Quality Assurance Project Plan

Morro Bay National Estuary Program's
Volunteer Monitoring Program

Funding Agreement #08-309-550

Prepared for
State Water Resources Control Board, Division of Financial Assistance
1001 I Street, 16th Floor
Sacramento, CA 95814

and

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

Prepared by
Morro Bay National Estuary Program

January 12, 2010
Version 5, Draft 2

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GROUP A ELEMENTS: PROJECT MANAGEMENT

1. TITLE AND APPROVAL SHEETS

Quality Assurance Project Plan

For

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

Proposal Identification Number: 08-309-550

Date: January 12, 2010

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	Daniel Berman		
MBNEP Program Manager	Ann Kitajima		
QA Officer	Ann Kitajima		

REGIONAL BOARD:

Title:	Name:	Signature:	Date:
QA Officer	Karen Worcester		

STATE WATER RESOURCES CONTROL BOARD:

Title:	Name:	Signature:	Date:
Contract Manager	Mark Fong		

US Environmental Protection Agency:

Title:	Name:	Signature:	Date:
USEPA Project Manager	Suzanne Marr		
USEPA QA Officer	Eugenia McNaughton, Ph.D.		

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.

2. TABLE OF CONTENTS

List of Appendices:

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3. DISTRIBUTION LIST

Title:	Name (Affiliation):	Tel. No.:	QAPP No*:
Contractor Program Director	Dan Berman (MBNEP)	805-772-3834	1
Contractor Program Manager/QA Officer /VMP staff	Ann Kitajima (MBNEP)	805-772-3834	ORIGINAL
SWRCB Contract Manager	Mark Fong (SWRCB)	916-341-5827	1
Regional Board QA Officer	Karen Worcester (RWQCB)	805-549-3333	1
USEPA Project Manager	Suzanne Marr(USEPA)	415-972-3468	1
USEPA QA Officer	Eugenia McNaughton, Ph.D.(USEPA)	415-972-3798	1
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.

Dan Berman is the program director of the MBNEP. He approves the contract invoices developed by the program manager. The program manager reports directly to the program director.

Ann Kitajima is 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. She is responsible for the activities of all VMP staff and volunteers.

Creek Environmental Laboratories, Inc. is the lab that conducts QA analysis of nutrient samples for the MBNEP and analysis of stormwater samples. This contract laboratory is not directly responsible for delivery of any contract submittals. The San Luis Obispo County Public Health Agency Laboratory conducts the QA analysis of bacteria samples. This contract laboratory is not directly responsible for delivery of any contract submittals. Both labs will analyze submitted samples in accordance with all method and quality assurance requirements found in this Quality Assurance Program Plan (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.

Table 4.1.1. Personnel responsibilities

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
Ann Kitajima	MBNEP Volunteer Monitoring Program	Program Manager/QA Officer	805-772-3834, (f) 805-772-4162, annk@mbnep.org
Dan Berman	MBNEP	Program Director	805-772-3834, (f) 805-772-4162, dberman@mbnep.org
Mike Ng	Creek Environmental Laboratories	Laboratory Director	805-545-9838, (f) 805-545-0107, mike@creeklabs.com
Sharon Beccaccio	San Luis Obispo County Public Health Agency	Supervising Health Officer	805-781-5507, (f) 805-781-1023
Gary Lester	Ecoanalysts, Inc.	President	208-882-2588, glister@ecoanalysts.com
John Callaway	University of San	Project Manager for SET project	(415) 422-5702, callaway@usfca.edu

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
	Francisco		

4.2 Quality Assurance Officer role

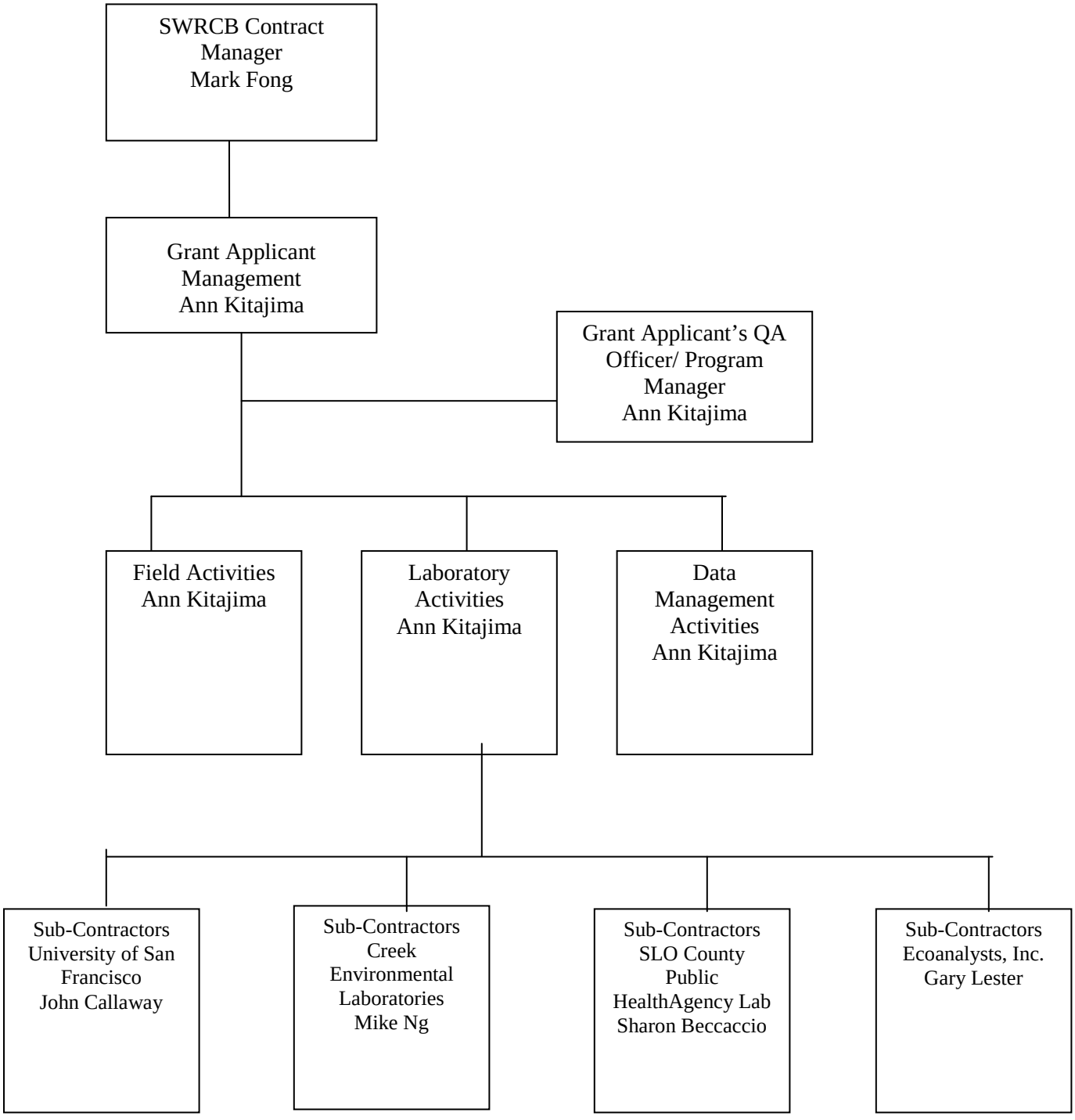
The MBNEP Program Manager is responsible for general oversight of the program including grant management, volunteer recruitment and training, protocol development, data management, data analysis and report writing. The Program Manager also serves as the MBNEP QA Officer for this small program. However, 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. While they receive training and oversight from the Program Manager, the data collection is conducted independently of VMP staff members. Data management and reporting, while overseen the Program Manager, are conducted by a VMP 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 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.

4.4 Organizational chart and responsibilities

Figure 4.4.1. Organizational chart



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. Increased Bacteria Concentrations
3. Increased Nutrients Concentrations
4. Reduction of Freshwater Flow
5. Increased Heavy Metals and Toxics
6. Habitat Loss
7. Loss of Steelhead

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.

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 Central Coast Regional Water Quality Control Board's (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 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 including stream profiling, shorebird surveying, surface elevation tables (SETs), stream flow, macroinvertebrates, eelgrass, and algal cover do not have specific criteria for comparison.

Table 5.3.1. MBNEP screening levels for monitoring data

Parameter	Criteria	Type	Qualifier
Total coliform (freshwater, estuarine)	> 10,000 MPN/100 mL	AB411 State Regulation of Beaches & Recreational Waters	If the ratio of fecal/total coliform bacteria exceeds 0.1, then the criteria is 1,000 MPN/100 mL
E. coli (freshwater)*	> 235 MPN/100 mL	Recommended standard from EPA Guidance, Ambient Water Quality Criteria for Bacteria, 1986	This value is not currently part of the CCRWQCB Basin Plan
Enterococcus (estuarine)	> 104 MPN/100 mL	Recommended standard from EPA Guidance, Ambient Water Quality Criteria for Bacteria, 1986	This value is not currently part of the CCRWQCB Basin Plan
Conductivity (for Water Quality)	> 3,000 uS	CCAMP Attention Level	Established for the Morro Bay watershed.
Dissolved oxygen (freshwater, estuarine)	< 7.0 mg/L	CCRWQCB Basin Plan standard	
Nitrate as nitrogen (for Water Quality)	> 10.0 mg/L	CCRWQCB Basin Plan Drinking Water Standard	
Orthophosphate as PO_4 (for Water Quality)	> 0.36 mg/L	CCAMP Attention Level	Value developed specifically for Pajaro River but being used for Morro Bay
pH (for Water Quality)	< 6.5 and > 8.3	CCRWQCB Basin Plan Standard	
Temperature (for Water Quality)	> 24 ºC	CCRWQCB Basin Plan Standard	

Parameter	Criteria	Type	Qualifier
Turbidity (for Water Quality)	> 10 NTU	CCAMP Attention Level	During non-storm events
Total dissolved solids (TDS) – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Total suspended solids (TSS) – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Oil & grease – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Dissolved metals – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Turbidity – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Urban Watch: Ammonia, Total Residual Chlorine, Turbidity, pH, Temperature, Conductivity, Nitrates, Orthophosphates	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing dry season runoff flows.
Suspended sediment concentration of creek storm flows	NA	NA	No standards exist either in the Basin Plan or as part of CCAMP.

* As there is no recommended EPA standard for analysis of *E. coli* in marine waters, there is no corresponding value in Table 5.3.1 for comparison of *E. coli* results in marine waters. However, this analysis is conducted by the program for marine samples because the shellfish regulations and the current Basin Plan regulations are written for fecal coliform. Because fecal coliform data is more closely comparable to *E. coli* data than enterococcus results, the program will continue to monitor for both *E. coli* and enterococcus in marine waters.

6. PROJECT/TASK DESCRIPTION

6.1 Work statement and produced products

Bacteria monitoring conducted by program 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 *E. coli* and enterococcus. Split samples are sent to a local laboratory for analysis. Each month, results for sites with levels of concern are forwarded to various landowners and agencies so that any potential public health threat can be addressed. Data is stored in a CCAMP developed database.

Deliverables include a consistent bacteria data set in electronic format and monthly notifications. All data is analyzed in an annual data summary report.

Water quality monitoring by program volunteers includes monthly sampling at local creek sites throughout the Morro Bay watershed. Samples are analyzed for pH, temperature, turbidity, conductivity, dissolved oxygen (DO), nitrates as nitrogen and orthophosphates as PO_4. Split samples are sent to a laboratory for nutrient analysis. Data is stored in a CCAMP database. Deliverables include a consistent water quality data set in an electronic format. All data is analyzed in an annual data summary report.

Flow monitoring by program volunteers includes monthly monitoring at local creek sites throughout the watershed. Volunteers estimate creek depth and velocity, and an instantaneous flow rate is estimated from this information. Data is stored in a CCAMP database. Deliverables include a consistent flow data set in an electronic format. All data is analyzed in an annual data summary report.

Bay water quality monitoring by program volunteers includes monthly sampling at shoreline and bay sites. Water at the shoreline sites is analyzed for temperature, salinity and nitrates as nitrogen. The bay sites are analyzed for DO, temperature and salinity. The shoreline data is stored in an Excel spreadsheet, and the bay data is stored in a CCAMP database. Deliverables include a consistent bay water quality data set in an electronic format. All data is analyzed in an annual data summary report.

For stormwater monitoring, program volunteers collect samples from local storm drains, culverts and other collection points within the first hour of the first major rain of the season, which is called First Flush monitoring. Samples are analyzed by the laboratory for nitrates, orthophosphates, pH, temperature, turbidity, *E. coli* , total coliform, TDS, TSS, oil & grease, and dissolved metals. Data is stored in a CCAMP database. Deliverables include a consistent stormwater data set in an electronic format and an annual stormwater monitoring report.

For Urban Watch (UW) monitoring, program volunteers collect samples and record observations of storm drain flows during the dry season. Samples are analyzed by the volunteers using test kits and meters. Samples are analyzed for pH, temperature, conductivity, turbidity, chlorine, ammonia, nitrates, orthophosphates, turbidity and bacteria. Data is stored in a CCAMP database. Deliverables include a consistent dry season runoff data set in an electronic format and an annual stormwater monitoring report.

For macroinvertebrate monitoring, program volunteers collect samples on local creeks each year. Samples are sent to a lab for analysis. The lab analyzes the sample following EPA's Western EMAP method with counts to the genus/species level, including the midges, with worms left at Class Oligochaeta, to a 500 count subsample. The lab provides the counts as well as various calculated metrics. Data is provided in electronic format and loaded into a CCAMP database. Deliverables include a consistent macroinvertebrate data set in electronic format. All data is analyzed in an annual data summary report.

For stream profiling, program volunteers monitor sites annually 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. Select data is analyzed in an annual data summary report.

For SET monitoring, sites are currently monitored approximately every five years, and more frequently if large storm events occur. During the dry season, a complete set of measurements is taken by University of San Francisco personnel at six sites in the salt marsh area of the bay. The results are presented in an annual sediment monitoring report.

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 collected each fall with a digital aerial sensor with four channels. 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. National Marine Fisheries Service staff collect data on bay-wide eelgrass using a Biosonics DE-X #03005 single-beam acoustic unit and Biosonics EcoSAVE software to analyze the data. Their survey covers the transects historically monitored by VMP staff and volunteers, as well as submerged eelgrass that is not captured by other monitoring efforts. VMP staff conducts fieldwork on four detailed transects to collect shoot density, biomass samples and other measurements. The data is stored electronically in Excel spreadsheets. An annual eelgrass report is created summarizing the effort and results for the year.

For algae documenting, photo documentation and visual observations are conducted by program volunteers at sites throughout the creeks to track algal growth. The data is stored in the form of a photo catalog and an Excel spreadsheet. The data is provided on an annual basis to CCRWQCB staff to support TMDL development. The results are presented in an annual data summary report.

For bird monitoring, volunteers participate in shorebird monitoring events each fall to conduct bay-wide counts. The data is shared with local birding organizations and stored in electronic Excel format. The data is included in an annual data summary report.

For phytoplankton monitoring, program volunteers collect samples twice monthly from bay and ocean sites to help the California Department of Public Health (DPH) track toxic algal blooms. Samples are analyzed under a microscope and cell counts and samples are sent to DPH for analysis. The results are stored in CCAMP. The data is included in an annual data summary report.

For suspended sediment concentration monitoring, samples are collected from creek sites during storm flows using automated samplers. Lab analysis is conducted by VMP staff to analyze the samples for their suspended sediment concentration. Data is stored in an Access database. Deliverables include a consistent suspended sediment concentration dataset stored in an electronic format and an annual sediment monitoring report summarizing the results.

