes include the collection of field splits for bacterial testing and the preparation of field blanks. Split samples are prepared by collecting a sample in a large, sterile container and then dividing it into multiple samples for analysis by the volunteer. The precision criterion is that the two volunteer-generated results must be within the R_{log} criteria, which is based on the results of 15 pairs of replicate samples analyzed by program staff. To verify volunteer accuracy, *E. coli* and enterococcus samples of a known range of concentration are obtained from IDEXX Laboratories. Volunteers analyze the sample and the results should be within the acceptable range.

Blanks will be prepared by pouring sterile distilled water into a sterile sample collection container, then subsampling into the appropriate number of replicate sample containers. This is to test both the volunteer sample handling and lab analysis as well as testing for contamination from each new batch of reagent. The result of the analysis from both the volunteer and the lab must be within the MDL for the method of analysis. See Section 14.1 for calculation.

In order to monitor the sampling process, the MBNEP QA Officer will randomly observe sampling processes and compare the actual actions against the sampling SOP.

The bacteria laboratory, County of San Luis Obispo Public Health Laboratory, is certified by Environmental Laboratory Accreditation Program (ELAP) (Certification # 2114) and undergoes an annual recertification process and biennial inspection. Any data that fails to meet the lab's own measurement quality objectives will be addressed by the laboratory following its own SOPs.

The completeness calculation is as above.

Data that is outside the QC criteria for both types of analysis will be flagged as such in the database and will not be used in subsequent analysis. If this occurs on a consistent basis, volunteer protocols and technique will be reviewed. If necessary, protocols will be revised and volunteers will be re-trained.

Table 14.2.1. Field QC for bacteria monitoring

Matrix: Water	
Sampling SOP: MBVMP Bacteria Monitoring Protocols	
Analytical Parameter(s): *E. coli*, total coliform, enterococcus	
Analytical Method/SOP Reference: IDEXX Colilert-18 and Enterolert	
# Sample locations: Various. (See Section 6.4)	
Field QC	**Frequency/Number per sampling event**
Field Blanks: total coliform, *E. coli*, enterococcus	One per month
Field Splits: total coliform, *E. coli*, enterococcus	10% of total samples

Table 14.2.2. Analytical QC for bacteria monitoring

Matrix: Water
Sampling SOP: Water Quality Sample Collection and Laboratory Procedure
Analytical Parameter(s): *E. coli*, total coliform, enterococcus, fecal/thermotolerant coliform
Analytical Method/SOP Reference: Enterolert– Standard Methods 9230 D, Colilert-18 (or Colilert) – Standard Methods 9223 B Fecal/thermotolerant coliform – Standard Methods 9221E+C (A1)
Sample locations: Various (See Section 6.4)

Laboratory QC	Frequency/Number
Reagent Blank Colilert 18/24 Enterolert	For each new lot of reagent, run a presence/absence test for Colilert 18/24 strains: *Escherichia coli ATCC 25922*, *Klebsiella variicola* ATCC 31488, and *Pseudomanas aeruginosa* ATCC 27853. For each new lot of reagent, run a presence/absence test for Enterolert Strains: *Enterococcus faecium* ATCC 35667, *Serratia marcescens* ATCC 43862, and *Aerococcus viridans* ATCC 10400
Storage Blank	NA
Instrument Blank	NA
Lab. Duplicate	Upon request from clients
Lab. Matrix Spike	NA
Matrix Spike Duplicate	NA
Multiple Tube Fermentation (MTF) Lab. Control sample: Negative Control – Fecal/thermotolerant Coliform Positive Control – Fecal/thermotolerant	For every test, run a negative control for *K.aerogenes* (ATCC # 13048) For every test, run a positive control for *E.coli* (ATCC # 25992)

Coliform	
Surrogates	NA
Internal Standards	NA
MTF Media QC: Negative Control – Fecal/thermotolerant Coliform Positive Control – Fecal/thermotolerant Coliform pH	For each new batch of prepared media, run a negative control for *K. aerogenes* (ATCC #13048) For each new batch of prepared media, run a positive control for *E.coli* (ATCC # 25992) pH is taken and recorded for reach new batch of prepared media
Media Sterility Test	Each new batch of prepared media or each new lot of purchased media
Others:	Sterility check on new lots of sterile sample collection containers. Run a growth test with Tryptic Soy Broth. Sterility check on new lots of dilution blanks. Run growth test with Tryptic Soy Broth. Sterility check on new lots of graduated pipettes. Also with Tryptic Soy Broth.
Others:	Volume check on each new lot of dilution blanks. Volume check on each new lot of IDEXX sample bottles. Volume check on each new lot of graduated pipettes. QC scale with weights calibrated every 5 years.

14.3 Bioassessment monitoring

MBNEP staff accompany volunteers on all sample collection field trips. MBNEP staff receive biennial refresher training from CCRWQCB staff or the California Department of Fish and Wildlife's Aquatic Bioassessment Lab to ensure that all collection methods are correct and up-to-date.

