QUALITY ASSURANCE PROJECT PLAN

FINAL VERSION 1.0

Santa Margarita River Estuary and Watershed Monitoring and Assessment Program

Submitted to:

California Regional Water Quality Control Board, San Diego Region
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San Diego, California 92108

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On Behalf of:

County of Riverside
Riverside Flood Control and Water Conservation District
County of San Diego
United States Marine Corps Base Camp Pendleton
City of Murrieta
City of Temecula
City of Wildomar

January 2020

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GROUP A ELEMENTS: PROJECT MANAGEMENT

1. TITLE AND APPROVAL SHEET

Final
Quality Assurance Project Plan

Santa Margarita River Estuary and Watershed
Monitoring and Assessment Program

January 2020

APPROVAL SIGNATURES

PROJECT ORGANIZATION/ RESPONSIBLE PARTIES:

Agency	Name and Title	Signature	Date
County of Riverside	Alonzo Barrera, County Executive Office Management Analyst		
Riverside County Flood Control and Water Conservation District	Richard Boon, Watershed Protection Division Chief		
County of San Diego	Jo Ann Weber, Water Quality Program Coordinator		
U.S. Marine Corps Base Camp Pendleton	Mark Bonsavage, Environmental Security Environmental Engineering Branch Head		
City of Murrieta	Mai Son, NPDES Coordinator		
City of Temecula	Stuart Kuhn, NPDES Coordinator		
City of Wildomar	Dan York, Public Works Director/City Engineer		
Contracted Consultant	**Name and Title**	**Signature**	**Date**
Naval Information Warfare Center Pacific (NIWC Pacific)	Kara Sorensen, Project Manager		
Naval Information Warfare Center Pacific (NIWC Pacific)	Ignacio Rivera QA Officer		

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD (San Diego Water Board):

Agency	Name and Title	Signature	Date
San Diego Water Board	Cynthia Gorham, Project Manager		
San Diego Water Board	Cynthia Gorham, QA Officer		

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LIST OF ACRONYMS AND ABBREVIATIONS

2006 Investigative Order	San Diego Water Board Investigative Order No. R9-2006-007
2019 Investigative Order	San Diego Water Board Investigative Order No. R9-2019-0007
303(d) List	Section 303(d) List of Water Quality Limited Segments
APHA	American Public Health Association
ASTM	American Society for Testing and Materials
Basin Plan	Water Quality Control Plan for the San Diego Basin
Bight '18	Southern California Bight 2018 Regional Marine Monitoring Survey
COC	chain of custody
DO	dissolved oxygen
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
Estuary	Santa Margarita River Estuary
HA	hydrologic area
HDPE	high-density polyethylene
LA	load allocation
LCS	laboratory control sample
LSMR Model	Lower Santa Margarita River Groundwater Model
MCB CamPen	U.S. Marine Corps Base Camp Pendleton
MLLW	mean lower low water
MOU	Memorandum of Understanding
MQO	measurement quality objective
MS	matrix spike
MS/MSD	matrix spike/matrix spike duplicate
NIWC Pacific	Naval Information Warfare Center Pacific
NNE	nutrient numeric endpoint
NPDES	National Pollutant Discharge Elimination System
NWIS	National Water Information System
PM	project manager
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
San Diego Water Board	San Diego Regional Water Quality Control Board
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists
SCCWRP	Southern California Coastal Water Research Project
SM	Standard Methods for the Examination of Water and Wastewater
SMR	Santa Margarita River
SOP	standard operating procedure
SPAWAR	Space and Naval Warfare Systems Pacific
SQO	sediment quality objective
State Water Board	State Water Resources Control Board
SUBS Sampler	multi-SUBstrate Subtidal sampler
SWAMP	Surface Water Ambient Monitoring Program
TBD	to be determined
TKN	total Kjeldahl nitrogen

TMDL	Total Maximum Daily Load
TOC	total organic carbon
U.S.	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	waste load allocation
WMA	Watershed Management Area
Workplan	Monitoring and Assessment Program Workplan
WQO	water quality objective

UNITS OF MEASURE

cm	centimeter(s)
^{o}C	degrees Celsius
g	gram(s)
g dry weight/m^2	grams dry weight per meter squared
g wet weight/m^2	grams of wet weight per meter squared
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
m	meter(s)
m^2	meter squared
mg/L	milligram(s) per liter
mg/kg	milligram(s) per kilogram
mm	millimeter(s)
NTU	nephelometric turbidity units
ppt	parts per thousand
%	percent
µg	microgram(s)
µS/cm	micro Siemens per centimeter

3. DISTRIBUTION LIST

Table 3-1 identifies those individuals who will oversee the implementation of the approved Quality Assurance Project Plan (QAPP). Copies of the QAPP will be distributed in either hard copy or electronic format. Key personnel listed in **Table 3-1** will ensure that the QAPP is distributed to their respective staff within their own organization.