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	Monitoring Frequency	Primary or Secondary	Method
Total coliform (freshwater)	Monthly	Primary	IDEXX Colilert-18 analysis
E. coli (marine and freshwater)	Monthly	Primary	IDEXX Colilert-18 analysis
Enterococcus (marine)	Monthly	Primary	IDEXX Enterolert analysis
Conductivity (freshwater)	Monthly	Primary	Meter
Dissolved oxygen (marine and freshwater)	Monthly	Primary	Meter

Parameter	Monitoring Frequency	Primary or Secondary	Method
Nitrate as nitrogen (marine, freshwater and dry season runoff)	Monthly	Primary	Test kit
Orthophosphate as PO_4 (freshwater and dry season runoff)	Monthly	Primary	Meter
pH (freshwater and dry season runoff)	Monthly	Primary	pH paper
Flow (freshwater)	Monthly	Primary	Meter
Temperature (marine and freshwater)	Monthly	Primary	Meter
Turbidity (freshwater and dry season runoff)	Monthly	Primary	Meter
Laboratory analysis - Nitrate as nitrogen (freshwater and FF stormwater)	Monthly	Primary	EPA Method 300.0
Laboratory analysis - Orthophosphate as P (freshwater and FF stormwater)	Monthly	Primary	SM 4500-P E
Laboratory analysis - Total dissolved solids (TDS) (FF stormwater)	Annually	Primary	SM 2540C
Laboratory analysis - Total suspended solids (TSS) (FF stormwater)	Annually	Primary	SM 2540D
Laboratory analysis - Oil & grease (FF stormwater)	Annually	Primary	EPA 1664 Rev. A
Laboratory analysis - Dissolved metals (FF stormwater)	Annually	Primary	EPA 200.8
Laboratory analysis – Turbidity (FF stormwater)	Annually	Primary	SM 2130B
Laboratory analysis - Macroinvertebrates	Annually	Primary	EPA's Western EMAP method with counts to genus/species level to a 500 count subsample
Stream profiling	Annually	Primary	NA
SETs	Annually	Primary	NA
Eelgrass	Annually	Primary	NA
Algae documenting	Monthly	Primary	NA
Bird surveys	Biannually	Primary	NA
Phytoplankton	Bimonthly	Primary	NA
Suspended sediment concentration	As needed, during storms	Primary	ASTM D 3977

6.3 Project schedule

All monitoring efforts are ongoing with the goal of tracking long-term trends. Monitoring efforts were carried on under a 319(h) grant from 2001 through 2003, a Proposition 13 Coastal Nonpoint Source Control Program grant from 2004 through 2007, and a Proposition 50 Coastal Nonpoint Source Pollution Control Program grant from 2007 through 2008. Upon suspension of proposition-funded grants in December 2008, the program received ARRA funding starting in May of 2009 that will fund the program through the fall of 2010. For each monitoring effort, the results are summarized in an annual data summary report. This monitoring is expected to continue, assuming adequate funding is available, beyond the conclusion of the current funding source. 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)		Deliverable	Deliverable Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Water quality, flow, bacteria, macroinvertebrates, stream profiling, eelgrass, algae documenting, shorebird surveys, phytoplankton	Ongoing		Annual data summary report	September of each year of grant
Stormwater	Ongoing		Annual data summary report	June of each year
Sedimentation: SETs, suspended sediment concentrations	Ongoing		Annual data summary report	September of each year
Bacteria	Ongoing		Data summary for sites of concern	Monthly

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 28,000-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.

In the following figures, the source data for the roads was the TIGER dataset produced by the US Census. In the legend for the figures, this was designated as “tiger_roads.”

This section includes maps showing monitoring sites as follows:

- Figure 6.4.2: MBNEP flow monitoring locations
- Figure 6.4.3: MBNEP creek and bay bacteria monitoring locations
- Figure 6.4.4: MBNEP creek water quality monitoring locations

- Figure 6.4.5: MBNEP bay nutrients monitoring locations
- Figure 6.4.6: MBNEP bay dissolved oxygen monitoring locations
- Figure 6.4.7: MBNEP First Flush stormwater monitoring locations
- Figure 6.4.8: MBNEP Urban Watch runoff monitoring locations in Los Osos
- Figure 6.4.9: MBNEP Urban Watch runoff monitoring locations in Morro Bay
- Figure 6.4.10: MBNEP stream profiling monitoring locations
- Figure 6.4.11: MBNEP SET monitoring locations
- Figure 6.4.12: MBNEP macroinvertebrate monitoring locations
- Figure 6.4.13: MBNEP eelgrass monitoring locations
- Figure 6.4.14: MBNEP algae monitoring locations
- Figure 6.4.15: MBNEP shorebird monitoring locations
- Figure 6.4.16: MBNEP phytoplankton monitoring locations
- Figure 6.4.17: MBNEP suspended sediment monitoring locations

6.5 Constraints

Low creek flow conditions can impact water quality, bacteria, flow and macroinvertebrate monitoring. For bay monitoring, tides must be high enough to avoid stranding in the soft mud.

Possible constraints for monitoring include funding for eelgrass and macroinvertebrate monitoring, which both involve costly consultants or laboratories. If funding is inadequate in the future, bay-wide aerial eelgrass maps and detailed macroinvertebrate sample analysis may not be conducted.

Figure 6.4.1. Location of Morro Bay Watershed and Tributaries

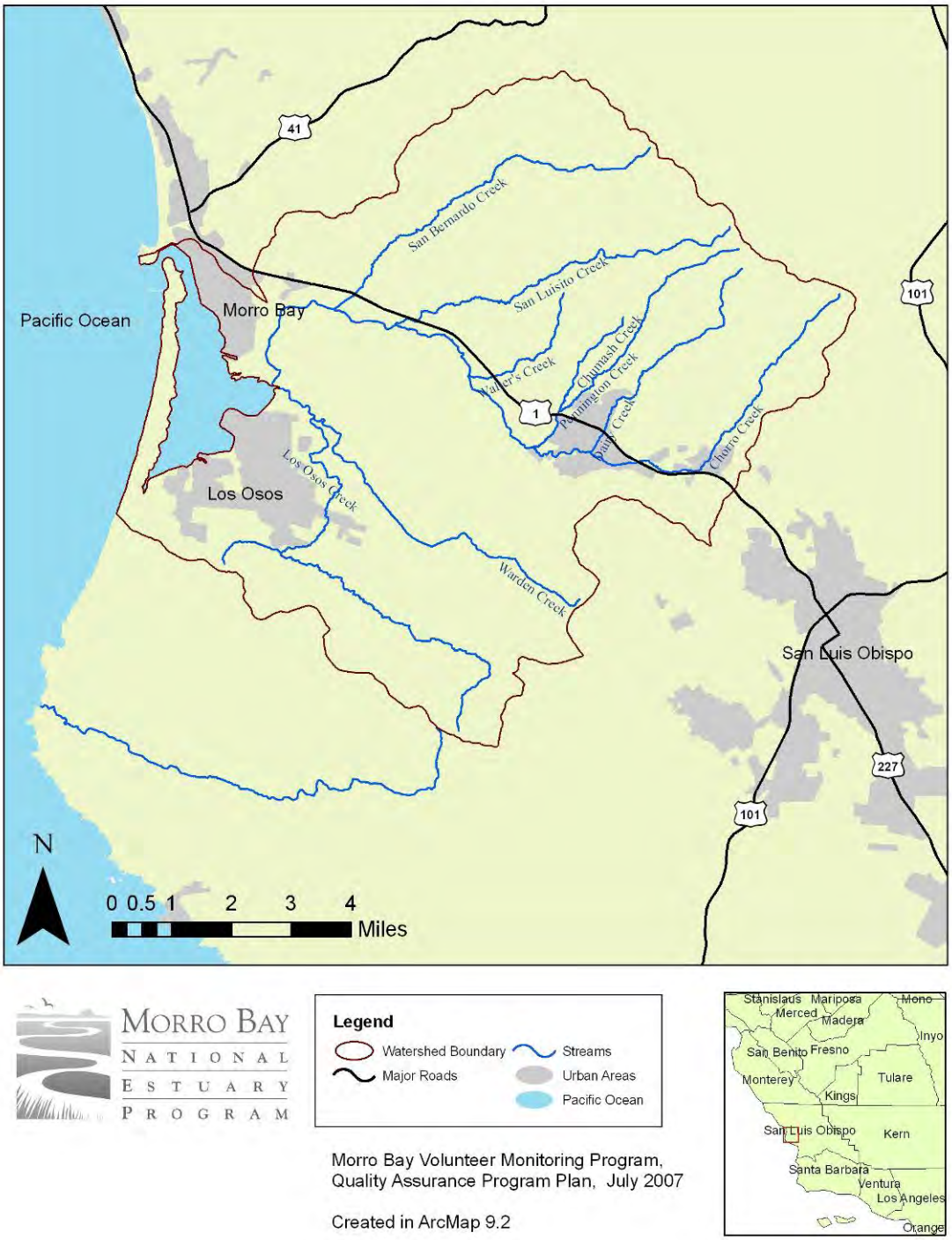
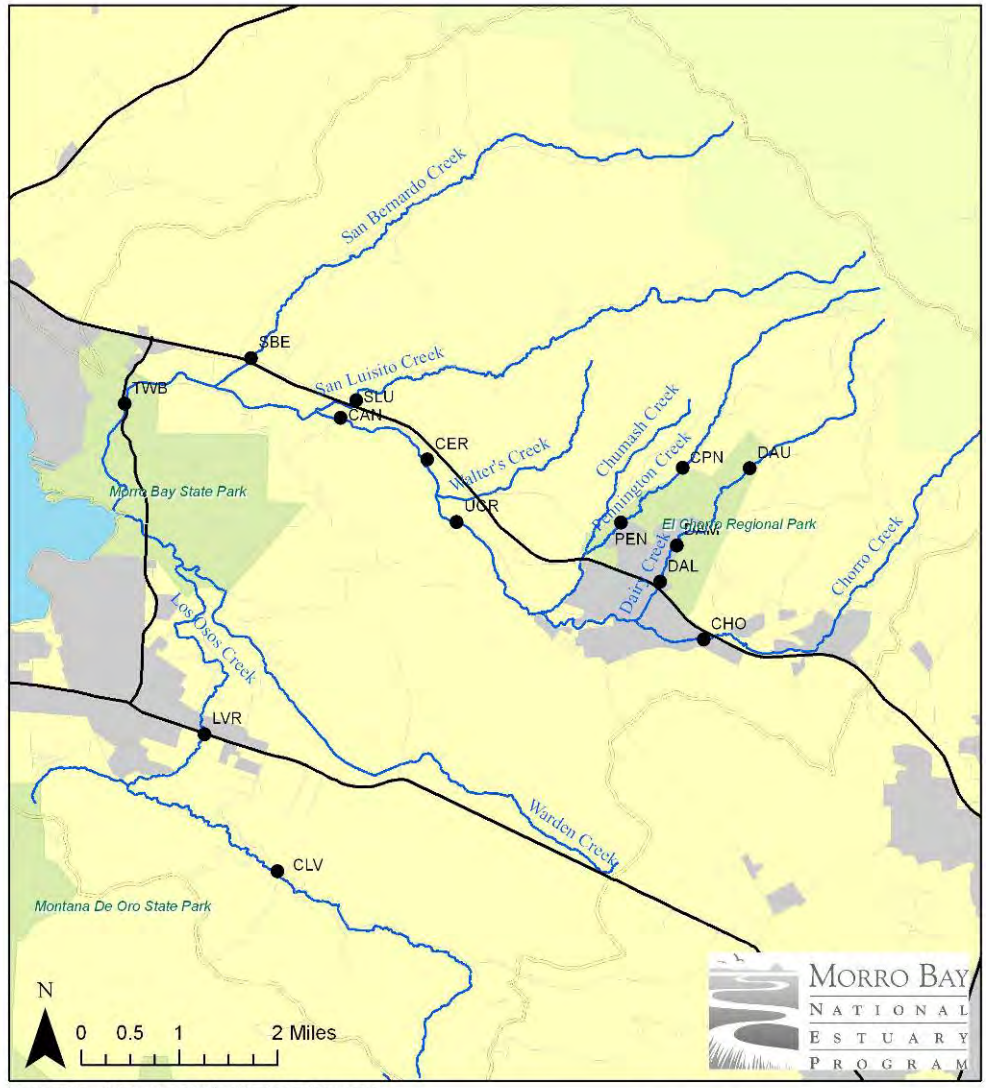


Figure 6.4.2. MBNEP Flow Monitoring Locations



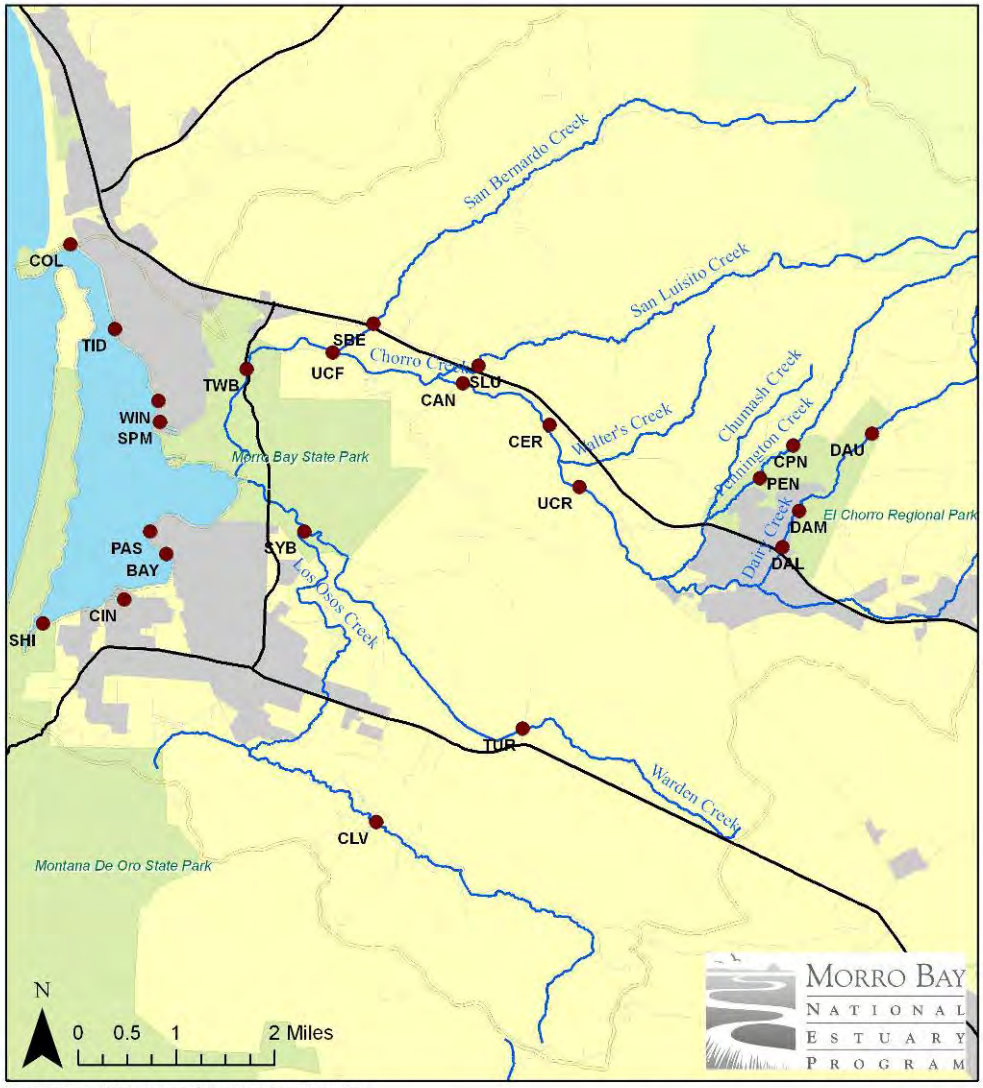
Morro Bay Volunteer Monitoring Program
Quality Assurance Program Plan Update, October 2009

Maps created in ArcMap 9.3
10/15/2009 A. Gillespie

Legend

- Flow Sites
- Watershed Boundary
- Major Roads
- Surface Streets
- Creeks
- Urban Areas

Figure 6.4.3. MBNEP Creek and Bay Bacteria Monitoring Locations



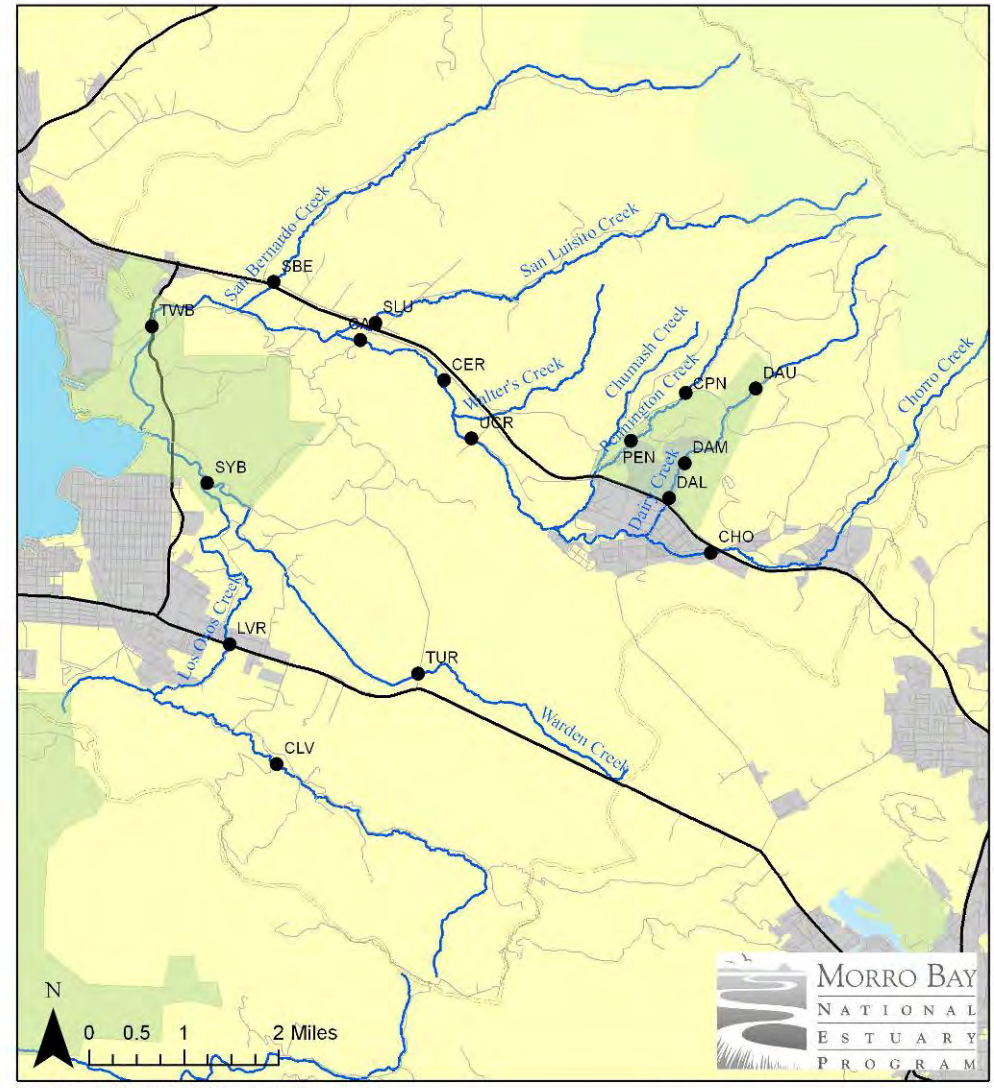
Morro Bay Volunteer Monitoring Program
Quality Assurance Program Plan Update, October 2009