The macroinvertebrate analysis laboratory conducts QA measures for sorting and identifying the sample. Following initial sorting of the sample, 100% of the sorted material is re-sorted by a specially trained sorting QC technician who is never the technician who originally sorted the sample. The QC technician re-sorts the sample until the percent sorting efficacy is 90% or greater. For QA of the identification process, a second taxonomist re-identifies 10% of the samples. A percent similarity is calculated to compare both sets of data. Any discrepancies are discussed by both taxonomists until a consensus is reached. Any data that fails to meet the lab's own measurement quality objectives will be addressed by the laboratory following its own SOPs.

Table 14.3.1. Analytical QC for bioassessment monitoring

Matrix: Benthic macroinvertebrates
Sampling SOP: Standard Operating Procedure for Collection of Field Data for Bioassessment of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat, March 2016 v2
Analytical Parameter(s): Benthic invertebrates
Analytical Method/SOP Reference: Standard Operating Procedures for Laboratory Processing and Identification of Benthic Macroinvertebrates in California, 2012
Sample locations: Various (See Section 6.4)

14.4 Flow monitoring

Quality assurance and quality control activities for flow monitoring include replicate measurements of flow velocity. RPD values should be within ± 25%. See above for method of calculation.

In order to monitor the process, the MBNEP QA Officer will randomly observe sampling processes and compare the actual actions against the sampling SOP.

Data that fails to meet the data quality objective will be flagged as such in the database and will not be used in subsequent analysis. If this occurs, volunteer protocols and techniques will be reviewed. If necessary, protocols will be revised and volunteers will be re-trained.

14.5 Bay Nutrient Monitoring

Quality assurance and quality control activities for sampling processes include the collection of field splits for bay nutrient testing and the preparation of field blanks. For field blanks, two samples are run using > 10 megohm-cm deionized (DI) water. A blank is re-run every 20 samples. Seawater blanks are also run using low nutrient seawater samples that are aged for months. This DI water is also used for all reagents, carriers, standards, and probe rinsing. For field duplicate pairs, the sample is split, with half analyzed by Cal Poly and half sent to the laboratory for analysis. The relative percent difference (RPD) between the two results should be within 25%. This analysis is conducted for 10% of samples analyzed by volunteers. The laboratory will analyze the split samples to assess the accuracy and bias criteria.

In order to monitor the sampling process, the Cal Poly staff will randomly observe sampling processes and compare the actual actions against the sampling SOP.

Table 14.5.1. Field QC for bay nutrient monitoring

Matrix: Water
Sampling SOP: Cal Poly Nutrient Monitoring Sample Collection Protocol
Analytical Parameter(s): Nitrates + Nitrites,

Nitrites, Phosphate, Silicic Acid, Ammonium
Analytical Method/SOP Reference: See Analytical QC for Nutrients Table
Sample locations: see maps in Section 6.4

Field QC	Frequency/Number per sampling event
Field Blanks: nutrients	One per month
Field Duplicate Pairs: nutrients	One per month

Table 14.5.2. Analytical QC for bay nutrient monitoring

Matrix: Water
Sampling SOP: Nutrient Monitoring Sample Collection Protocol
Analytical Parameter(s): Nitrates + Nitrites, Nitrites, Phosphate, Silicic Acid, Ammonium
Analytical Method/SOP Reference: QA Manual MSIAL
Sample locations: see maps in Section 6.4

Laboratory QC	Frequency/Number
Method Blank	Two at the beginning of each run.
Reagent Blank	NA
Storage Blank	One per sampling trip (cruise)
Instrument Blank	One every 20 samples
Lab. Duplicate	One in DI and one in SW at the beginning of analytical batch and one (DI or seawater) every 20 samples.
Lab. Matrix Spike	One per every 20 samples, spiked sample aliquots.
Matrix Spike Duplicate	One per 20 samples, spiked sample aliquots.
Lab. Control sample	Seawater spike and DI spike, one in every 20 samples, one at end of run at concentration above

	highest measured result
Surrogates	NA
Internal Standards	NA
External Standards	12 standards run in duplicate at the beginning of the analytical batch to establish calibration curves for each analyte.

14.6 Stormwater Monitoring

MBNEP staff use a combination of training and field notes to ensure sample quality and consistency in the field. Samples are delivered to Pace Analytical Services for analysis.

Pace Analytical Services conducts routine QA within sample batches and also for the instruments and protocols used to analyze stormwater samples (Table 14.6.1)

Table 14.6.1. Analytical QC for stormwater monitoring

Matrix: Water	
Sampling SOP: MBNEP Stormwater Monitoring Protocols, BCORG026, BCMET037, BCGEN022, BCORG003, BCORG005	
Analytical Parameter(s): Oil and Grease, Dissolved metals (copper, zinc, lead), Total suspended solids, Total petroleum hydrocarbons (TPH)-Gasoline, Total petroleum hydrocarbons (TPH)-Diesel	
Analytical Method/SOP Reference: Oil and Grease (EPA 1664), Dissolved metals: copper, zinc, and lead (EPA 200.8), Total suspended solids (SM2540D), Total petroleum hydrocarbons (TPH)-Gasoline (EPA 8015), Total petroleum hydrocarbons (TPH)-Diesel (EPA 8015)	
# Sample locations: four (see Section 6.4)	
Laboratory QC	**Frequency/Number**
Method Blank	One per batch
Reagent Blank	One per lot
Instrument Blank	One per day of analysis
Lab Duplicate (TSS, Metals and Oil and Grease)	One per batch (10 Samples)

Lab. Matrix Spike	One per batch (20 Samples TPH-Gasoline /Diesel
Lab. Matrix Spike Duplicate	One per batch (20 Samples TPH-Gasoline /Diesel
Lab control Sample	One per batch (20 Samples TPH-Gasoline /Diesel

14.7 Toxicity Monitoring

Quality control (QC) for field measurements is covered by MBNEP's QAPP 16.1 (Table 14.1.1). QC for analytical parameters is outlined in the SPoT QAPP (SWRCB, 2023).