Table 3-1. Quality Assurance Project Plan Distribution List

Contact Agency/Organization	Name	QAPP Version No.
San Diego Water Board	Cynthia Gorham	1.0
San Diego Water Board	Cynthia Gorham – QA Officer	1.0
County of Riverside	Alonzo Barrera	1.0
Riverside County Flood Control and Water Conservation District	Richard Boon, Matt Yeager, and Rebekah Guill	1.0
Riverside County Transportation Department	Jan Bulinski	1.0
County of San Diego	Jo Ann Weber	1.0
U.S. Marine Corps Base Camp Pendleton	Mark Bonsavage and Matthew Winterbourne	1.0
City of Murrieta	Mai Son	1.0
City of Temecula	Stuart Kuhn	1.0
City of Wildomar	Jason Farag	1.0
NIWC Pacific	Kara Sorensen	1.0
NIWC Pacific	Ignacio Rivera – QA Officer	1.0
TBD -Laboratory	TBD – QA Officer	1.0

4. PROJECT/TASK ORGANIZATION

4.1 INVOLVED PARTIES AND ROLES

This element of the QAPP describes individuals and their respective roles for this project. **Table 4-1** provides a summary of individuals, their key role, and contact information. **Figure 4-1** is an organizational chart showing the roles and lines of communication between key individuals.

San Diego Regional Water Quality Control Board (San Diego Water Board) Project Manager: Cynthia Gorham will serve as the temporary Project Manager for the San Diego Water Board until the vacancy is filled. Ms. Gorham will receive annual reports and data generated from this program.

San Diego Water Board Quality Assurance (QA) Officer: The San Diego Water Board QA Officer is Cynthia Gorham. The QA Officer will be responsible for reviewing annual reports to ensure that the monitoring plan and QAPP guidelines are being met.

County of Riverside: As the Management Analyst of the County's Executive Office, Alonzo Barrera will serve as the Contact for the County of Riverside. Mr. Barrera will be responsible for representing the County in approval of final plans, annual reports, and invoices for payment in accordance with the Memorandum of Understanding (MOU).

Riverside County Flood Control and Water Conservation District (District): As Chief of the Watershed Protection Division, Richard Boon will serve as the Contact for the District. Mr. Boon will be responsible for representing the District in approval of final plans, annual reports, and invoices for payment in accordance with the MOU. As the Water Quality Compliance Section Manager Dr. Matt Yeager will serve as the Project Manager for the District, responsible for the day-to-day contract administration with Consultant, coordination with Consultant on annual field activities and schedules; technical review of plans, reports, and ensuring that the QAPP is being implemented. As the District's Watershed Monitoring Section Manager, Rebekah Guill will serve as support for the above-mentioned roles. Ms. Guill will also be responsible for oversight of County-specific river monitoring efforts in accordance with the MOU. The District will complete the Riverside County-specific river monitoring requirements on behalf of the Riverside County Copermittees under a separate cooperative agreement. The District will be responsible for timely submittal of complete river monitoring data packages to NIWC for assessment and compliance reporting.

County of San Diego: Jo Ann Weber will serve as the Contact for the County of San Diego. Ms. Weber will be responsible for representing the County in approving final plans, annual reports, and invoices for payment in accordance with the MOU. Ms. Weber will also be responsible for oversite of County-specific river monitoring efforts in accordance with the MOU. The County of San Diego will complete the San Diego County-specific river monitoring requirements and be responsible for timely submittal of complete river monitoring data packages to NIWC for assessment and compliance reporting.

United States (U.S.) Marine Corps Base Camp Pendleton (MCB CamPen) Environmental Security Engineering: As the Environmental Security Engineering Branch Head, Mark Bonsavage will serve as the Contact for MCB CamPen. Mr. Bonsavage will be responsible for representing the Base in approving final plans, annual reports, and invoices for payment in accordance with the MOU. As the Water Quality Section Head, Matt Winterbourne will serve as the Project Manager for MCB CamPen. Mr. Winterbourne will be responsible for the day-to-day contract administration with Consultant, coordination with Consultant on annual field activities and schedules; technical review of plans, reports, and additional QC of data and analyses.

City of Murrieta: Mai Son will serve as the Contact for the City of Murrieta. Ms. Son will be responsible for representing the City in approval of final plans, annual reports, and invoices for payment in accordance with the MOU.