Maps created in ArcMap 9.3
10/15/2009 A. Gillespie

Legend

- Bacteria Monitoring Sites
- Watershed Boundary
- Major Roads
- Surface Streets
- Creeks
- Urban Areas

Figure 6.4.4. MBNEP Creek Water Quality Monitoring Locations



Morro Bay Volunteer Monitoring Program
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Maps created in ArcMap 9.3
10/15/2009 A. Gillespie

Legend

- Watershed Boundary
- Surface Streets
- Major Roads
- Creeks
- Water Quality Sites
- Urban Areas

Figure 6.4.5. MBNEP Bay Nutrients Monitoring Locations

Figure 6.4.6. MBNEP Bay Dissolved Oxygen Monitoring Locations

Figure 6.4.7. MBNEP First Flush Stormwater Monitoring Locations

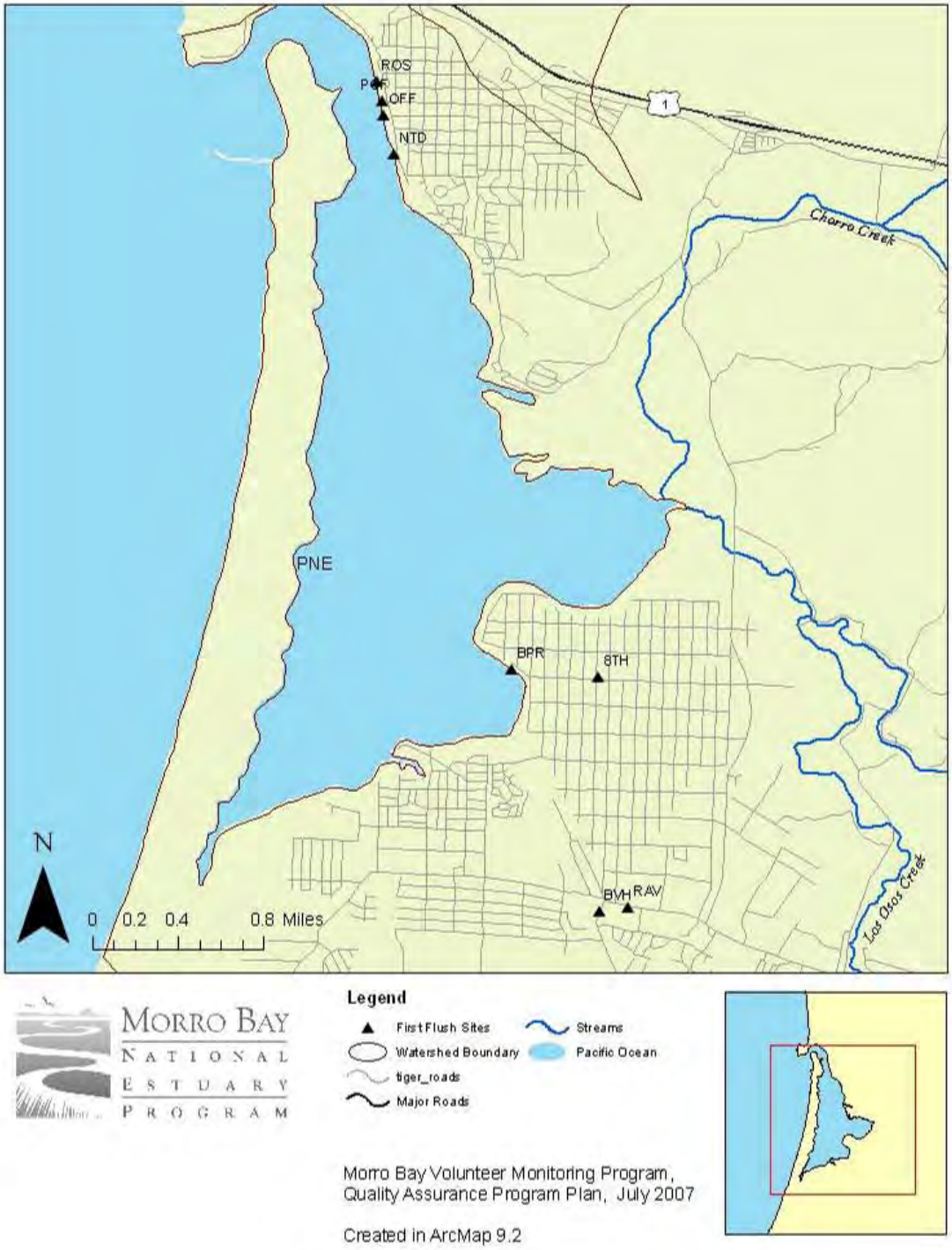


Figure 6.4.8. MBNEP Urban Watch Runoff Monitoring Locations in Los Osos

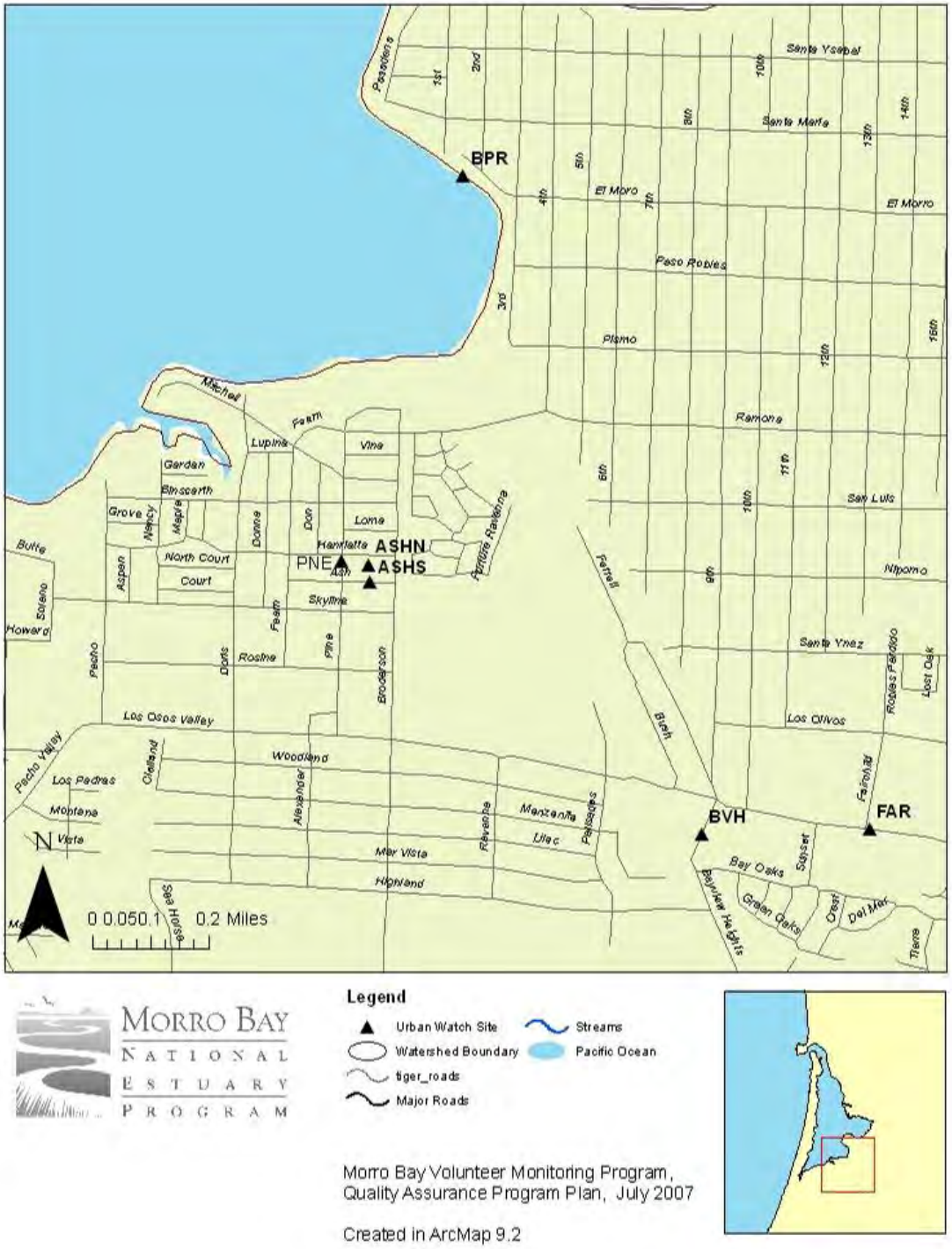


Figure 6.4.9. MBNEP Urban Watch Runoff Monitoring Locations in Morro Bay

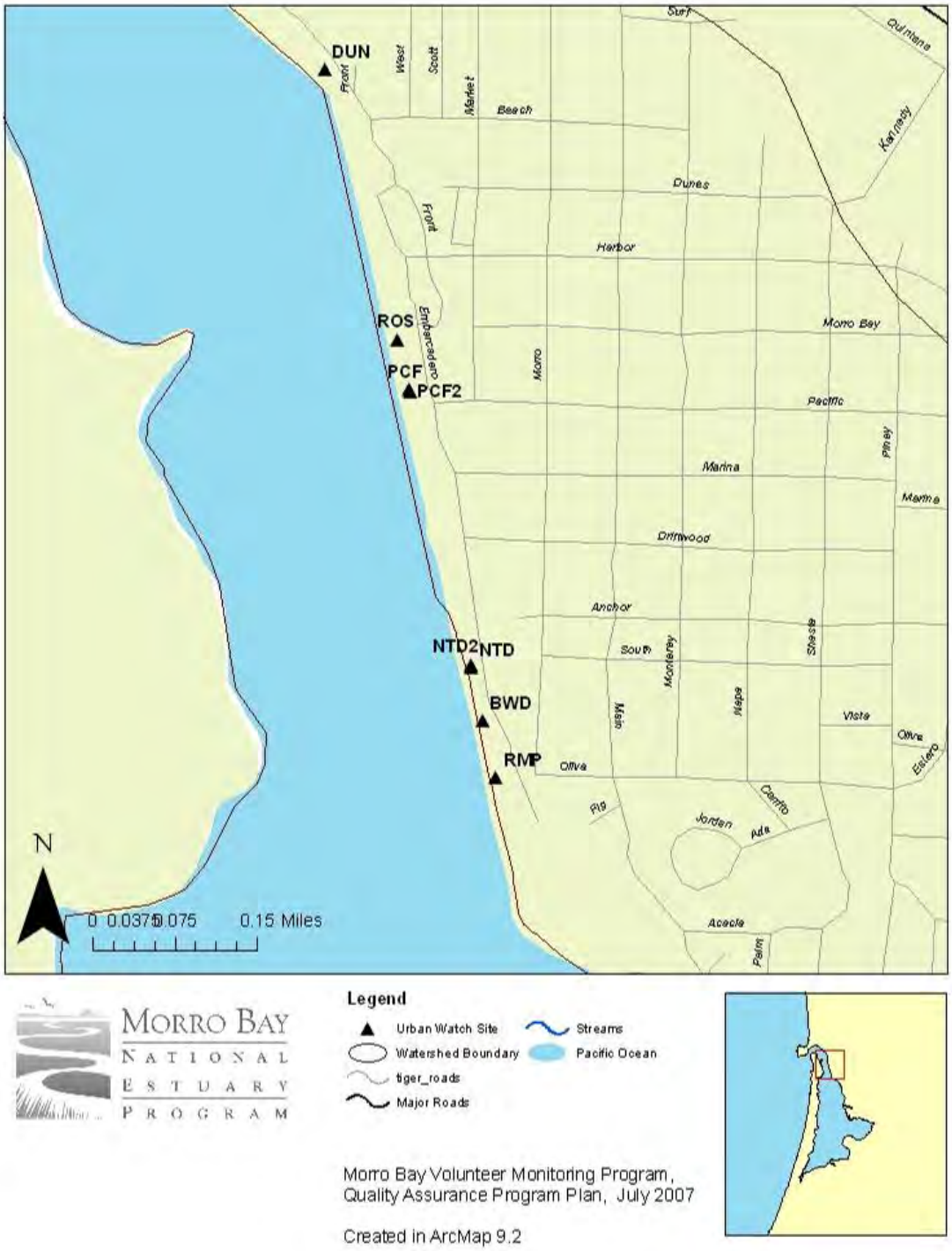