Table 14.7.1. Analytical QC for water toxicity

Matrix: Water
Sampling SOP: MBNEP Toxicity Monitoring Protocol, SPoT QAPP 2023
Analytical Parameter(s): Water Toxicity
Analytical Method/SOP Reference: SPoT QAPP 2023
Sample locations: Various (See maps)

Laboratory QC	**Frequency/Number**	**Acceptance Limits**
Method blanks	Laboratory control water consistent with appropriate EPA method and must be tested with each analytical batch.	Laboratory control water must meet all test acceptability criteria of the appropriate EPA method for the species of interest.
Conductivity/Salinity control water	A conductivity or salinity control must be tested when these parameters are above or below the species tolerance.	Follow EPA guidance on interpreting data and refer to tables in SPoT QAPP for tolerance ranges.
Additional method blanks	Additional method blanks are required whenever manipulations are performed on one or more of the ambient samples within each analytical batch.	There must be no statistical difference between the laboratory control water and each additional control water within an analytical batch.

Table 14.7.2. Analytical QC for sediment toxicity

Matrix: Sediment

Sampling SOP: MBNEP Toxicity Monitoring Protocol, SPoT QAPP 2023
Analytical Parameter(s): Sediment Toxicity
Analytical Method/SOP Reference: SPoT QAPP 2023
Sample locations: Various (See maps)

Laboratory QC	**Frequency/Number**	**Acceptance Limits**
Method blanks	Laboratory control water consistent with appropriate EPA method and must be tested with each analytical batch.	Laboratory control water must meet all test acceptability criteria of the appropriate EPA method for the species of interest.
Conductivity/salinity control water	A conductivity or salinity control must be tested when these parameters are above or below the species tolerance.	Follow EPA guidance on interpreting data and refer to tables in SPoT QAPP for tolerance ranges.
Additional method blanks	Additional method blanks are required whenever manipulations are performed on one or more of the ambient samples within each analytical batch.	There must be no statistical difference between the laboratory control water and each additional control water within an analytical batch.
Sediment control	Sediment control consistent with the appropriate EPA method must be tested with each analytical batch of sediment toxicity tests.	Sediment control must meet all data acceptability criteria of the appropriate EPA method for the species of interest.

15. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

15.1 Equipment testing, inspection and maintenance

Field measurement equipment will be checked in accordance with the manufacturer's specifications. This includes battery checks, routine replacement of membranes, and cleaning of conductivity electrodes. All equipment will be inspected when first handed out and when returned from use for damage.

All laboratories maintain their equipment in accordance with its SOPs, which include those specified by the manufacturer and those specified by the method.

MBNEP staff are responsible for equipment inspection, testing and maintenance. Field equipment inspection is carried out prior to each trip in the field. Testing is conducted if equipment appears visibly worn or if volunteers report problems with the equipment upon returning from the field. If deficiencies are found, MBNEP staff will perform the needed maintenance and then re-calibrate and re-inspect the equipment. A pre- and post-calibration will be run to determine if the problem has been fixed. If it has not, maintenance and re-calibration will be conducted. If this does not correct the problem, then the equipment will be taken out of use and sent to the manufacturer for servicing.

Table 15.1.1. Testing, inspection, maintenance of sampling equipment and analytical instruments

Equipment / Instrument	Maintenance Activity, Testing Activity or Inspection Activity	Responsible Person	Frequency	SOP Reference
YSI ProQuatro, YSI Pro 2030 DO Meters	Inspected periodically throughout monitoring time period	MBNEP staff	Weekly during water quality monitoring effort	Operator manual
YSI ProQuatro, YSI Pro 2030 DO Meters	Change membrane	MBNEP staff	As needed, approximately 4 times/year	Operator manual
HACH 2100Q Turbidimeters	Inspected periodically throughout monitoring time period.	MBNEP staff	Inspected weekly during water quality monitoring effort.	Operator manual
YSI EXO3 Multi-Parameter Water Quality Sonde	Inspected periodically throughout monitoring time period.	MBNEP staff	Each time deployed	Operator manual
HOBO TidbiT V2 MX2203	Inspected prior to deployment and following retrieval	MBNEP staff	Each time deployed	Operator manual
HACH DR/890, DR/900 for orthophosphates for Water Quality	Inspected periodically throughout monitoring time period. Monthly, run a sample of reagent of a known PO_4 concentration. Twice monthly run a blank to test the meter results.	MBNEP staff	Inspected weekly during water quality monitoring effort. Monthly analysis of known reagent and blank.	Operator manual
In-Situ Level TROLL 500, 700 for Water Depth	Inspected when download data. Compare water depth readings to staff gauge reading. Analyze downloaded data for equipment issues.	MBNEP staff	Monthly	Operator manual
Incubators and thermometers for bacteria monitoring	Inspected periodically throughout	MBNEP staff	Monthly	Operator manual