City of Temecula: Stuart Kuhn will serve as the Contact for the City of Temecula. Mr. Kuhn will be responsible for representing the City in approval of final plans, annual reports, and invoices for payment in accordance with the MOU.

City of Wildomar: Dan York, Public Works Director/City Engineer, is the City's responsible signatory for the QAPP. The Primary contact for the City of Wildomar is water quality engineering consultant Jason Farag. Mr. Farag will be responsible for representing the City in approval of final plans, annual reports, and invoices for payment in accordance with the MOU.

Naval Information Warfare Center Pacific (NIWC Pacific).[1] **Technical Advisor**: Dr. Kara Sorensen from NIWC Pacific will serve as Technical Advisor. Dr. Sorensen will oversee groundwater and estuary monitoring in accordance with the MOU and act as a consultant to the dischargers. NIWC Pacific will be responsible for completion of the required assessment and compliance reporting in accordance with the IO on behalf of all of the "Partners" as identified in the MOU. NIWC Pacific will serve the project by fulfilling the following roles:

- **Consultant Project Manager**. The Consultant Project Manager (PM) is Dr. Kara Sorensen. The Consultant PM will be responsible for the day-to-day activities of implementing the Santa Margarita River Estuary and Watershed Monitoring and Assessment Program. These responsibilities include contract administration, coordination of annual field activities and schedules; and technical review of reports. Should NIWC Pacific use subcontractors for completion of the work outlined in the IO Workplan, the Consultant Project Manager shall ensure that all subcontractors comply with the requirements of the IO and this QAPP.

- **Consultant Field Sampling Lead**: The Consultant Field Sampling Lead is TBD. The Consultant Field Sampling Lead will be responsible for field team efforts and provide oversight for all field activities, including developing field schedules, coordinating field staff, maintaining equipment utilized for watershed and estuary monitoring, conducting the sampling, and ensuring samples are delivered to the analytical laboratory with proper documentation and sample preservation, and maintaining field records associated with each monitoring task.

[1] Formerly known as NAVY Space and Naval Warfare Systems Pacific (SPAWAR).

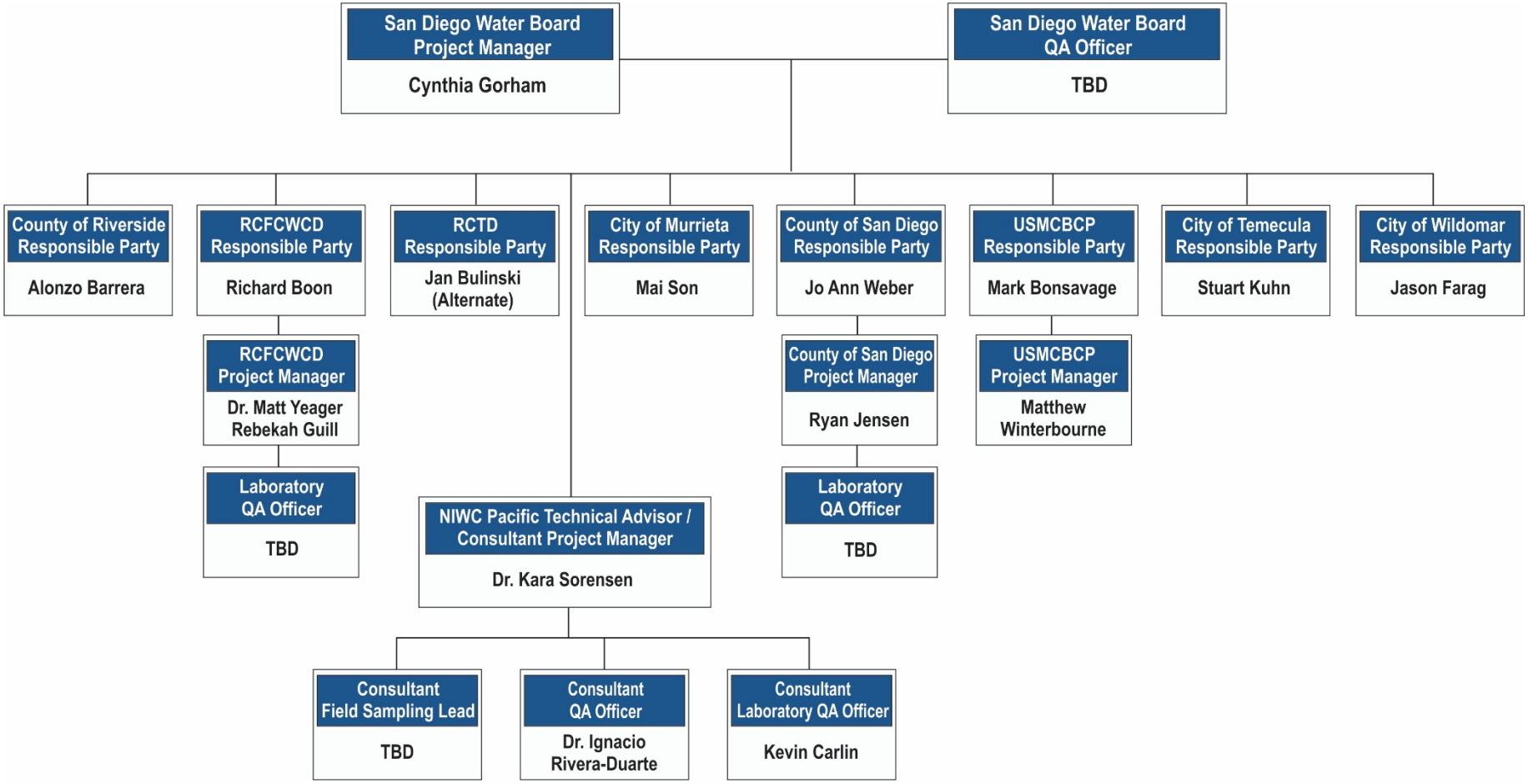
- **Consultant Quality Assurance (QA) Officer:** The Consultant QA Officer is Dr. Ignacio Rivera. The Consultant QA Officer will be responsible for guaranteeing the overall QA and QC procedures and will ensure that data reported by the Consultant have been generated in compliance with the appropriate protocols. The Consultant QA Officer will report all findings to the Consultant PM, including all requests for corrective actions. If there is evidence of significant deviations from protocols stated in this QAPP or if there is evidence of systematic failure, the Consultant QA Officer has the authority to stop all activities until corrective actions can be documented and performed.