Figure 6.4.10. MBNEP Stream Profiling Monitoring Locations

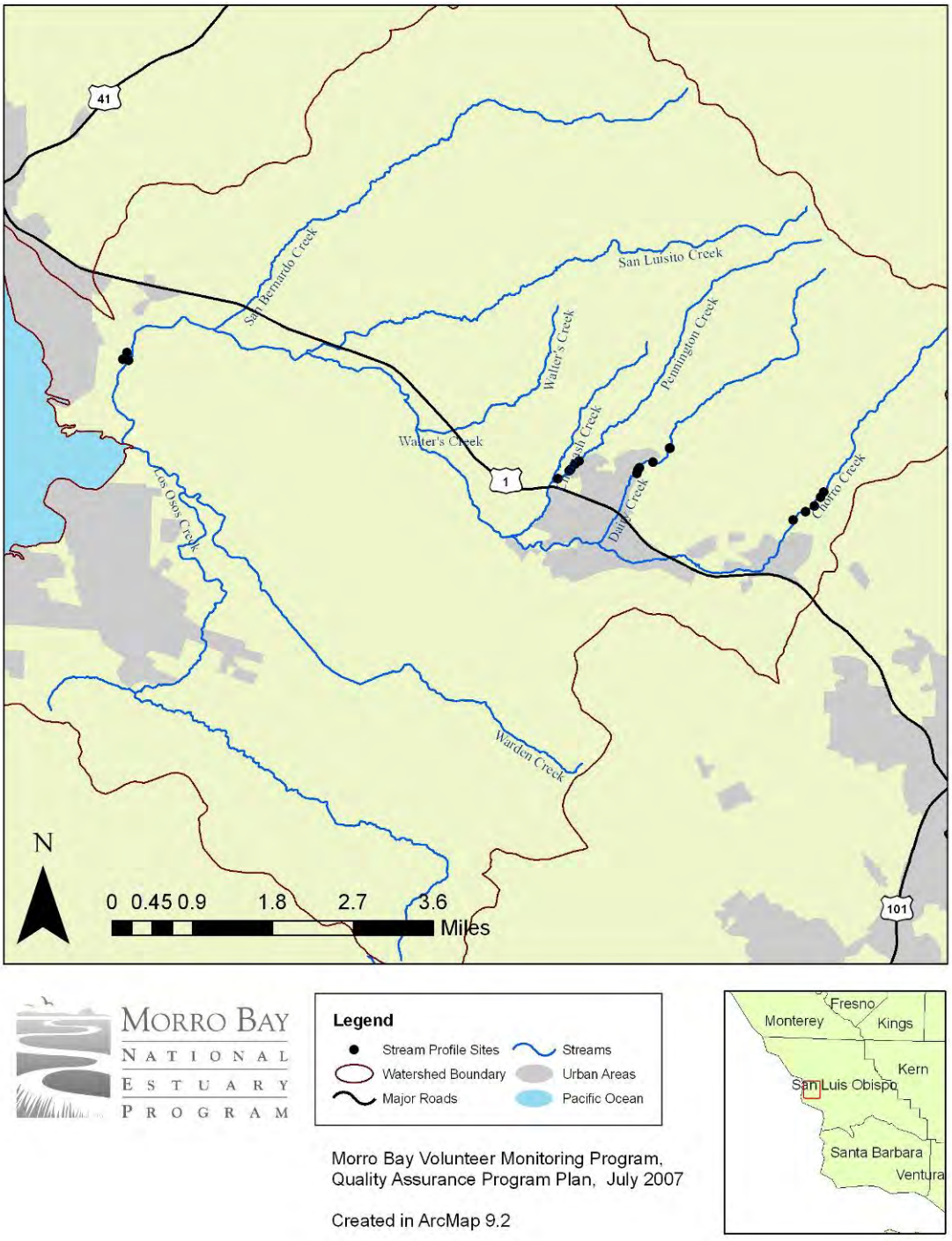


Figure 6.4.11. MBNEP SET Monitoring Locations

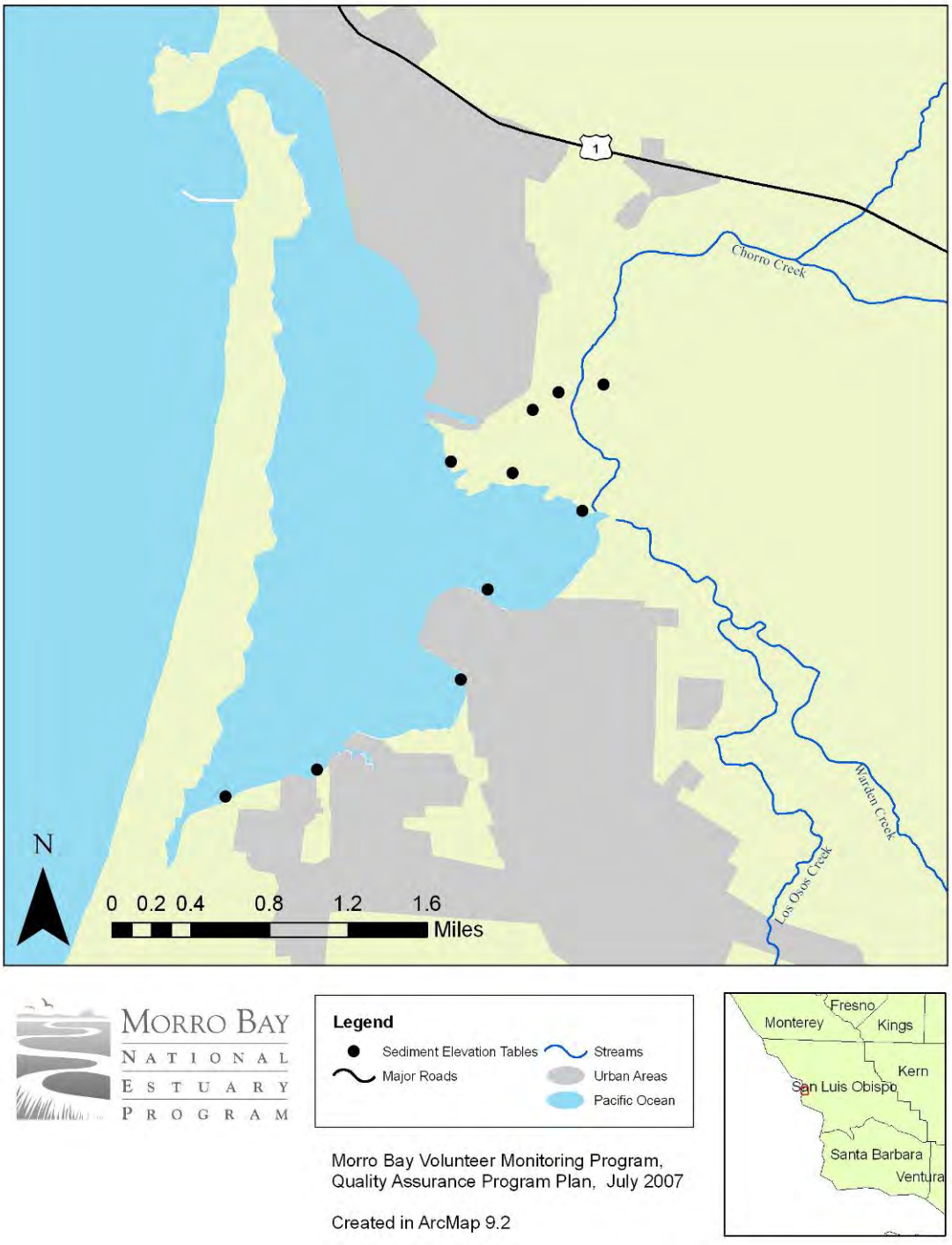
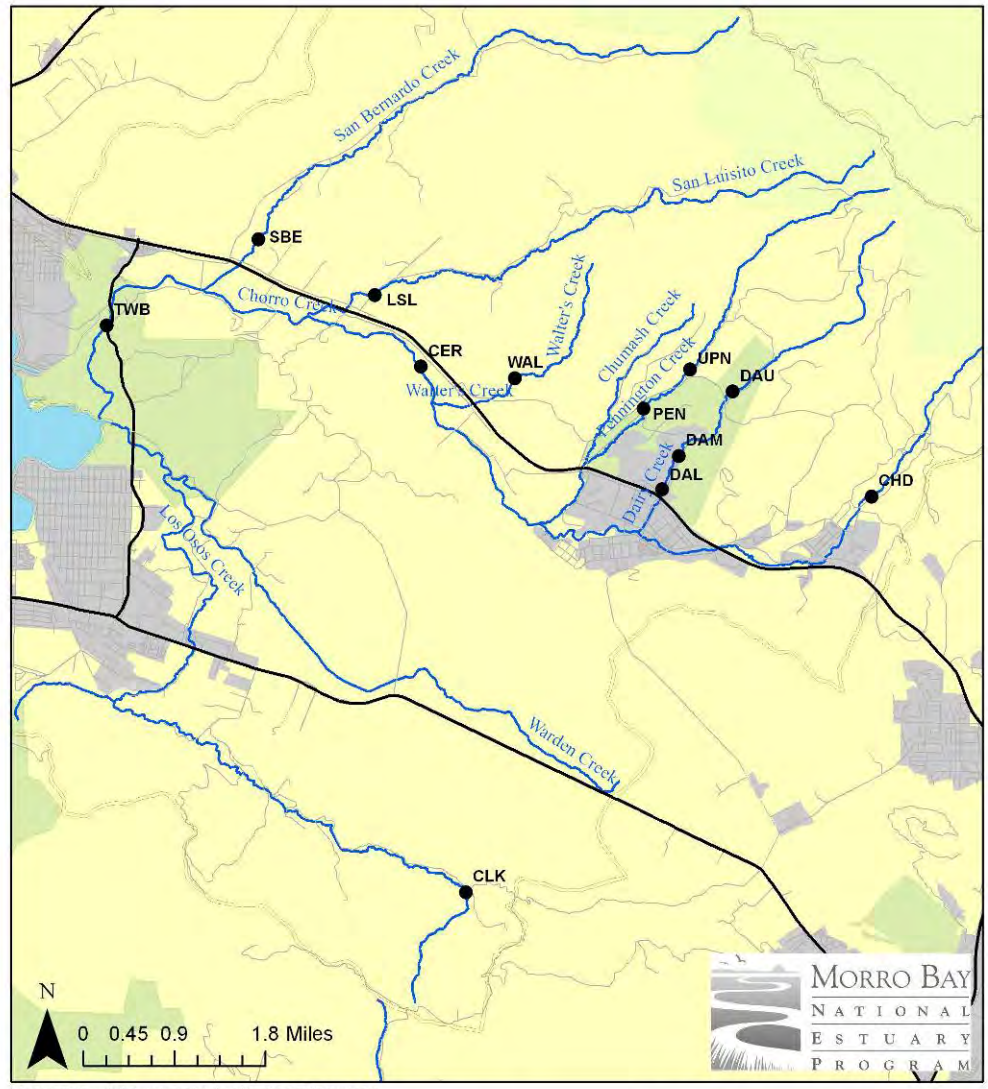


Figure 6.4.12. MBNEP Macroinvertebrate Monitoring Locations



Morro Bay Volunteer Monitoring Program
Quality Assurance Program Plan Update, October 2009

Maps created in ArcMap 9.3
10/15/2009 A. Gillespie

Legend

- Macroinvertebrate Sites
- Watershed Boundary
- Major Roads
- Surface Streets
- Creeks
- Urban Areas

Figure 6.4.13. MBNEP Eelgrass Monitoring Locations

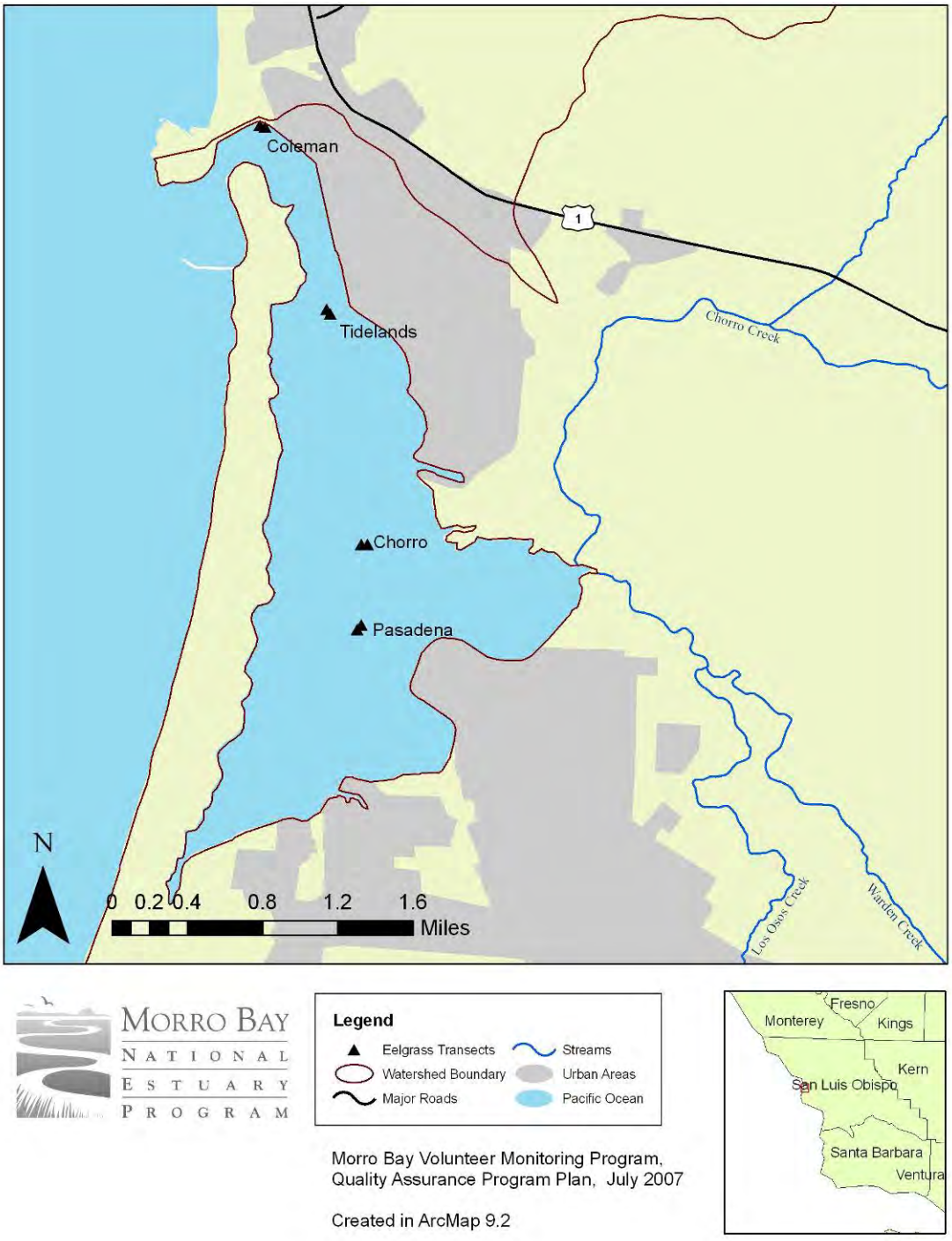
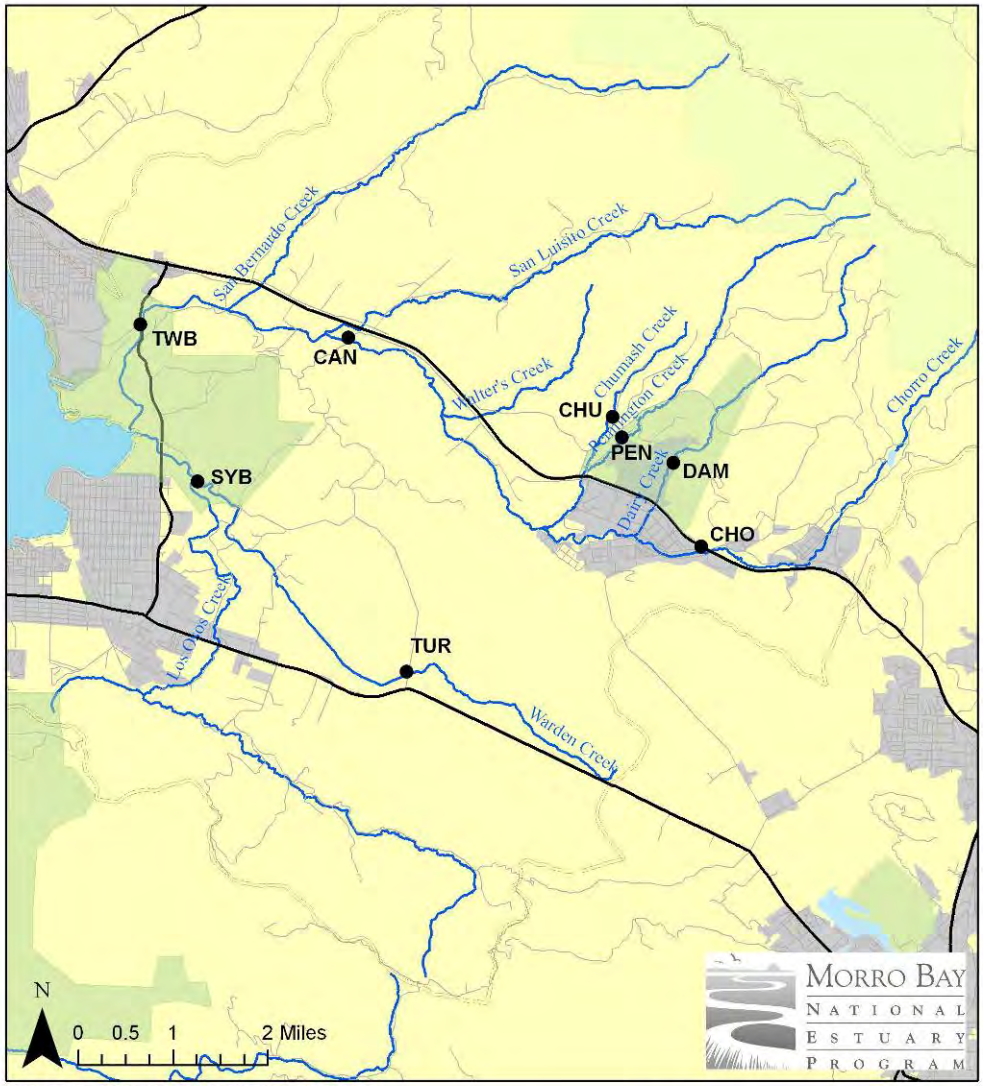


Figure 6.4.14. MBNEP Algae Monitoring Locations



Morro Bay Volunteer Monitoring Program
Quality Assurance Program Plan Update, October 2009

Maps created in ArcMap 9.3
10/15/2009 A. Gillespie

Legend

- Watershed Boundary
- Major Roads
- Algae Documenting Site
- Surface Streets
- Creeks
- Urban Areas