Equipment / Instrument	Maintenance Activity, Testing Activity or Inspection Activity	Responsible Person	Frequency	SOP Reference
	monitoring time period			
SeaBird SeaFET V2	Quarterly calibration and inspection.	Cal Poly staff	Quarterly or whenever sensor is cleaned	Operator manual

All spare parts, reagents and calibration standards are maintained in the MBNEP equipment room, located adjacent to the MBNEP office. All necessary parts and standards are kept on hand so that equipment can be kept in good repair and properly calibrated. Cal Poly maintains all parts, reagents, and other equipment necessary for operating the SeaBird SeaFET pH sensors.

To ensure that there is no carry-over contamination in the vials and syringes used for water quality analysis, MBNEP staff conducts split analysis for precision on a biannual basis. Samples are split and analyzed in a new vial and in a vial that has been in use and undergone the regular procedure of rinsing with DI water and with sample water prior to use. The acceptability criteria for the two results are the precision criteria described in Table 7.1.2. If the criteria are not met, all affected sample vials and syringes will be replaced with new ones immediately. The split sample procedure will be repeated biannually. Volunteers are trained to emphasize the importance of the cleaning procedures. All glassware, vials and syringes are replaced on a biannual basis.

16. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

16.1 Field instruments

Water quality field monitoring uses instruments requiring regular calibration. Each calibration is documented and kept in the calibration log.

Table 16.1.1. Testing, inspection, maintenance of field sampling equipment and analytical instruments

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
HACH FH950 Flow Meters	MBVMP Equipment Calibration Protocols	Bucket test the meters and zero them Send to manufacturer for repair and calibration	Weekly As needed	MBNEP staff. If meter won't zero properly, sensor is cleaned and meter is re-zeroed. Manufacturer will continue to repair meter until problems are corrected or meter needs to be replaced.
YSI ProQuatro, YSI Pro 2030 DO Meters	MBVMP Equipment Calibration Protocols	Internal calibration, verification against Winkler titration. Two readings must be within $\pm$ 20%.	Bimonthly	MBNEP staff. Replace membrane and recondition probe. If this fails, send equipment in for servicing.
YSI ProQuatro, YSI Pro 2030	MBVMP Equipment	Calibration standards. Reading must be within $\pm$	Twice monthly	MBNEP staff.

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
Conductivity Sensors	Calibration Protocols	10% of calibration standard.		
YSI ProQuatro pH Sensors	MBVMP Equipment Calibration Protocols	Calibration standards. Reading must be within ± 10% of calibration standard.	Twice monthly	MBNEP staff.
HACH 2100Q Turbidimeters	MBVMP Equipment Calibration Protocols	Formazin calibration standards. The acceptable difference between the two readings are: for ≤ 5 NTU (± 2 NTU), for ≤ 25 NTU (± 5 NTU), for ≤ 100 NTU (± 20 NTU), for ≤ 500 NTU (± 50 NTU), for ≤ 1,000 NTU (± 100 NTU), for ≤ 10,000 NTU (± 200 NTU), for ≤ 100,000 NTU (± 300 NTU)	Twice monthly	MBNEP staff. Recalibrate. If cannot be corrected, return to manufacturer for serving.
HACH DR/890 and DR/900 meters	MBVMP Equipment Calibration Protocols	Run a known calibration standard and DI water to ensure accuracy. Apply reagent correct factor.	Monthly	MBNEP staff. Split samples are sent to laboratory for analysis. See Table 7.1.2 for criteria.
YSI EXO3 Water Quality Sonde; DO Sensor	MBVMP EXO3 Sonde Protocol	Internal calibration, verification against Winkler titration and/or YSI Pro 2030 meters. Compared readings must be within ± 20%.	Prior to each deployment	MBNEP staff.
YSI EXO3 Water Quality Sonde; pH Sensor	MBVMP EXO3 Sonde Protocol	Calibration standards. Reading must be within ± 10% of calibration standard.	Prior to each deployment	MBNEP staff.
YSI EXO3 Water Quality Sonde; Conductivity Sensor	MBVMP EXO3 Sonde Protocol	Conductivity calibration standard. Reading must be within ± 10% of calibration standard.	Prior to each deployment	MBNEP staff.
YSI EXO3 Water Quality Sonde; Chlorophyll Sensor	MBVMP EXO3 Sonde Protocol	Prepare 0.625 mg/L Rhodamine calibration solution. Reading must be within ± 10% of calibration solution.	Prior to each deployment	MBNEP staff.
Incubator and thermometer (Bacteria lab)	MBVMP Bacteria Quality Assurance Protocol	Log incubator temperature each time remove a batch of trays. Incubator must be from 35 ± 0.5ºC for the	Each batch	Volunteers record values. Reviewed by QA Officer. Adjust incubator temperature as needed.