Laboratory QA Officer: It is likely that the County of San Diego, the District, MCB CamPen and/or NIWC Pacific will utilize separate contracted laboratories for completion of the monitoring conducted within their respective jurisdictions; therefore, it is the responsibility of each agency to ensure that the contracted laboratory have a designated Laboratory QA Officer and to provide oversight to the contracted laboratory. The Laboratory QA Officer will be responsible for all analyses conducted by the laboratory and will ensure that the QAPP guidelines are being met.

Table 4-1. Personnel Responsibilities and Contact Information

Name	Organizational Affiliation	Title	Contact Information (Telephone Number and Email Address)
Cynthia Gorham	San Diego Water Board	Project Manager	619-521-3921 Cynthia.Gorham@waterboards.ca.gov
Cynthia Gorham	San Diego Water Board	QA Officer	619-521-3921 Cynthia.Gorham@waterboards.ca.gov
Alonzo Barrera	County of Riverside	Responsible Party Contact	951-955-1402 abarrera@rivco.org
Jan Bulinski	Riverside County Transportation Department	Responsible Party Contact (Alternate)	951-955-6589 JBulinski@rivco.org
Richard Boon	Riverside County Flood Control and Water Conservation District	Responsible Party Contact	951-955-1273 rboon@rivco.org
Matt Yeager	Riverside County Flood Control and Water Conservation District	Project Manager	951 955-0843 myeager@rivco.org
Rebekah Guill	Riverside County Flood Control and Water Conservation District	Project Manager Support	951-955-2901 rguill@rivco.org
Jo Ann Weber	County of San Diego	Responsible Party Contact	858-495-5317 joann.weber@sdcounty.ca.gov
Mark Bonsavage	U.S. Marine Corps Base Camp Pendleton	Responsible Party Contact	760-725-9753 mark.bonsavage@usmc.mil
Matthew Winterbourne	U.S. Marine Corps Base Camp Pendleton	Project Manager	760-725-0141 matthew.p.winterbour@usmc.mil
Mai Son	City of Murrieta	Responsible Party Contact	951-461-6085 mson@murrietaca.gov
Stuart Kuhn	City of Temecula	Responsible Party Contact	951-308-6387 Stuart.kuhn@temeculaca.gov
Jason Farag	City of Wildomar	Responsible Party Contact	951-677-7751 Ext 219 jfarag@cityofwildomar.org
Kara Sorensen	NIWC Pacific	Technical Advisor, Consultant Project Manager	619-553-1340 sorensek@spawar.navy.mil
Ignacio Rivera	NIWC Pacific	Consultant QA Officer	TBD