Figure 6.4.15. MBNEP Shorebird Monitoring Locations

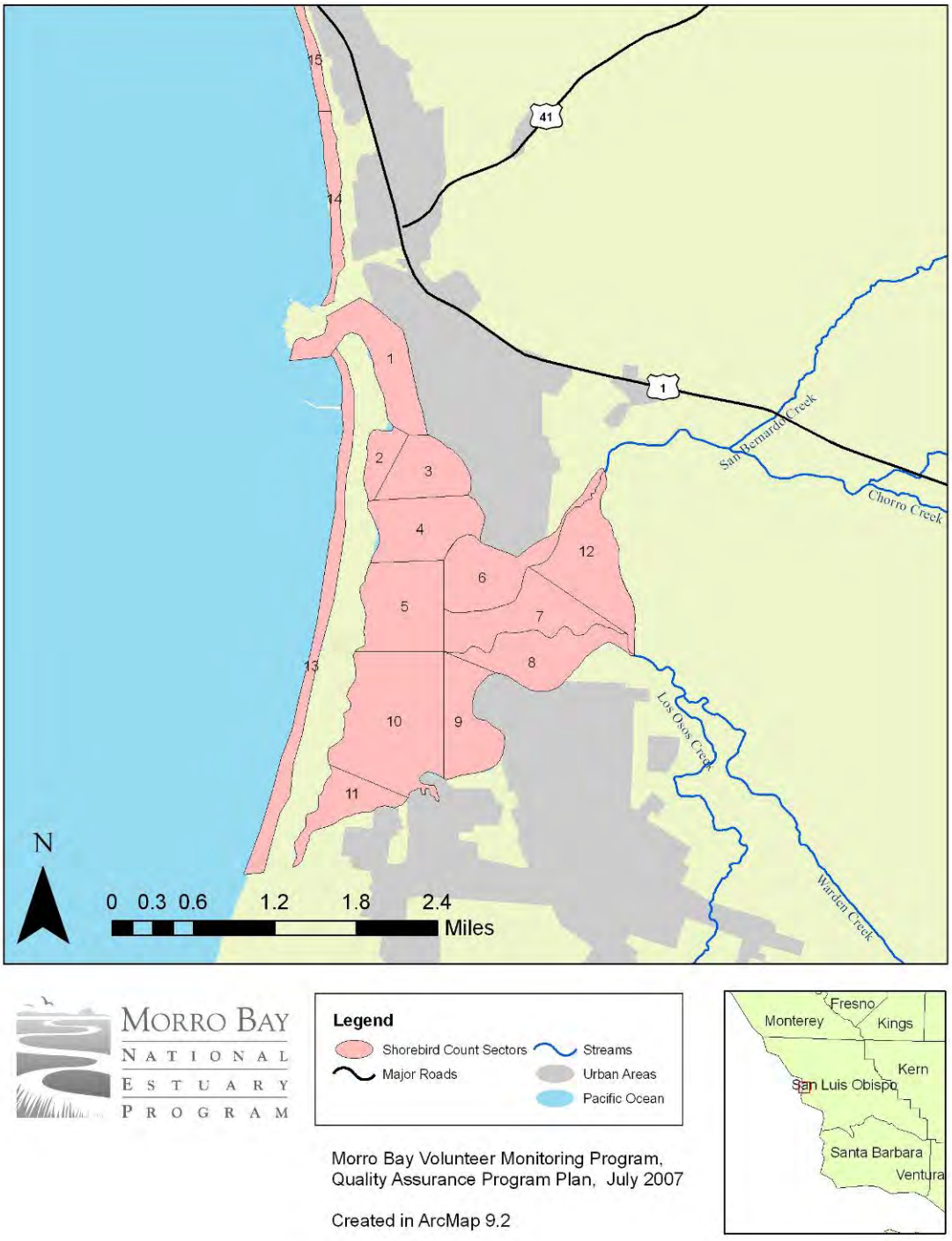
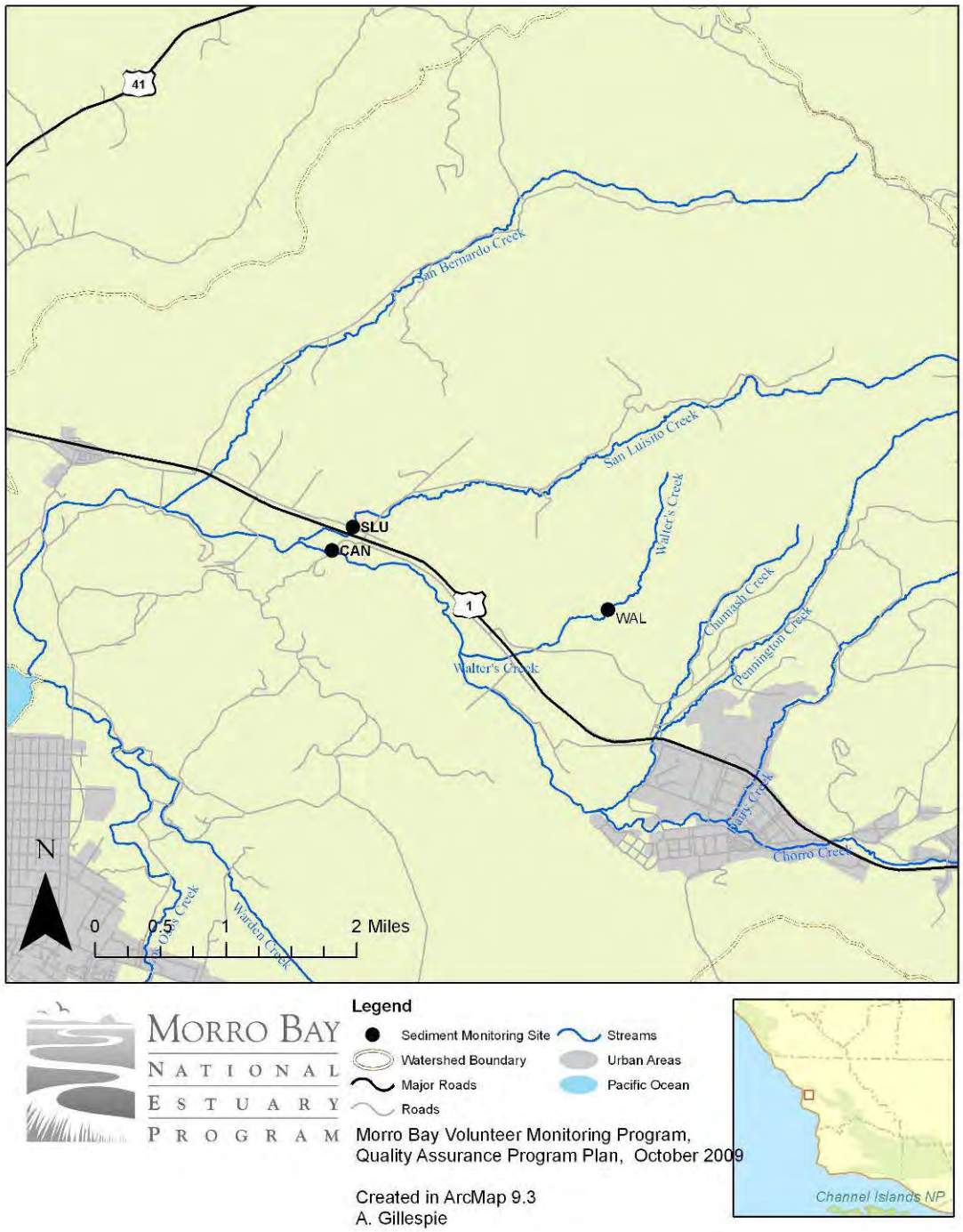


Figure 6.4.16. MBNEP Phytoplankton Monitoring Locations

Figure 6.4.17. MBNEP Suspended Sediment Monitoring Locations



7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

7.1 Measurement quality objectives

This section contains the measurement quality objectives for the program monitoring. This includes analysis both in the field and the laboratory.

Table 7.1.1. Measurement quality objectives

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity
Field	Bacteria	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.	NA	NA	Yes. See Table 7.1.2.	NA
Laborat ory	Bacteria	NA	Yes. Samples split and analyzed by volunteers and lab. Results must be within 95% confidence interval.	Yes. Two laboratory replicates per year.	Yes. Presence/absen ce	Yes. See Table 7.1.2.	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
	Water	NA	Yes. See	Yes. See Table	Yes. See Table	Yes. See	Yes. See

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity
Laboratory	quality		Table 7.1.2.	7.1.2.	7.1.2.	Table 7.1.2.	Table 7.1.2.
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.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Stream Profiling	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually during the dry season. 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
Field	SETs	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually during the dry season. 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
Field	Macroinvertebrates	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually each	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
		spring. This frequency provides an adequate level of seasonality. It was determined to be an adequate frequency for statistical analysis.					
Laboratory	Macroinvertebrates	NA	NA	Yes. Lab resorts 20 to 25% of all samples and 10% of the samples are re-identified by a second taxonomist.	Yes. Lab resorts 20 to 25% of all samples and 10% of the samples are re-identified by a second taxonomist.	Yes. See Table 7.1.2.	NA
Field	Eelgrass	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
Field	Algae	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly in the dry season, 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.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Phytoplankton	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly throughout the	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
		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.					
Field	Shorebird surveys	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually each spring and 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
Field	Dry season runoff (Urban Watch)	Yes. Monitoring sites were selected to maximize spatial variability and provide safe access. Monitoring takes place twice monthly in the dry season, which was determined to be an adequate frequency.	Yes. Training in field techniques minimizes bias.	NA. Data collected is screening-level data. Inadequate sample sizes prohibit splits and duplicates of samples, in many cases.	NA	NA	NA
Field	Suspended sediment concentration	Yes. Monitoring sites were selected based on safety considerations, existing infrastructure, and to target sediment loads in relation to on-going and future restoration work. Monitoring takes place during storms of various amounts of rainfall to represent varying flow conditions.	Yes. Training in field techniques minimizes bias.	NA	NA	NA	NA
Laborat	Suspended	NA	NA	Yes. SLQA	Due to the	NA	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity
ory	sediment concentrati on			provides replicate samples for analysis. Results must be within +/- 1 mg.	nature of the analysis, samples cannot be split for analysis by an independent laboratory. However, single blind samples are obtained from the USGS Sediment Lab for analysis. Sample results must be within +/- 1 mg.		

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.

See Table 7.1.2 for a description of how each measurement quality objective will be determined.

Table 7.1.2. Measurement quality objectives for field measurements

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Complete-ness
Water quality	Dissolved oxygen	± 0.3 mg/L	± 0.75 mg/L or 15%	NA	0.01 mg/L	90%
Water quality	Temperature	± 0.1°C	± 0.5 °C or 10%	NA	0.1 °C	90%
Water quality and Urban Watch	Conductivity	± 1% of range	± 5 or 10%	NA	200 uS for low range meter and 0.1 uS for high range meter	90%
Water quality and Urban Watch	pH paper	± 0.5 units	± 0.5	NA	4.5 units	90%
Water quality and Urban	Turbidity	See below.	± 10% or 0.1, whichever	NA	0.01 NTU	90%

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Complete-ness
Watch			is greater			
Water quality and Urban Watch	Nitrate as N	± 20%	± 20%	NA	1.0 mg/L	90%
Water quality and Urban Watch	Orthophosphate as PO_4	± 20%	± 20%	NA	0.05 mg/L	90%
Flow	Flow (cubic feet per second)	± 0.25 ft^3/sec	± 25%	NA	NA	90%
Stream profiling	Elevation along profile	± 0.05 ft	NA	NA	NA	90%
SETs	Elevation change	± 1.5 mm	NA	NA	NA	90%
Eelgrass	Shoot density, biomass, etc.	NA	NA	NA	NA	90%
Algae documenting	Photo documenting	NA	NA	NA	NA	90%
Phyto-plankton	Cell counts	NA	NA	NA	NA	90%
Shorebirds	Bird counts	NA	NA	NA	NA	90%
Dry season runoff – Urban Watch	Ammonia (Nitrogen)	± 20%	± 20%	NA	0.25 ppm	90%
Dry season runoff – Urban Watch	Total Residual Chlorine	NA	± 20%	NA	0.20 ppm	90%
Suspended sediment monitoring	Suspended sediment concentration	NA	+/- 1 mg	Single blind samples from USGS sediment lab.	2 mg	NA

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Complete-ness
				Analyzed twice annually. Results must be within ± 1 mg.		

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).

Completeness is the percentage of how much of the data are 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.

Urban Watch dry season runoff data is considered to be screening-level data to aid local agencies and city governments in identifying areas and analytes meriting further investigation. Methods for analysis were selected to be inexpensive, simple and easy to conduct in the field, so test strips and other simple test kits were chosen. Additionally, volunteers can only collect minimal amounts of water at many sites due to the transient nature of storm drain flows. Often there is not adequate water to allow for duplicates and replicates. When possible, duplicates and replicate samples will be run for up to 5% of the samples collected during a monitoring season. In the case of chlorine, analysis for accuracy will only be run on a sample where the test kit yielded a positive result as a verification of the ability of the test kit to detect the presence or absence of chlorine.

The Urban Watch analysis methods for many of the parameters are identical to the methods used for creek water quality monitoring except for two additional parameters. The chlorine test kit involves comparing a reaction to a color chart. The color chart provides the following corresponding readings for total residual chlorine: 0.2, 0.4, 0.6, 0.8, 1.0, 1.5, 2.0 and 3.0 ppm. The ammonia nitrate test strips involve comparing a test strip to a color chart, which provides the following corresponding readings: 0, 0.25, 0.5, 1, 3 and 6 ppm.

The suspended sediment monitoring methods were selected in consultation with USGS's Sediment Monitoring Laboratory in Marina, CA as well as staff in the Santa Maria office. The method of monitoring does not allow for splitting of samples for analysis to determine accuracy, precision or completeness. Analysis will be conducted to assess recovery. The monitoring program will participate in the USGS SLQA program which produces single blind samples which will be analyzed in our laboratory at least annually. Based on this analysis, we will be able to assess our recovery rate.

Table 7.1.3. Measurement quality objectives for laboratory measurements

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Complete-ness

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Complete-ness
Bacteria	*E. coli*	Presence/ absence	95% confidence interval	NA	2 MPN/100 mL	90%
Bacteria	Total coliform	Presence/ absence	95% confidence interval	NA	2 MPN/100 mL	90%
Bacteria	Enterococcus	Presence/ absence	95% confidence interval	NA	2 MPN/100 mL	90%
Stormwater quality – First Flush	Total dissolved solids	75 – 125%	± 20%	NA	10 mg/L	90%
Stormwater quality – First Flush	Total suspended solids	NA	± 20%	NA	5 mg/L	90%
Stormwater quality – First Flush	Dissolved Metals	Standard Reference Materials (SRM, CRM, PT) 75% to 125%	Field replicate, lab dup or MS/MSD ± 25% RPD.	Matrix spike 75% - 125%	Cu, Ni, Pb: 0.001 mg/L Zn: 0.005 mg/L	90%
Stormwater quality – First Flush	Oil & Grease	78 – 114%	± 18%	78 – 114%	5 mg/L	90%
Water quality and stormwater quality – First Flush, Urban Watch	Nitrates as N	80 – 120%	± 20%	80 – 120%	0.1 mg/L	90%
Water quality and stormwater quality – First Flush, Urban Watch	Ortho-phosphate as P	70 – 130%	± 30%	70 – 130%	0.01 mg/L	90%
Water quality and stormwater quality – First	Turbidity	80- 120%	± 30%	NA	0.1 NTU	90%

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Complete-ness
Flush, Urban Watch						
Urban Watch	Total Residual Chlorine	NA	+ 30%	NA	0.02 mg/L	90%
Urban Watch	Ammonia (nitrogen)	70 – 130%	+ 30%	70 – 130%	0.3 mg/L	90%
Macro-invertebrates	Benthic invertebrates	≤ 10% difference in sorting efficacy, 0% difference in identification.	≤ 10% difference in sorting efficacy, 0% difference in identification.	NA	NA	80%

8. SPECIAL TRAINING NEEDS/CERTIFICATION

8.1 Specialized training or certifications

Each of the trainings sessions is to prepare program volunteers for MBNEP volunteer monitoring efforts. All are offered on an as-needed basis. All trainees receive information on safety in the field. 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. All staff and volunteers receive training prior to the start of a monitoring effort. No special training or certifications are required for this project.

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

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

Water Quality Monitoring Training:

This training, conducted by VMP staff, emphasizes water sampling safety protocols. Training includes instruction on how to calibrate and properly operate field meters to monitor nutrients, DO, turbidity, temperature, pH, and conductivity. This training also covers Urban Watch monitoring. Water quality training will be split into estuarine, freshwater and Urban Watch monitoring training. Documentation of training attendees will be recorded and maintained in a training log.

Flow Monitoring Training:

A training conducted by VMP staff demonstrates the use of the flow meter, while emphasizing water safety precautions. Documentation of training attendees will be recorded and maintained in a training log.

Macroinvertebate Monitoring Training:

VMP staff train program volunteers in the techniques for collection of macroinvertebrate 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 VMP staff member. VMP staff receive a refresher training from CCRWQCB staff, who are trained annually by CDFG staff. Documentation of training attendees will be recorded and maintained in a training log.

Bacteria Monitoring Training:

VMP staff trains program volunteers in proper technique for sample collection in the field, including sterile technique. Volunteers are then trained in the lab by VMP 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:

VMP 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 VMP staff member. Documentation of training attendees will be recorded and maintained in a training log.

Algae DocumentingTraining:

VMP staff train program volunteers in the techniques for conducting photodocumentation and making observations of algal growth. Documentation of training attendees will be recorded and maintained in a training log.

Shorebird Monitoring Training:

VMP staff and 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.