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
		Colilert-18 incubator and 41 ± 0.5 ºC for the Enterolert incubator.		
Incubator and thermometers (Bacteria lab)	MBVMP Bacteria Quality Assurance Protocol	Replace the certified thermometer in the incubators.	Annually	MBNEP staff.
Autoclave thermometer (Bacteria lab)	MBVMP Bacteria Quality Assurance Protocol	Place certified Maximum Registering Thermometer inside autoclave for each sterilization. Temperatures should reach at least 121°C.	Each batch	MBNEP staff.
Autoclave thermometer (Bacteria lab)	MBVMP Bacteria Quality Assurance Protocol	Place autoclave tape on items to be processed. Tape should change color if temperature reaches 121 ºC.	Each batch	MBNEP staff.
Autoclave (Bacteria lab)	MBVMP Bacteria Quality Assurance Protocol	Run a vial of geobascillus stereothermophillus spores through an autoclave cycle. Place in incubator along with an unautoclaved vial. The unautoclaved vial should change color due to cell growth and the autoclaved one should not.	Monthly	MBNEP staff.
Autoclave timer (Bacteria lab)	MBVMP Bacteria Quality Assurance Protocol	Run autoclave cycle and verify internal timer results using exact National Time Standard (NIST) website time.	Quarterly	MBNEP staff.
HOBO MX2203 Temperature Sensor	MBVMP Continuous Temperature Logger Protocol	Readings verified with a second HOBO MX2203 Temperature Sensor or a calibrated YSI 2030 Pro.	Monthly at one site	MBNEP Volunteer. Sent to manufacturer if error is detected.
HOBO MX2203 Temperature Sensor	MBVMP Continuous Temperature Logger Protocol	Retrieve all sensors and place inside a large bucket with a known temperature. Verify readings of ± 0.2°C.	Annually	MBNEP Staff. Sent to manufacturer if error is detected.
SeaBird SeaFET pH sensor	SeaBird SeaFET Sensor Deployment and	Annual calibration: gel cap replacement, external reference electrode replacement	Various (see previous column)	Cal Poly. Sent to manufacturer if errors are detected.

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
	Calibration Procedures	Calibration prior to deployment: compare results to sample analyzed on a spectrophotometric pH instrument Quarterly: discrete sample calibration		
Fine scale (algae biomass)	MBNEP Bay Macroalgae Monitoring Protocol	Verify accuracy of scale using calibration weights. Certification and calibration of scale, as needed.	Each time scale is used or if drift becomes greater than ± 0.0002 g.	MBNEP staff. Re-calibrate scale. If problem cannot be corrected, scale must be sent to the manufacturer for service.
Gross scale (algae biomass)	MBNEP Bay Macroalgae Monitoring Protocol	Verify accuracy of scale using calibration weights. Certification and calibration of scale, as needed.	Each time scale is used and if drift becomes greater than ± 0.02 g.	MBNEP staff. Re-calibrate scale. If problem cannot be corrected, scale must be sent to the manufacturer for service.
Oven (algae biomass)	MBNEP Bay Macroalgae Monitoring Protocol	Verify accuracy of temperature adjustment using certified thermometer.	Each time oven is started.	MBNEP staff. Adjust oven thermostat so that temperature remains within +/- 10 of the desired temperature.
Desiccators (algae biomass)	MBNEP Bay Macroalgae Monitoring Protocol	Ensure desiccant is dry.	As begin processing each batch of samples.	MBNEP staff. Bake desiccant in oven at designated temperature for desired time and cool before re-using in desiccator.

A calibration log is maintained. See Appendix for a sample. Pre-calibration levels and post-calibration levels are recorded, as well as the name of the person conducting the analysis and the date of calibration. Each piece of equipment is assigned a unique ID number. This number is also recorded in the calibration log, allowing for tracking of performance history for each individual piece of equipment. All equipment maintenance is recorded in a log book and Excel database to document the date and nature of the maintenance required. Cal Poly maintains all calibration results in a calibration log.

If equipment is not meeting the criteria, it is the responsibility of the MBNEP QA Officer to address the problem. This may include repair or replacement of equipment. All corrective actions are documented in the Calibration Log and the Equipment Maintenance Log.

16.2 Laboratory analytical equipment

Calibration of analytical equipment used by each laboratory is outlined in each laboratory's standard operating procedures and quality assurance documentation. Any deficiencies are addressed by the individual laboratory's QA plan. Laboratories comply with the procedures listed below.

Table 16.2.1. Testing, inspection, maintenance of analytical laboratory instruments