Phytoplankton Monitoring Training:

VMP staff train program volunteers in the techniques for collecting and identifying phytoplankton samples. Periodic refresher training is provided for both VMP staff and program volunteers by the DPH Marine Biotoxin Monitoring staff. Documentation of training attendees will be recorded and maintained in a training log.

Stormwater Monitoring Training:

VMP staff train program volunteers in the techniques for collecting and, where applicable, analyzing samples for stormwater monitoring. Site locations and safety are emphasized. 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, VMP 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 VMP staff training is provided by the MBNEP QA Officer who ensures that all necessary training has been completed. All volunteer training is overseen by the MBNEP QA Officer and provided by VMP 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 the Excel-based CCAMP format or other Excel spreadsheet to store all program data. The Data Manager, a VMP staff member, maintains this electronic data with oversight by the MBNEP QA Officer. The database is backed up on a tape back-up drive that is written over every other week. A CD back-up is created of the database each quarter and stored off-site.

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 or email 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.

Copies of this QAPP will be distributed to all parties involved with the project and made available to VMP 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 this first and 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. VMP staff will maintain all sample collection, sample transport, chain of custody, and laboratory analyses forms at the MBNEP office. VMP 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. VMP 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.

All electronic records will be passed to the SWRCB Contract Manager Mark Fong at project completion. 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 reports, an annual training log, and an annual database submittal. This documentation is submitted to the SWRCB Contract Manager per the submittal due dates outlined in the project's grant agreement.

GROUP B: DATA GENERATION AND ACQUISITION

10. SAMPLING PROCESS DESIGN

Size of study area: Water quality, bacteria, flow, stream profiling and macroinvertebrate 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. The eelgrass sites were distributed throughout the bay to look at the influence from different factors present in each region of the bay. Eelgrass mapping covers the entire bay. Algae documenting sites were distributed throughout the creeks (eight sites) to provide a wide distribution. The shorebird study area follows the historical sites established in historical studies. Phytoplankton sites were established to be easily accessible but provide adequate information with a minimal amount of sampling. The SETs were established in a portion of the bay where the most change due to sedimentation could be expected. Stormwater monitoring sites were established to represent multiple land use types and to include historical sites, where applicable. Suspended sediment concentration sites were established to help characterize the effects of on-going and future restoration work as well as to track overall suspended sediment load from the Chorro watershed

Volume or time period represented by a sample: Water quality, bacteria, flow and algae documenting monitoring are conducted on a monthly basis (between April and November for creek algae documenting). Phytoplankton pulls are conducted on a twice monthly basis. Stream profiling, macroinvertebrate analysis, SET monitoring, First Flush stormwater monitoring and eelgrass monitoring are conducted once a year in the appropriate season. Urban Watch stormwater monitoring is conducted twice monthly from June through the first significant fall rain of the season, typically in October or November. Shorebird monitoring events are conducted each fall. Suspended sediment monitoring data is collected during storms which generate flow above base-flow conditions.

Type and total number of samples needed: Water samples for bacteria analysis are collected at 15 creek sites and eight bay sites. One 120-mL water sample is collected at each site, unless quality assurance analysis is being conducted for that site, in which case larger volumes of water may be required. Water quality monitoring is conducted at 15 creek sites and at three shoreline and seven bay sites. Water samples are not collected unless quality assurance is being conducted and a sample is needed for laboratory analysis. Flow data is collected at 14 creek sites during times of measurable flow. Stormwater monitoring for First Flush is conducted at eight sites with water samples collected for analysis. Urban Watch stormwater monitoring is conducted at eight sites in Morro Bay and six sites in Los Osos. Macroinvertebrate samples include insects and debris collected from creek beds. The total number of macroinvertebrate monitoring sites are 12, but the number monitored varies from year to year based on water levels, funding, staff availability and other factors. For phytoplankton, a water sample is collected from each site from a total of two sites each month. For eelgrass, 30 shoots are collected from each of four transects. The samples are dried and weighed to make a biomass determination. For stream profiling, SETs, algae documenting and bird surveys, no samples are collected. For suspended sediment concentration monitoring, creek water samples are collected at three sites. Each sample bottle is filled to 350 mL by an automated sampler, and 24 bottles can be collected during a sampler run. The sampler must then have the bottles swapped out and the timer re-set for additional sample collection.

Where samples are taken: See maps from Section 6.4. Sites are identified in various ways. While all are identified through GPS, volunteers in the field for bacteria, water quality, flow, stormwater, macroinvertebrates, algae, shorebirds and phytoplankton monitoring identify sites through the use of landmarks. For monitoring of suspended sediment, eelgrass, SETs and stream profiling, permanent benchmarks are established at each of the monitoring sites, and they are located with the aid of GPS. Either VMP staff or contractors conduct these monitoring efforts and are trained in the use of GPS.

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

Project activity schedules: Monitoring for water quality, bacteria and flow is conducted on a monthly basis, year-round. Creek algae documenting takes place on a monthly basis from April through November. Some creek sites go dry during the summer months or become stagnant, in which case monitoring is discontinued until the next rains occur. Urban Watch stormwater monitoring is conducted twice a month during the dry months, typically from June through October or November. Bay samples must be collected at the appropriate tidal cycle and thus this monitoring schedule is dictated by the tides. Bay nutrient monitoring to be conducted from the shoreline can take place during a tide that allows adequate access. In-bay monitoring for DO must be conducted within two hours after sunrise on a tide to allow adequate 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 VMP staff. Staff will make every effort to deliver the bacteria samples to the lab in time for them to be analyzed within six hours of collection. If this is not possible, they will be delivered for analysis within 24 hours of collection. First Flush stormwater monitoring, stream profiling, macroinvertebrates, SETs and eelgrass are monitored once a year. First Flush stormwater and nutrient QA samples are delivered to the lab within 48 hours for analysis. Macroinvertebrate samples are typically delivered to the lab within six months, although they can be held for up to five years. Phytoplankton is monitored twice a month. Tidally-influenced monitoring such as bay water quality, bacteria, eelgrass, SETs, shorebirds and phytoplankton are scheduled upon review of a tide table to ensure adequate access. Suspended sediment monitoring is conducted during storms taking place during the rainy season. Samples are delivered within 48 hours of collection to the sediment laboratory. Samples do not have a hold time requirement.

Critical vs. informational data: All data collected for this effort is considered to be critical data.

Sources and reconciliation of variability: For water quality, First Flush stormwater 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 flow monitoring and macroinvertebrate sampling, proper site selection is the largest source of variability and is addressed through volunteer training. For algae documenting, eelgrass, shorebird monitoring and phytoplankton, 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 suspended sediment monitoring, the largest sources of variability include malfunctioning of the automated sampler, sample bottles that are not clean, and contamination during the

laboratory analysis process. These are addressed through training and use of detailed protocols.

Sources of bias or misrepresentation: For bacteria, water quality and Urban Watch stormwater monitoring, a potential source of bias is in the interpretation of test kit results. Volunteers must interpret a color change to read the results. This bias is addressed by periodically splitting samples for all analysis except Urban Watch. The volunteer analyzes half of it and the QA lab analyzes the other half. The compared results must be within the measurement quality objectives outlined in Table 7.1.3. If they are not, then the volunteer's 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 Urban Watch, the screening-level monitoring techniques and the lack of adequate flow prohibit the splitting of samples. For flow monitoring and macroinvertebrate sampling, proper site selection is the largest source of bias and is addressed through volunteer training. For algae documenting, eelgrass, shorebird monitoring and phytoplankton, 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 suspended sediment monitoring, the method of analysis does not allow for splits or duplicates to be analyzed for comparison. The largest source of bias would be improper laboratory techniques such as inadequate drying of filters and improperly calibrated lab equipment such as scales. This is addressed through training in laboratory techniques as well as detailed calibration procedures.

11. SAMPLING METHODS

All bacteria samples are aquatic samples. They will be collected as grab samples using sterile jars from approximately mid-stream and from just below the water's surface. The sterile sample jars 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 jars contain sodium thiosulfate to neutralize chlorine present at some sampling sites. These bottles are used once and then disposed of. When samples are collected, the volunteer 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 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 deionized water. MBNEP bacterial analysis by program volunteers is conducted at the Morro Bay-Cayucos Wastewater Treatment Plant Laboratory. Plant personnel operate the facility's autoclave to provide the sterilized glassware and deionized 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 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 and analysis is conducted in the field. If water samples are collected for quality assurance purposes, they 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 for the volunteer's analysis, and a portion stored in a clean container provided by the laboratory for one-time use. 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 follow the protocol. If a source of error is identified, the protocol will be revised and volunteers will be re-trained.

For Urban Watch monitoring, samples are collected from storm drains and curb inlets while avoiding stirring up of any sediment in the bottom of the drain. All sampling equipment is triple rinsed with deionized water upon completion of the monitoring. Temperature, conductivity, pH, ammonia as nitrate and chlorine are monitored in the field and analysis is conducted immediately. Analysis for nitrates, orthophosphates, turbidity and total coliform are conducted in the office, and the samples can be held for 24-hours. If excess sample is available and water samples can be collected for quality assurance purposes, a large, clean container is used to collect a single sample. The sample is gently mixed and then split. A portion is used for the volunteer's analysis, and a portion stored in clean containers with appropriate preservative provided by the laboratory for one-time use. All samples are aqueous samples. Samples for Urban Watch are collected in sterile Whirl-Pak bags and analyzed within 24 hours of collection. Excess sample is disposed of down the drain. 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 follow the protocol. If a source of error is identified, the protocol will be revised and volunteers will be re-trained.

For stormwater monitoring, water samples are collected from storm drains culvert outfalls, pooling areas or drainage gutters. Samples for First Flush are collected in clean containers provided by the laboratory for one-time use. The sample for dissolved metals is filtered within 2 hours and delivered to the lab who then conducts the acidification. The containers for oil and grease contain an H_2SO_4 preservative. Excess sample is disposed of by the lab.

Macroinvertebrate samples 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% ethyl 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 follow the protocol. If a source of error is identified, the protocol will be revised and volunteers will be re-trained.

For phytoplankton, water samples are filtered using a fine mesh net and stored in a clean plastic container for transport to the MBNEP office. Once at the office, the sample is studied under a microscope and a portion of the sample is mailed to DPH for their analysis. The net is rinsed with freshwater and hung to dry. Excess sample is disposed of down the drain.

For eelgrass, 30 eelgrass shoots are collected at each of the four transects and stored in plastic bags. They are stored in the refrigerator until they are dried and weighed to make a biomass determination. Excess sample is disposed of in the trash. The drying ovens and balances required for the sample analysis are the same equipment used for suspended sediment analysis.

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

For suspended sediment monitoring, samples are collected from creeks during storms using automated samplers which draw water through an intake in the creek and up into a sampler housing which contains 24 bottles. The intake is located in an area in the creek where it will remain submerged but is not at risk of becoming buried by sediment or crushed in a debris jam. All samples are aqueous samples. The samplers are programmed to draw a certain volume of water at a certain frequency. Each sample is 350 mL, leaving headspace at the top of the bottles. These samples do not require any refrigeration. Following filtration,

sample supernate water is disposed of down the drain. Sample bottles are rinsed with DI water and allowed to dry completely before being re-deployed in the field. If it is determined that the method of sample collection is introducing bias into the results, the protocol will be revised and monitoring personnel will be retrained.

In all of these monitoring efforts, any problems are identified by VMP 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 #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ analysis
Bacteria - All creek sites	See Fig 6.4.3	Water	Below surface	*E. coli*, total coliform	1 per month at each site plus one split per month	MBVMP Bacteria Monitoring Protocol	120 mL	1-120 mL container/ site, sterile IDEXX bottle	Sodium thiosulfate, stored on ice at 4 °C, dark	Optimal hold time: 6 hours. If not possible to analyze within 6 hrs: 24 hours.
Bacteria - All bay sites	See Fig 6.4.3	Water	Below surface	*E. coli* and entero-coccus	1 per month at each site plus one split per month	MBVMP Bacteria Monitoring Protocol	120 mL	1-120 mL container/ site, sterile IDEXX bottle	Sodium thiosulfate, stored on ice at 4 °C, dark	Optimal hold time: 6 hours. If not possible to analyze within 6 hrs: 24 hours.
Water Quality - All creek sites	See Fig 6.4.6	Water	Below surface	Various	1 set of measure-ments per month at each site plus one split sample per month sent to lab for	MBVMP Water Quality Monitoring Protocol	250 mL	250 mL container/ site, clean plastic container provided by lab	None	48 hours at 4 °C, dark

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ analysis
					analysis					
Water Quality – bay nutrient sites	See Fig 6.4.5	Water	Below surface	Salinity, tempera-ture, NO_3-N	1 sample per month at each site, duplicate collected for 10% of samples and sent to lab for analysis	MBVMP Back Bay Nitrate Monitoring Protocol	120 mL	120 mL container/ site	None	48 hours at 4 °C, dark
Water Quality – bay dissolved oxygen sites	See Fig 6.4.6	Water	Below surface	Salinity, temper-ature, DO	1 sample per month at each site	MBVMP DO in the Bay Protocol	NA	NA	NA	NA
Stormwater quality – First Flush	See Fig 6.4.7	Water	Surface	Total dissolved solids/total suspended solids	One per site	MBVMP Stormwater Monitoring Protocol	0.5 gal	Plastic container	None	7 days at 4 °C, dark
Stormwater quality – First Flush	See Fig 6.4.7	Water	Surface	Turbidity	One per site	MBVMP Stormwater Monitoring Protocol	8 oz.	Plastic bottle	None	48 hours at 4 °C, dark

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ analysis
Stormwater quality – First Flush	See Fig 6.4.7	Water	Surface	Dissolved metals: Pb, Zn, Cu, Ni	One per site	MBVMP Stormwater Monitoring Protocol	8 oz.	Plastic bottle	None	Filtered by lab within 24 hours, preserve with HNO_3. Holds for 6 months.
Stormwater quality – First Flush	See Fig 6.4.7	Water	Surface	Oil & grease	One per site	MBVMP Stormwater Monitoring Protocol	1 quart	Amber glass	Sulfuric acid, light protected	28 days
Urban Watch (for field analylsis)	See Fig. 6.4.8 and 6.4.9	Water	Surface	Various	One per site	MBVMP Urban Watch Monitoring Protocol	100 mL	Whirl-Pak bags	None	24 hours
Urban Watch	See Fig. 6.4.8 and 6.4.9	Water	Surface	Ammonia-nitrogen	5% of samples split	MBVMP Urban Watch Monitoring Protocol	8 oz.	Plastic bottle	H_2SO_4 preservative, light protected, 6° C	28 days
Urban Watch	See Fig. 6.4.8 and 6.4.9	Water	Surface	Total residual chlorine	5% of samples split	MBVMP Urban Watch Monitoring Protocol	40 mL	Glass vial	Fill vial without headspace, light protected, 6°	As soon as possible (deliver to lab within 3 hours)

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ analysis
									C	
Suspended sediment	See Fig. 6.4.17	Water	Surface	Suspended sediment concentration	Depends on number of storms and frequency of sample collection	MBVMP Suspended Sediment Monitoring Protocol	350 mL	1 L plastic sampler bottles	None, light protected	No holding time limit
Macroinvertebrates - All sites	See Fig 6.4.12	Macroinvertebrate samples	Creek bottom	Benthic invertebrates	1 composited sample per site	MBVMP Macroinvertebrate Sampling and Rapid Bioassessment Protocol	16-oz	16-oz widemouth plastic jars	95% ethyl alcohol	5 years, store in dark away from extreme temperatures
Eelgrass – All Sites	See Fig 6.4.13	Eelgrass biomass samples	Eelgrass exposed at low tides	Eelgrass plant biomass	30 shoots per transect	MBNEP Eelgrass Monitoring Protocols	30 shoots	Plastic bag	Refrigerated	7 days, refrigerated

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 to be analyzed in the field or by a lab should include the date and time of collection, sample location, sample identification, sampler, and analysis to be performed. When sampling water, collected samples will be kept in an ice chest (4ºC) 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, pH, 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, and parameter to be analyzed for.

For macroinvertebrate samples, 95% ethanol should be added to the sample as soon as possible.

Eelgrass samples should be stored in a refrigerator or freezer as soon as possible after collection.

After returning from the field, all water samples for water quality, stormwater, bacteria or phytoplankton analysis will be analyzed immediately or transferred to the laboratory refrigerator.

Upon completion of sample collection, suspended sediment samples should be capped and transported to the sediment lab. Each bottle will be labeled with the date and time of sample collection and then weighed, without the cap, to determine the total sample weight. Bottles have been pre-weighed and the tare weights are stored in the sediment monitoring database. Samples can then be stored either in the refrigerator or in a dark, cool location until they are processed.

All water quality, stormwater and bacteria samples are hand delivered to the labs. Macroinvertebrate samples are drained of alcohol, double-bagged and overnight shipped to the lab. Lab personnel immediately refill the samples with alcohol.

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, total coliform	Sterile, sealed plastic jar purchased from IDEXX Laboratories	120 mL	Sodium thiosulfate, cool to 4°C; dark.	6 hour at 4°C, dark. If not possible to analyze within 6 hours, then analyze within 24 hours.

Parameter	Container	Volume	Initial Preservation	Holding Time
Nitrates as N and Orthophosphate as P	Plastic jar provided by Creek Environmental Laboratories	250 mL	None	48 hour at 4°C, dark.
TDS and TSS	Plastic bottle provided by Creek Environmental Laboratories	64 oz.	None	7 days at 4°C
Oil & Grease	Amber glass bottle provided by Creek Environmental Laboratories	32 oz.	Sulfuric acid preservative	28 days at 4°C
Dissolved metals	Plastic bottle provided by Creek Environmental Laboratories	8 oz.	None	24 hours at 4°C. Filtered within 2 hours of collection Preserved with HNO_3 by the lab within 48 hours. Can hold for 6 months after filtered and acidified.
Turbidity	Plastic bottle provided by Creek Environmental Laboratories	8 oz.	None	48 hours at 4°C
Total residual chlorine	Glass VOA vial provided by Creek Environmental Laboratories	40 mL	None	Analyze immediately, transport at 6°C in the dark.
Ammonia-nitrogen	Plastic bottle provided by Creek Environmental Laboratories	8 oz.	H_2SO_4 preservative	28 days, at 6°C in the dark.
Benthic invertebrates	Widemouth plastic jar	16 oz.	95% ethanol	5 years
Eelgrass	Plastic bag	Various	None	7 days, refrigerate or freeze.

Parameter	Container	Volume	Initial Preservation	Holding Time
Suspended sediment	Plastic bottle with cap	350 mL	None	Unlimited hold time, in dark cool location.

12.2 Chain of custody procedure

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

See Appendix for a sample chain of custody form.

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, eelgrass, algae, shorebirds, or phytoplankton 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 generally established by the lab conducting the analysis. The term Method refers to when an MDL is specified by the method itself. 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)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
Flow	Field monitoring by MBNEP volunteers	NA	Depth = 0.2 ft, Velocity = 0.01 ft/sec	MBVMP Water Quality Monitoring Protocols	No	NA	NA
pH (Water Quality, FF Stormwater and Urban Watch)	Field monitoring by MBNEP volunteers	< 6.5 or > 8.3 pH units (for Water Quality only)	4.5 units	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Conductivity (Water Quality and Urban	Field monitoring by MBNEP volunteers	> 3,000 uS(for Water Quality only)	200 uS for low range meter and 0.10 uS for high range meter	MBVMP Water Quality Monitoring Protocols	No	NA	NA

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
Watch)							
Dissolved oxygen (Water Quality and Dawn Patrol)	Field monitoring by MBNEP volunteers	< 7.0 mg/L	0.01 mg/L	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Temperature (Water Quality and Dawn Patrol)	Field monitoring by MBNEP volunteers	> 24°C	0.1°C	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Turbidity (Water Quality and Urban Watch)	Field monitoring by MBNEP volunteers	> 10 NTU (for Water Quality only)	0.01 NTU	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Nitrate as N (Water Quality and Urban Watch)	Field monitoring by MBNEP volunteers	> 10 mg/L (for Water Quality only)	1.0 mg/L	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Orthophosphates as PO_4 (Water Quality and Urban Watch)	Field monitoring by MBNEP volunteers	> 0.36 mg/L (for Water Quality only)	0.05 mg/L	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Ammonia Nitrogen (Urban Watch)	Field monitoring by MBNEP volunteers	NA	0.25 ppm	MBVMP Urban Watch Monitoring Protocol	No	NA	NA
Total Residual Chlorine (Urban Watch)	Field monitoring by MBNEP volunteers	NA	0.2 ppm	MBVMP Urban Watch Monitoring Protocol	No	NA	NA

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
Suspended sediment concentration	Sample collection and analysis by VMP staff	NA	NA	MBVMP Suspended Sediment Monitoring Protocol	No	NA	NA

Table 13.1.2. Field equipment features

Monitoring Effort	Equipment Description	Measurement Principle	Major Attributes
Flow	Marsh-McBirney Flo-Mate 2000	electromagnetic	Velocity averaging
pH (Water Quality, First Flush and Urban Watch)	pH paper	pH paper	
Conductivity (Water Quality and Urban Watch)	Oakton ECTestr Low range and ECTestr 11 Plus	Voltage drop	Temperature correction
	YSI Model 30 and 85	Voltage drop	Temperature correction
Dissolved oxygen (Water Quality and Dawn Patrol)	YSI Model 55 and 85	membrane covered polarographic	Self-calibrating
Temperature (Water Quality and Dawn Patrol)	YSI Model 55 and 85	Thermistor	
Turbidity (Water Quality and Urban Watch)	HACH 2100P Turbidimeter	Nephelometric	Auto ranging
Nitrate as N (Water Quality and Urban Watch)	LaMotte Test No. 3354 Nitrate-Nitrogen	Zinc reduction reaction	
Orthophosphates as PO_4 (Water Quality and Urban Watch)	Hanna Low Range Phosphate Meter, Model 93713	Ascorbic acid reduction reaction, colorimeter	
Ammonia Nitrogen	HACH Test Strips, No.	Ammonia salicylate test	

Monitoring Effort	Equipment Description	Measurement Principle	Major Attributes
(Urban Watch)	2755325	strip	
Total Residual Chlorine (Urban Watch)	LaMotte Test No.3308 Total and Combined Chlorine Test Kit	N,N diethyl-p-phenylenediamine sulfate and potassium iodide reaction	

Table 13.1.3. Laboratory analytical methods

Analyte/ Instru-mentation	Labora-tory / Organiza-tion	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (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	No	1 MPN/100 mL for an undiluted sample	Not applicable
E. coli (IDEXX Colilert-18)	MBNEP In-house laboratory	> 235 MPN/100 mL	2 MPN/100mL for an undiluted sample	MBVMP Bacteria Monitoring Protocols	No	1 MPN/100 mL for an undiluted sample	Not applicable
Entero-coccus (IDEXX Colilert-18)	MBNEP In-house laboratory	> 104 MPN/100 mL for salt water, 61 MPN/100 mL for fresh water	2 MPN/100mL for an undiluted sample	MBVMP Bacteria Monitoring Protocols	No	1 MPN/100 mL for an undiluted sample	Not applicable
Nitrate as N (Dionex DX-100 IC) for First Flush, Water Quality and Urban Watch	Creek Environ-mental Laborator-ies	10 mg/L for Water Quality; NA for FF	0.1 mg/L	EPA Method 300.0	No	0.03 mg/L	0.002 mg/L
Orthophos phates as P(Spectro nic 20D+)	Creek Environ-mental Laborator-	> 0.12 mg/L for Water Quality; NA	0.01 mg/L	SM 4500-P E	No	0.003 mg/L	0.010 mg/L

Analyte/ Instru-mentation	Labora-tory / Organiza-tion	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
for First Flush, Water Quality and Urban Watch	ies	for FF					
Ammonia-nitrogen for Urban Watch	Creek Envrionmental Laboratories	NA	0.3 mg/L	SM 4500-NH3 D	No	0.04 mg/L	0.03 mg/L
Total residual chlorine for Urban Watch	Creek Envrionmental Laboratories	NA	0.02 mg/L	SM 4500-C1 G	Yes. Due to logistics of sampling, it is not possible to analyze the sample within 15 minutes of collection. The sample will be analyzed as soon as possible upon arrival at lab.	0.02 mg/L	0.01 mg/L
Total dissolved solids (gravi-metric) for First Flush	Creek Environ-mental Laborator-ies	NA	10 mg/L	SM 2540C	No	5 mg/L	Not provided
Total suspended solids (gravi-metric) for First Flush	Creek Environ-mental Laborator-ies	NA	5 mg/L	SM 2540D	No	2.5 mg/L	Not provided
Oil & Grease (gravi-	Creek Environ-mental Laborator-	75 mg/L	5 mg/L	EPA 1664 Rev. A	No	1.1 mg/L	1.4 mg/L

Analyte/ Instru-mentation	Labora-tory / Organiza-tion	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
metric) for First Flush	ies						
Dissolved metals: Cu, Ni, Zn, Pb (PE ELAN 6000 ICP-MS) for First Flush	Creek Environ-mental Laborator-ies	Pb: 20 ug/L Ni: 50 ug/L Zn: 7 ug/L Cu: 30 ug/L (for receiving waters, not for runoff)	Ni,Pb, Cu: 1 ug/L Zn: 5 ug/L	EPA 200.8	Yes. Due to logistics of sampling, it is not possible to filter the sample within 15 minutes of collection. The sample will be filtered and then acidified as soon as possible after collection, typically within 2 hour of collection.	Ni, Pb, Cu: 0.1 ug/L Zn: 1 ug/L	Ni: 0.5 ug/L Pb: 0.6 ug/L Cu: 0.5 ug/L Zn: 1.8 ug/L
Turbidity for Water Quality	Creek Environm ental Laboratori es	10 NTU	0.1 NTU	SM 2130B	No	0.02 NTU	0.02 NTU
Turbidity for First Flush and Urban Watch	Creek Environm ental Laboratori es	NA	0.1 NTU	SM 2130B	No	0.02 NTU	0.02 NTU
Total coliform (IDEXX Colilert-18)	SLO County Public Health Agency Labora-tory	> 10,000 MPN/100 mL	2 MPN/100mL for an undiluted sample	Standard Methods 9223	No	1 MPN/100 mL for an undiluted sample	Not applicable
E. coli (IDEXX	SLO County	> 235 MPN/100	2 MPN/100mL for an	Standard Methods	No	1 MPN/100 mL for an	Not applicable

Analyte/ Instru-mentation	Labora-tory / Organiza-tion	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
Colilert-18)	Public Health Agency Labora-tory	mL	undiluted sample	9223		undiluted sample	
Enterococcus (IDEXX Enterolert)	SLO County Public Health Agency Labora-tory	> 104 MPN/100 mL for salt water, 61 MPN/100 mL for fresh water	2 MPN/100mL for an undiluted sample	ASTM D6503.99	No	1 MPN/100 mL for an undiluted sample	Not applicable
Benthic macroin-vertebrates	Ecoanalysts	NA	0 to 500 individuals	Ecoanalysts Laboratory SOP/QA Plan 2007	No	NA	NA
Suspended sediment concentration	MBNEP Sediment Laboratory by VMP staff	NA	2 mg	MBVMP Suspended Sediment Monitoring Protocol (Derived from ASTM D 3977)	No	NA	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 fax in a more timely manner. Macroinvertebrate samples typically take six months for analysis and reporting.

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 a 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 using the field test kits 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 the Grubbs outlier test is applied. The ratio Z is calculated as follows:

Z = absolute value (mean – value) / SD where the mean is the mean value of all results analyzed, the value refers to the reading in question, and SD is the standard deviation of all results analyzed

If the Z ratio exceeds the ratios in the table below, then the P value is less than 0.05, which means that there is a less than 5% chance that this outlier was obtained by chance alone if all of the data were from a single Gaussian distribution. If this is the case, then the data is flagged and excluded from future analysis.

Critical Values for Z: N is the number of values in the group

N	Critical Z	N	Critical Z
3	1.15	27	2.86
4	1.48	28	2.88
5	1.71	29	2.89
6	1.89	30	2.91
7	2.02	31	2.92

8	2.13	32	2.94
9	2.21	33	2.95
10	2.29	34	2.97
11	2.34	35	2.98
12	2.41	36	2.99
13	2.46	37	3.00
14	2.51	38	3.01
15	2.55	39	3.03
16	2.59	40	3.04
17	2.62	50	3.13
18	2.65	60	3.20
19	2.68	70	3.26
20	2.71	80	3.31
21	2.73	90	3.35
22	2.76	100	3.38
23	2.78	110	3.42
24	2.80	120	3.44
25	2.82	130	3.47
26	2.84	140	3.49

For FF stormwater sampling, quality assurance and quality control activities for sampling processes include the collection of field replicates and the preparation of field blanks. For field replicates, the volunteers split samples for analysis by the laboratory. The laboratory will run both the original sample and the replicates samples to assess the accuracy and bias criteria. See Table 7.1.3 for the accuracy criteria. The RPD is calculated as above. This splitting of samples will take place for one site during each annual sampling run. Blanks will be prepared by pouring deionized water into a clean sample collection container provided by the laboratory. This blank is a carried in the field, in a cooler with ice packs, to simulate as closely as possible how the samples are handled. The blank is compared to the MDL, as above. The laboratory will analyze the field blank for nutrients. One blank will be submitted each year. 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. Outlier calculations will not be applied to stormwater data because the data is by its nature highly variable.

The QA laboratory, Creek Environmental Laboratories, is an ELAP-certified lab that undergoes the annual inspection and recertification process. 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:

Accuracy % difference = [(X1 – X2) * 100]/ (X1) where X1 is the known value

% Recovery = [(matrix plus spike result – matrix result) / (expected matrix plus spike result)] * 100

% Completeness = [# valid samples / # 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
Analytical Parameter(s): Nitrates, orthophosphates
Analytical Method/SOP Reference: See Table 14.1.2.
Sample locations: Various. (See Section 6.4).

Field QC	Frequency/Number per sampling event	Acceptance Limits
Equipment Blanks		
Field Blanks: nutrients	One sample per year for water quality monitoring, one sample per year for stormwater analysis	< MDL for target analyte
Trip Blanks		
Cooler Temperature		
Field Duplicate Pairs		
Field Splits: nutrients	10% of total samples for water quality nutrient analysis	RPD < 25%
Field Splits: turbidity	One sample per month analyzed both by MBNEP equipment and a certified lab.	The acceptable difference between the two readings are: for $\leq$ 5 NTU ($\pm$ 2 NTU), for $\leq$ 25 NTU ($\pm$ 5 NTU), for $\leq$ 100 NTU ($\pm$ 20 NTU), for $\leq$ 500 NTU ($\pm$ 50 NTU), for $\leq$ 1,000 NTU ($\pm$ 100 NTU), for $\leq$ 10,000 NTU ($\pm$ 200 NTU), for $\leq$ 100,000 NTU ($\pm$ 300 NTU)
Field Splits: DO	One sample per month analyzed both by MBNEP equipment and Winkler titration	$\pm$20%
Field Matrix Spikes		
Other:		

Table 14.1.2. Analytical QC for water quality, stormwater and Urban Watch monitoring

Matrix: Water
Sampling SOP: MBVMP First Flush Monitoring Protocols, MBVMP Water Quality Monitoring Protocols, MBVMP Urban Watch Protocols
Analytical Parameter(s): Nitrates as N, orthophosphates as P, TDS, TSS, oil & grease, dissolved metals, turbidity, residual chlorine, ammonia-nitrogen
Analytical Method/SOP Reference: Nitrates (EPA Method 300.0), Orthophosphates (SM 4500-P E), TDS (SM 2540C), TSS (SM 2540D), oil & grease (EPA 1664 Rev A), Dissolved metals (EPA 200.8), Turbidity (SM 2130B), Residual Chlorine (SM 4500-C1 G), Ammonia-Nitrogen (SM 4500-NH3 D)
Sample locations: Various (See Section 6.4)

Laboratory QC	**Frequency/Number**	**Acceptance Limits**
Method Blank	One per batch	< TRL
Reagent Blank	One per new lot	< TRL
Storage Blank	NA	
Instrument Blank: Dissolved metals	One per day of analysis	< TRL
Lab. Duplicate	One per batch or one per 20 samples	Dissolved metals: RPD $\leq$ 25% Orthophosphates: RPD $\leq$ 20% Nitrates: RPD $\leq$ 20% TDS: RPD $\leq$ 20% TSS: RPD $\leq$ 20% Oil & grease: RPD $\leq$ 18% Turbidity: $\leq$ 30% Total Residual Chlorine: RPD $\leq$ 30% Ammonia-Nitrogen: RPD $\leq$ 30%
Lab. Matrix Spike	One per batch or one per 20 samples	Dissolved metasl: recovery 75-125% Orthophosphates: recovery 80-120% Nitrates: recovery 80-120% TDS: NA TSS: NA Oil & grease: recovery 78-114% Turbidity: NA

		Total Residual Chlorine: NA Ammonia-Nitrogen: recovery 70-130%
Matrix Spike Duplicate	One per batch or one per 20 samples	Dissolved metals: 75-125%, RPD ≤ 25% Orthophosphates: 80-120%, RPD ≤ 20% Nitrates: 80-120%, RPD ≤ 20% TDS: NA TSS: NA Oil & grease: 78-114%, RPD ≤ 18% Turbidity: NA Total Residual Chlorine: NA Ammonia-Nitrogen: 70-130%, RPD ≤ 30%
Lab. Control sample	One per batch	Dissolved metals: 75-125% Orthophosphates: 80-120% Nitrates: 80-120% TDS: 75-125% TSS: NA Oil & grease: 78-114% Turbidity: 80-120% Total Residual Chlorine: NA Ammonia-Nitrogen: recovery 70-130%
Surrogates	NA	
Internal Standards	NA	
Others:	NA	

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 and by the QA laboratory. The precision criterion is that the lab-generated result must be within the 95% confidence interval of the volunteer-generated result. Confidence interval charts are provided by IDEXX, the manufacturer of the bacterial testing methodology.