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person
County of San Luis Obispo Public Health Laboratory: Incubators	QA Manual	Read and record temperature in incubators twice a day. Thermometers are certified and ASTM calibrated.	Calibrated annually	All Analysts
County of San Luis Obispo Public Health Laboratory: Tray sealer	QA Manual	Run a tray through the sealer containing water with dye to check for leaks.	Monthly	All Analysts
County of San Luis Obispo Public Health Laboratory: Refrigerator	QA Manual	Read and record temperature once a day. Thermometers are certified and ASTM calibrated.	Calibrated annually	All Analysts
EcoAnalysts: Benthic invertebrates	NA	NA	NA	Gary Lester
Fruit Growers Laboratory: Nitrate as N, Nitrite as N, Orthophosphate as P	FGL SOP 2D0900256	External calibration with minimum 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the RL. Linear regression r2 $\geq$ 0.995. Calibration verification every 10 samples after initial calibration. Standard source different than that used for initial calibration. Recover 90 - 110%.	As needed	LDM
Fruit Growers Laboratory: Ammonia as N, Total Nitrogen, Organic Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus	FGL SOPs 2D0900022, 2D0900023, 2D0900089	External calibration with minimum 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the RL. Linear regression $\geq$ 0.995. Calibration verification every 10 samples after initial calibration. Standard source different than used for initial calibration. Recovery 90 – 110%.	90 – 110% Daily	LDM
Fruit Growers Laboratory: Turbidity (for QA)	FGL SOP 2D0900019	Calibration performed Secondary standard check	Daily	LDM
Pace Analytical Services: Oil & Grease	BCORG026	N/A	N/A	MAM

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person
Pace Analytical Services: Dissolved Copper, Dissolved Zinc, Dissolved Lead	BCMET037	External calibration with 3 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the MDL. Linear regression r2 $\geq$ 0.995. Calibration verification every 10 samples after initial calibration. Standard source different than that used for initial calibration. Must pass in order to continue the analysis.	As needed	ARD
Pace Analytical Services: Total Petroleum Hydrocarbons (TPH)-Gasoline, Total Petroleum Hydrocarbons (TPH)-Diesel	BCORG003 BCORG005	External calibration with 6 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the MDL. Linear regression r2 $\geq$ 0.995. Calibration verification every 10 samples after initial calibration. Standard source different than that used for initial calibration. Must pass in order to continue the analysis.	As needed	TDH BUP
Pace Analytical Services: Total Suspended Solids	BCGEN022	Sample / Sample Duplicate	N/A	TJV
UCSB: Lachat Instruments QuickChem 8500 Series 2	QA Manual MSIAL	Blanks, certified reference materials, calibration curve with 12 concentrations, control spikes, check standards, and final checks.	Daily	Ken Marchus

17. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Supplies will be examined for damage as they are received. The following supplies will receive additional checks as follows.

Conductivity and turbidity standards will be checked by comparing their readings with those generated by the current lot of standards. Standards must agree exactly.

Bacterial media will be checked with a sterility check. New batches of media will be used to run a bacteria test using sterile distilled water as the sample. The results should be below the method detection limit.

Each new batch of nutrient and bacteria media will be tested using distilled water as the sample. The results should be below the method detection limit.

All analytical laboratories used by the program maintain a supply inspection and acceptance SOP, which are available from the laboratories upon request.

MBNEP staff, overseen by the MBNEP QA Officer, are responsible for receipt of all consumables and supplies. All supplies are stored in the MBNEP equipment room adjacent to the office. MBNEP staff track supplies and ensure that they are reordered in a timely fashion. All supplies are stored per the manufacturer's recommendations.

Cal Poly inspects and stores all supplies and standards pertaining to bay pH monitoring.

18. NON-DIRECT MEASUREMENTS (EXISTING DATA)

The primary source of non-direct data to this project is the CCRWQCB, which collects data under a SWAMP-approved QAPP, and thus its validity is well-documented. Only data that had undergone CCRWQCB's own approval process would be used. Data is typically provided in a CEDEN-compatible database format. This data would be used in combination with MBNEP data. For details see the MBNEP EMP. The data would need to meet the data quality objectives laid out in Section 7.

The other potential sources of data listed below provide data that would be used anecdotally. If data was to be used for program decision-making, it would be considered based on details provided in data collection protocols. The MBNEP QA Officer would conduct internal audits of the precision, accuracy, bias and completeness to determine if the data would be acceptable for incorporation into its analysis. Outside data is not incorporated into the Access database. Methods of data collection and analysis would be analyzed to ensure that they met the MBNEP's acceptability criteria. Data that did not meet the MBNEP's own criteria laid out in Section 7 would be analyzed separately so that it did not become intermixed with data that had met acceptance criteria.

If that data had confidentiality constraints on it, it would be used without revealing the exact location of sample collection.

These other sources include (but are not limited to):

- California Men's Colony Wastewater Treatment Plant
- California Polytechnic State University, San Luis Obispo student project data
- California Polytechnic State University, San Luis Obispo research data
- Resource Conservation District maintenance and monitoring records
- Point Blue
- Applicable Environmental Impact Report data
- County of San Luis Obispo Environmental Health Department and Department of Public Works
- Los Osos Community Services District
- Surfrider Foundation
- California Department of Fish and Wildlife
- California Department of Parks and Recreation
- US Fish and Wildlife Service
- California Native Plant Society
- California Department of Public Health
- City of Morro Bay
- Central and Northern California Ocean Observing System (CeNCOOS)

19. DATA MANAGEMENT

Upon completion of fieldwork, volunteers or MBNEP staff check over datasheets for completeness and any obvious errors. As datasheets come in from the field, MBNEP staff will review them for any obvious omissions or errors. Data is then entered into the appropriate computerized system, either the Excel or Access database. Upon completion of data entry, a different MBNEP staff member than the one who originally entered that data reviews all entered data to ensure its accuracy and completeness. Once this is complete, the original paper copy datasheets are filed. The database is backed up on an external hard drive and uploaded to cloud storage each night.

When data is received from the analytical laboratories, MBNEP staff reviews the data and then enters it into the appropriate electronic data management system or uploads the electronic data delivery report from the lab. Upon completion of the data entry, an MBNEP staff member reviews all entered data to ensure its accuracy and completeness. Once this is completed, the paper copy report is filed. The database is backed up on an external hard drive and uploaded to cloud storage each night.

The data management protocols are outlined in an SOP titled MBVMP Data Management Protocols (see Appendices).

All Cal Poly-generated data is stored on the Cal Poly OneDrive server and backed up to the cloud.

As SOPs are updated, the date of the update is inserted in the document footer so that users can be sure that they are using the most recent version.

Data is analyzed periodically for various reports or data summaries generated for agencies, non-profits and other users of the data. The majority of this analysis is conducted with Access, Excel and ESRI ArcGIS. This analysis is conducted by MBNEP staff and is overseen by the MBNEP QA Officer.

Data that are submitted to the California Environmental Data Exchange Network (CEDEN) is reviewed by the MBNEP QA Officer and an automated data checker, which is maintained by CEDEN. If data fails the automated check criteria, data will be returned to the QA Officer for edits. Successfully submitted data is available for download by CCRWQCB, CCAMP staff, and others.

The MBNEP contracts with an independent contractor to provide server maintenance and upkeep. As our primary data management system is a CEDEN-compatible database, MBNEP staff relies on guidance from State Water Board staff to inform us of the requirements of both hardware and software for properly maintaining the CEDEN-compatible database.

GROUP C: ASSESSMENT AND OVERSIGHT

20. ASSESSMENTS & RESPONSE ACTIONS

To ensure that the QAPP is being implemented as approved, the QC procedures outlined in Section 14 are conducted. The MBNEP QA Officer is responsible for this assessment. Progress or problems are reported to the RWQCB QA Officer. These assessments include review of calibration logs, review of QA data from the laboratories, audits of field and laboratory activities, and review of all data management activities. These activities are all on-going and happen at least on a quarterly basis. The approximate schedule for these activities is in March, June, September and December of each year.

While no formal external assessments are planned, any problems or issues are shared with the RWQCB QA Officer and advice is sought to correct the problem.

Corrective actions noted during a field or laboratory audit would be addressed through a review of the SOP and re-training of staff or volunteers. Actions to address calibration problems or QA data from the laboratories would be addressed by the MBNEP QA Officer and might include repair or maintenance to a piece of equipment, review of SOPs, re-training of staff or volunteers, or replacement of a problematic piece of equipment. Corrective actions for data management issues would include review of SOPs and retraining of VMP staff to correct any problems.

Laboratory personnel are responsible for assessing laboratory QC results and implementing any necessary corrective actions.

The MBNEP QA Officer has the authority to halt all sampling and analytical work by the MBNEP staff or volunteers as well as any of the analytical laboratories with which it contracts.

Cal Poly is responsible for all QA issues related to bay nutrient and pH monitoring, including review of calibration logs, review of QA data, audits of field and lab activities, and review of data.

21. REPORTS TO MANAGEMENT

MBNEP staff and volunteers are in constant communication with the MBNEP QA Officer and any issues, discrepancies or problems would immediately be reported.

The MBNEP staff and MBNEP QA Officer create an annual detailed QA analysis. This QA analysis will outline any results that did not meet the QC objectives. Any outstanding issues are discussed with the RWQCB QA Officer.

SOPs are updated continuously throughout the year. Once a year, a QAPP update will be submitted to the RWQCB and EPA QA Officers for their review and approval. It will include all of the updates to SOPs and QA procedures.

For the bay pH monitoring and bay nutrient monitoring, Cal Poly will produce a report which will includes QA information such as accuracy and precision estimates.

Table 21.1.1 QA management reports

Type of Report	Frequency	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Data Summary Report and Memos	Annually	Variable	MBNEP Program Manager	Project partners
Calibration Log	Annually	Variable	MBNEP Program Manager	Maintained on-site
QAPP Update	Annually	Variable	MBNEP QA Officer	RWQCB QA Officer, EPA QA Officer

GROUP D: DATA VALIDATION AND USABILITY

22. DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

All raw data, data entry, calculations, and data analysis are reviewed and verified by the MBNEP QA Officer. All data received by laboratories are also reviewed by the MBNEP QA Officer or a trained staff person. Information such as chain of custody forms are also reviewed to ensure that all hold times, sample preservation requirements, etc. have been met.

Data will be reviewed against the measurement quality objectives in Section 7 and separated into one of the following categories: data meeting all MQOs, data failing precision criteria, or data failing to meet accuracy criteria. Data meeting all MQOs is usable for future analysis. Data in the last category is not usable. For data failing the precision category, the following actions will be taken based on the type of data. For bacteria, data failing the 95% confidence interval criteria will not be used. The orthophosphate meter has a practical quantitation limit (PQL) of 0.33 mg/L as PO_4. When assessing the orthophosphates precision criteria and the replicate readings are less than the PQL, then regardless of the relative percent difference (RPD) between the two readings the results pass the acceptance criteria and data will be retained. If the replicate readings are greater than the PQL and the RPD is greater than 25%, then the replicate criteria has not been met and the data will be rejected. All other water quality parameters will follow the precision criteria listed in Table 7.1.2 and if they are not met, the data are rejected. Each failing value will be flagged as such in the database so it can easily be excluded from all data analysis. All decisions regarding data validation will be performed by the MBNEP QA Officer.