Blanks will be prepared by pouring sterile deionized 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 above 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 QA laboratory, the SLO County Public Health Agency Laboratory, is ELAP-certified and undergoes an annual inspection and recertification process. 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 95% confidence interval 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	Acceptance Limits
Equipment Blanks		
Field Blanks: total coliform, *E. coli*, enterococcus	One per year	< MDL for target analyte
Trip Blanks		
Cooler Temperature		
Field Duplicate Pairs		
Collocated Samples		
Field Splits: total coliform, *E. coli*, enterococcus	10% of total samples	95% confidence interval
Field Matrix Spikes		
Other:		

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
Analytical Method/SOP Reference: Enterolert – ASTM D6503.99, Colilert-18 – Standard Methods 9223
Sample locations: Various (See Section 6.4)

Laboratory QC	Frequency/Number	Acceptance Limits
Method Blank	NA	
Reagent Blank	For each new lot of reagent, run a presence/absence test for *E. coli*, *Klebsiella*	Presence/absence

	pneumoniae and *Pseudomonas aeruginosa*	
Storage Blank	NA	
Instrument Blank	NA	
Lab. Duplicate	Upon request from clients	95% confidence interval
Lab. Matrix Spike	NA	
Matrix Spike Duplicate	NA	
Lab. Control sample	NA	
Surrogates	NA	
Internal Standards	NA	
Others:	Sterility check on new lots of sterile sample collection containers. Run a presence/absence test with sterile DI water.	No contamination

14.3 Macroinvertebrate monitoring

VMP staff accompany volunteers on all sample collection field trips. VMP staff receive biennial refresher training from CCRWQB staff 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, 20 to 25% of *every* submitted sample 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 macroinvertebrate monitoring

Matrix: Benthic invertebrates
Sampling SOP: Standard Operating Procedure for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California, 2007
Analytical Parameter(s): Benthic invertebrates
Analytical Method/SOP Reference: Ecoanalysts Laboratory SOP/QA Plan 2007
Sample locations: Various (See Section 6.4)

14.4 Flow monitoring

Quality assurance and quality control activities for flow monitoring include the comparison of volunteer-collected flow data with established gauges at San Luisito and Chorro Creeks. Flows calculated with volunteer-collected data will be compared to flow data from these gauges. RPD values should be within $\pm$ 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 Suspended sediment monitoring

For suspended sediment monitoring, samples cannot be split, and replicate samples would not provide any meaningful information. Instead, single-blind samples prepared by the USGS Branch of Quality Systems, will be analyzed by VMP staff in our laboratory at the minimum on an annual basis to assess the accuracy and precision of our procedures and equipment. Values should be within +/- 1 mg. In addition, blank samples of DI water will be analyzed to ensure that proper sample handling techniques are being used.

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.

VMP 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, VMP 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 55 and YSI 85 DO Meters	Inspected periodically throughout monitoring time period	VMP staff	Weekly during water quality monitoring effort	Operator manual
YSI 55 and YSI 85 DO Meters	Change membrane	VMP staff	As needed, approximately 4 times/year	Operator manual
HACH 2100P Turbidimeter	Inspected periodically throughout monitoring time period	VMP staff	Weekly during water quality monitoring effort	Operator manual
Oakton ECTestr and YSI Model 30 Meter	Inspected periodically throughout monitoring time period	VMP staff	Weekly during water quality monitoring effort	Operator manual
LaMotte Nitrate as N test kit	Inspected periodically throughout monitoring time period	VMP staff	Weekly during water quality monitoring effort.	Operator manual
Hanna PO_4 meter	Inspected periodically throughout monitoring time period. Quarterly, run a sample of reagent of a known PO_4 concentration to test the meter results.	VMP staff	Inspected weekly during water quality monitoring effort.	Operator manual
Incubators and thermometers for bacteria monitoring	Inspected periodically throughout monitoring time period	VMP staff	Monthly	Operator manual
ISCO Model	Inspected	VMP staff	Each time sampler is	Operator manual

Equipment / Instrument	Maintenance Activity, Testing Activity or Inspection Activity	Responsible Person	Frequency	SOP Reference
6712 Automated sampler (suspended sediment)	periodically throughout monitoring time period		deployed	

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.

To ensure that there is no carry-over contamination in the vials and syringes used for water quality and Urban Watch analysis, VMP staff will conduct split analysis for precision as soon as possible. Samples will be 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, the following corrective actions will be taken immediately. All affected sample vials and syringes will be replaced with new ones immediately. The split sample procedure will be repeated quarterly. Volunteers will be re-trained to emphasize the importance of the cleaning procedures.

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
Marsh McBirney Flow Meters	MBVMP Equipment Calibration Protocols	Sent to manufacturer for calibration and conditioning	Annually	VMP staff. Manufacturer will continue to repair meter until problems are corrected or meter needs to be replaced.
YSI 85 DO Meters	MBVMP Equipment Calibration Protocols	Internal calibration, verification against Winkler titration. Two readings must be within $\pm$ 20%.	Monthly	VMP staff. Replace membrane and recondition probe. If this fails, send equipment in for servicing.
HACH 2100P Turbidimeter	MBVMP Equipment Calibration Protocols	Formazin calibration standards. The acceptable difference between the two readings are: for $\leq$ 5 NTU ($\pm$ 2 NTU), for $\leq$ 25 NTU ($\pm$ 5 NTU), for $\leq$ 100 NTU ($\pm$ 20 NTU), for	Monthly	VMP staff. Recalibrate. If cannot be corrected, return to manufacturer for serving.

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
		≤ 500 NTU (± 50 NTU), for ≤ 1,000 NTU (± 100 NTU), for ≤ 10,000 NTU (± 200 NTU), for ≤ 100,000 NTU (± 300 NTU)		
Oakton ECTestr, ECTestr 11 Plus and YSI Model 30 Meter	MBVMP Equipment Calibration Protocols	Calibration standards. Reading must be within ± 10% of calibration standard.	Monthly	VMP staff. Recalibrate. If cannot be corrected, return to manufacturer for servicing.
LaMotte Nitrate as N test kit	MBVMP Equipment Calibration Protocols	Run a known calibration standard and DI water to ensure accuracy. Kits cannot be calibrated.	Quarterly	VMP staff. Kits cannot be recalibrated. Split samples are sent to laboratory for analysis. See Table 7.1.2 for criteria.
Hanna PO_4 meter	MBVMP Equipment Calibration Protocols	Run a known calibration standard and DI water to ensure accuracy. Meters cannot be calibrated.	Quarterly	VMP staff. Meter cannot be recalibrated. Split samples are sent to laboratory for analysis. See Table 7.1.2 for criteria.
Bacteria Lab: Incubator and thermometer	MBVMP Equipment Calibration Protocols	Log incubator temperature each time remove a batch of trays. Incubator must be from 34.5 to 37 ºC for the Colilert-18 incubator and 41 ± 0.5 ºC for the Enterolert incubator	Each batch	Volunteers record values. Reviewed by QA Officer. Adjust incubator temperature as needed.
Bacteria Lab: Certified thermometer	MBVMP Equipment Calibration Protocols	Run incubator for 12 hours with both a thermometer and a certified thermometer. Record the temperature difference.	Annually	VMP staff. Provides amount of correction required for the thermometer. Adjust incubator temperature as needed.
Incubator and thermometers (Bacteria lab)	MBVMP Equipment Calibration Protocols	Place a certified thermometer in the incubator to check both incubator temperature and accuracy of thermometers.	Annually	VMP staff. Incubator temperature can be adjusted. Record the difference in temperature readings and correct the non-certified thermometer readings.
ISCO Model 6712, automated sampler (suspended sediment)	MBVMP Suspended Sediment Monitoring Protocol	Verify the volume of sample collected by the sampler	Annually	VMP staff. Adjust sampler programming as needed.

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
Fine scale (sediment lab)	MBVMP Suspended Sediment Monitoring Protocol	Verify accuracy of scale using calibration weights. Annual certification and calibration of scale.	Each time scale is used or if drift becomes greater than ± 0.0002 g.	VMP staff. Re-calibrate scale. If problem cannot be corrected, scale must be sent to the manufacturer for service.
Gross scale (sediment lab)	MBVMP Suspended Sediment Monitoring Protocol	Verify accuracy of scale using calibration weights.	Each time scale is used and if drift becomes greater than ± 0.02 g.	VMP staff. Re-calibrate scale. If problem cannot be corrected, scale must be sent to the manufacturer for service.
Oven (sediment lab)	MBVMP Suspended Sediment Monitoring Protocol	Verify accuracy of temperature adjustment using certified thermometer.	Each time oven is started.	VMP staff. Adjust oven thermostat so that temperature remains within +/- 10 of the desired temperature.
Dessicators (sediment lab)	MBVMP Suspended Sediment Monitoring Protocol	Ensure desiccant is dry.	As begin processing each batch of samples.	VMP 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 to document the date and nature of the maintenance required.

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
SLO County Public Health Agency Lab: incubators	QA Manual for Water and Shellfish Testing	Read and record temperature in incubators twice a day. Thermometers are certified and ASTM calibrated.	Certified annually	Keya Bergman
SLO County Public Health Agency Lab: tray sealer	QA Manual for Water and Shellfish Testing	Run a tray through the sealer containing water with dye to check for leaks	Once for each new lot of trays	Keya Bergman
SLO County Public Health Agency	QA Manual for Water and	Place inoculated plate in the incubator to test incubator	Each time incubator is	Keya Bergman

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person
Lab: incubators	Shellfish Testing	temperature	used	
Ecoanalysts: Benthic invertebrates	NA	NA	NA	Gary Lester
Creek Environmental Lab: Nutrient analysis	Creek Environmental Laboratory SOP	External calibration with 3 to 5 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 20 samples after initial calibration. Standard source different than that used for initial calibration. Recover 80 – 120%.	Nitrate as N: Initial calibration: Every 6 months Calibration verification: Once per batch Ortho-phosphate: Once per batch	Mike Ng
Creek Environmental Lab: Dissolved Metals	Creek Environmental Laboratory SOP	Internal calibration. Minimum of a blank and one standard covering the range of sample concentrations prior to sample analysis. Calibration verification every 20 samples after initial calibration. Standard source different than that used for initial calibration. Recover 90 - 110%.	Once per batch	Mike Ng
Creek Environmental Lab: Oil & Grease	Creek Environmental Laboratory SOP	NA	NA	Mike Ng
Creek Environmental Lab: TDS and TSS	Creek Environmental Laboratory SOP	NA	NA	Mike Ng
Creek Environmental Lab: Turbidity	Creek Environmental Laboratory SOP	NA	NA	Mike Ng
Morro Bay-Cayucos Wastewater Treatment Plant Lab: autoclave	Morro Bay-Cayucos Wastewater Treatment Plant Laboratory QA Manual	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	Bruce Keogh
Morro Bay-Cayucos Wastewater	Morro Bay-Cayucos Wastewater	Place autoclave tape on items to be treated. Tape should change color if temperature	Each batch	Bruce Keogh

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person
Treatment Plant Lab: autoclave	Treatment Plant Laboratory QA Manual	reaches 121 ºC.		
Morro Bay-Cayucos Wastewater Treatment Plant Lab: autoclave timer	Morro Bay-Cayucos Wastewater Treatment Plant Laboratory QA Manual	Run batch with two timers, one certified, to ensure accuracy.	Quarterly	Bruce Keogh
Morro Bay-Cayucos Wastewater Treatment Plant Lab: autoclave thermometer	Morro Bay-Cayucos Wastewater Treatment Plant Laboratory QA Manual	Run batch with two thermometers, one which holds the maximum temperature reached during the autoclave run.	Each batch	Bruce Keogh

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 DI 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 DI 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.

VMP 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. VMP staff track supplies and ensure that they are reordered in a timely fashion. All supplies are stored per the manufacturer's recommendations.

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 the CCAMP 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 own CCAMP database format. 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 not be included in the CCAMP database and 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 Mens Colony Wastewater Treatment Plant
- Morro Bay Power Plant
- California Polytechnic State University, San Luis Obispo student project data
- Resource Conservation District maintenance and monitoring records
- Point Reyes Bird Observatory
- Applicable Environmental Impact Report data
- County of San Luis Obispo Environmental Health
- Los Osos Community Services District
- Surfrider
- California Department of Fish and Game
- California Department of Parks and Recreation
- US Fish and Wildlife
- California Native Plant Society

19. DATA MANAGEMENT

Upon completion of fieldwork, volunteers or VMP staff check over datasheets for completeness and any obvious errors. As datasheets come in from the field, VMP staff will review them for any obvious omissions or errors. Data is then entered into the appropriate computerized system, either CCAMP or an Excel spreadsheet. Upon completion of data entry, the MBNEP QA Officer reviews all entered data to ensure its accuracy and completeness. Once this is complete, the original paper copy datasheets are filed. The database and other electronic data records are backed up on tape drive, overwritten every other week. CD backups of the database are made quarterly and stored off-site.

Suspended sediment data is stored in an Access database which is maintained at the Sediment Laboratory located at Cuesta College. All sample-related data is stored in the database. Twice monthly during times of sample processing, an Access query is run to generate a paper copy of all relevant data to provide a hard copy. The database is backed up twice a month during periods when samples are being processed and stored off-site.

When data is received from the analytical laboratories, VMP staff reviews the data and then enters it into the appropriate electronic data management system. Upon completion of the data entry, the MBNEP QA Officer reviews all entered data to ensure its accuracy and completeness. Once this is completed, the paper copy report is filed. The database and other electronic data records are backed up on tape drive, overwritten every other week. CD backups are made quarterly and stored off-site.

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

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 either the RWQCB Contract Manager or for the public. The majority of this analysis is conducted with Excel and ESRI

ArcGIS. The database is forwarded regularly to CCRWQCB CCAMP staff. This analysis is conducted by VMP staff and is overseen by the MBNEP QA Officer. The CCAMP database is SWAMP-compatible, and data should be easily uploaded into a SWAMP database if needed.

The MBNEP contracts with an independent contractor to provide server maintenance and upkeep. As our primary data management system is a CCAMP database, VMP staff relies on guidance from CCAMP staff to inform us of the requirements of both hardware and software for properly maintaining the CCAMP 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 both the RWQCB Contract Manager and 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 are 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 Contract Manager and 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 both the VMP staff and volunteers as well as any of the analytical laboratories with which it contracts.

21. REPORTS TO MANAGEMENT

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

The VMP staff and MBNEP QA Officer create an annual detailed QA report to accompany their annual data summary report. This QA report will outline any results that did not meet the QC objectives. These reports are submitted in writing to the RWQCB Contract Manager and 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.

Table 21.1. QA management reports

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Data Summary Report, including QA Report	Annually	January 31	MBNEP Program Manager	SWRCB Contract Manager and RWQCB QA Officer
Calibration Log	Annually	December 31	MBNEP Program Manager	SWRCBContract Manager
QAPP Update	Annually	Variable	MBNEP QA Officer	SWRCB Contract Manager, 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. 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 will not be used. For nitrates, readings of 0.5 mg/L or less that fail the criteria will be retained. Higher readings that fail the criteria will be rejected. For orthophosphates, readings of 0.5 mg/L or less that fail the criteria will be retained. Higher readings that fail will be rejected. Orthophosphate data that falls below the project quantitation limit (PQL) of 0.5 mg/L will be flagged in the database in the QAComments field as being less than the PQL. 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. First Flush analysis for dissolved metals will be flagged because they will not comply with the Standard Methods since they cannot be filtered immediately after sample collection. For suspended sediment data, sample results that are invalid due to errors during processing or data management will be removed from the sediment monitoring database and will not be used in any data analysis. All decisions regarding data validation will be performed by the MBNEP QA Officer.

23. VERIFICATION AND VALIDATION METHODS

All data records will be checked visually prior to data entry into either the CCAMP database or other electronic formats. Any corrections will be written directly on the datasheet. VMP staff will conduct all reviews and the MBNEP's QA Officer will review all datasheets and all data entry into CCAMP and other electronic formats. Laboratory QA Officers will perform checks of all of their records. All

submittals by laboratories will be reviewed by the MBNEP Program Manager. 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 CCAMP 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 VMP staff with input, if applicable, from laboratory directors and from the RWQCB QA Officer. Any special notes on decisions regarding data usability will be entered in the 'Notes' column of the CCAMP 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.

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. 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 indicates whether this data will be adequate. The completeness criteria is 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 we receive requests for our data or if we conduct any data 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 a data summary report that is submitted to the RWQCB Contract Manager. 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. While not currently part of the SWAMP umbrella, it could easily be incorporated at any time.

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