Cal Poly is responsible for the review, verification, and validation of the bay pH data. The discrete pH samples will be used to assess error by establishing an error envelope for the sensor time-series calculated as a function of the discrete pH error. The data will be used to create time series anomaly plots to identify periods of sensor conditioning, drift, fouling, and failure. It will also be used to create property-property plots to examine the agreement between the sensor pH and independent reference pH values from the discrete samples. For absolute differences in sensor and discrete sample results of greater than 0.1 pH units, the data would be discarded from further analysis.

23. VERIFICATION AND VALIDATION METHODS

All data records will be checked visually prior to data entry into either the Access database, the Excel files or other electronic formats. Any corrections will be written directly on the datasheet. MBNEP staff will conduct all reviews and a different MBNEP staff member will review all datasheets and all data entry into Access, Excel and other electronic formats. Laboratory QA Officers will perform checks of all of their records. All submittals by laboratories will be reviewed by MBNEP staff. Any questions with the data submitted by the laboratories will be addressed with the appropriate laboratory personnel who verify the data. Once any issues have been resolved, the data can be loaded into the Access database, Excel database and other electronic formats.

Data validation is conducted by the MBNEP QA Officer and is done by a manual review of the data. The MBNEP QA Officer is responsible for verifying and validating all datasheets, chain of custody forms, maintenance logs and calibration logs. The MBNEP QA Officer also validates the data entry into the CCAMP database and other electronic formats, as well as any calculations.

Issues will be noted. Reconciliation and correction will be done by a committee composed of the MBNEP QA Officer and MBNEP staff with input, if applicable, from laboratory directors and from the RWQCB QA Officer. Any special notes or decisions regarding data usability will be entered in the 'Notes' column of the Access or Excel database. If it has been determined that the data should not be used in future calculations, it will be flagged as such in the electronic format.

Data validation is conducted by Cal Poly for the bay pH and nutrient data, per analysis described in the Section 22. Issues are noted, reconciled, and corrected by Cal Poly.

24. Reconciliation with User Requirements

The overall goal of this monitoring effort is to track long-term trends in the Morro Bay estuary and its watershed, as well as assess effectiveness of implementation efforts. The specific goals of the monitoring are laid out in Section 5.2. The monitoring was designed to include sampling locations, methods and frequency to assist in addressing these goals. However, MBNEP-generated data will not be adequate for completely addressing all of these goals and is expected to be supplemented by other sources.

Uncertainty regarding the data will be assessed with data verification and validation procedures as outlined in Sections 22 and 23. The project requires adequate data to address its goals, and the completeness criteria indicate whether this data will be adequate. The completeness criteria are the most essential in determining whether the collected data provide enough information to answer the original questions asked. Long-term trend data is required, with no gaps in the data collection and consistent sample collection and handling.

All data with limitations on its data use are flagged in our database. If requests are received for program data or analysis, those questionable data records will not be included.

All data will be analyzed for outliers and trends. Data is summarized in graphs and charts and presented on an annual basis in data summary memos that are made publicly available. All trends, anomalies and relationships are discussed in the report. Adequate information on sample design will be provided to inform users of limitations in data use.

All data is collected, managed and maintained in a SWAMP-compatible manner. All historic data for water quality, flow, bacteria and bioassessment has been submitted to CEDEN via the Regional Data Center. Data is submitted to CEDEN on a quarterly basis.

Bay pH data will be submitted to the Water Board rather than CEDEN, as the data portal cannot currently accept continuous monitoring data. Only data that meets QA criteria will be submitted.

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Acronym List

Acronym	Definition
CCAMP	Central Coast Ambient Monitoring Program
CCMP	Comprehensive Conservation & Management Plan
CCRWQCB	Central Coast Regional Water Quality Control Board
CDPH	California Department of Public Health
CEDEN	California Environmental Data Exchange Network
CWA	Clean Water Act
DI	Deionized
DO	Dissolved oxygen
ELAP	Environmental Laboratory Accreditation Program
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Agency
GPS	Global Positioning System
ISS	Inferometric sidescan sonar
MBNEP	Morro Bay National Estuary Program
MBVMP	Morro Bay Volunteer Monitoring Program
MDL	Minimum Detection Limit
MPN	Most Probable Number
MQO	Measurement Quality Objective
MTF	Multiple Tube Fermentation
NTU	Nephelometric turbidity units
PQL	Project Quantitation Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
RWQCB	Regional Water Quality Control Board
SET	Surface elevation table
SM	Standard Method
SOP	Standard Operating Procedure
SPoT	Stream Pollution Trends
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
UAV	Unmanned aerial vehicle
UCD-GC	UC Davis Granite Canyon
USGS	United States Geological Survey
VMP	Volunteer Monitoring Program