Name	Organizational Affiliation	Title	Contact Information (Telephone Number and Email Address)
TBD	NIWC Pacific	Consultant Field Sampling Lead	TBD
TBD	NIWC Pacific	Laboratory QA Officer	TBD
TBD	Consultant (Riverside) - TBD	Laboratory QA Officer	TBD
TBD	Consultant (San Diego) - TBD	Laboratory QA Officer	TBD



NIWC = Naval Information Warfare Center
RCFCWCD = Riverside County Flood Control and Water Conservation District
RCTD = Riverside County Transportation Department
USMCBCP = U.S. Marine Corps Base Camp Pendleton

Figure 4-1. Organizational Chart

4.2 QUALITY ASSURANCE OFFICER ROLE

The Project QA Officer will be responsible for maintaining the QAPP and ensuring that personnel listed in **Element 3** have the most recent version of the QAPP. The QA Officer will ensure that project staff understand and perform all QA/QC procedures related to field sample collection, laboratory analysis, and data analysis according to QAPP requirements throughout the duration of this project.

4.3 PERSONS RESPONSIBLE FOR QAPP UPDATE AND MAINTENANCE

Changes and updates to this QAPP may be made after a review of the evidence for change by the Santa Margarita River Nutrient Initiative Group Technical Advisory Committee (SMRNIG TAC) with the concurrence of the Riverside County Flood Control and Water Conservation District (District), County of San Diego, and MCB CamPen. The Consultant PM, with input from the Consultant QA Officer, will be responsible for making the changes, submitting drafts for review, preparing a final amended copy, and submitting the final for signature. Project work must be halted while revisions to the QAPP are made, unless authorized by the District, the County of San Diego, and MCB CamPen.

5. PROBLEM DEFINITION/BACKGROUND

5.1 DECISIONS OR OUTCOMES

Surface water and groundwater monitoring will be conducted in the Estuary and SMR Watershed in order to assess progress toward attainment of numeric targets in accordance with the 2019 Investigative Order (San Diego Water Board, 2019). Data collected during the four-year monitoring period will be used to address the following questions:

1. *Is watershed mass loading of total nitrogen and total phosphorus to the River and Estuary reduced to levels that do not exceed the calculated assimilative capacity of the Estuary?*

2. *Based on available information, do monitoring results confirm the assumption that the implementation and compliance with the Discharger's existing NPDES permits are sufficient to bring about the necessary nutrient load reductions to restore the Estuary in accordance with the schedule provided in the Draft Staff Report?*

3. *Are the Estuary numeric targets for macroalgal biomass, dissolved oxygen, and Benthic Community Condition being achieved and sustained? If not, based on available information, what are the primary stressors causing unsatisfactory eutrophication conditions?*

These questions will be answered utilizing the data collected each year, including the following parameters:

- Estuary resurfacing groundwater discharge rates and loading into the Estuary from the Santa Margarita Valley Groundwater Basin;
- Estuary groundwater total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus concentrations;
- Estuary ambient water quality parameters including DO (concentration and percent saturation); temperature, pH, salinity/conductivity, water depth, turbidity, and degree of tidal muting or influence;
- Estuary surface water chlorophyll-a and total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus concentrations;
- Estuary macroalgal biomass;
- Estuary benthic community condition;
- Estuary sediment grain size, total organic carbon, nitrogen, and phosphorus concentrations;
- Santa Margarita River Watershed flow, temperature, conductivity, and ambient total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus concentrations.

The monitoring will be conducted during dry weather periods in both summer and winter for four years (2020-2023). Monitoring reports will be prepared annually to allow the Dischargers to evaluate the effectiveness of their actions to reduce nitrogen and phosphorus loading to the Estuary and achieve the numeric targets of the 2019 Investigative Order.

5.2 PROBLEM STATEMENT

The Santa Margarita River Estuary (Estuary) is a 192 acre coastal estuarine habitat located in northern San Diego County on the southwestern edge of the United States (U.S.) Marine Corps Base Camp Pendleton (MCB CamPen) (**Figure 5-1**). Beneficial uses for the Estuary include Contact Water Recreation (REC-1), Non-Contact Water Recreation (REC-2), Estuarine Habitat (EST), Wildlife Habitat (WILD), Rare, Threatened, or Endangered Species (RARE), Marine Habitat (MAR), Migration of Aquatic Organisms (MIGR), and Spawning, Reproduction, and/or Early Development (SPWN). The lower Santa Margarita River (SMR) and Estuary are largely undeveloped and support multiple habitats for populations of federally- and/or state- listed endangered species. The SMR begins in Riverside County near the City of Temecula, at the confluence of Murrieta and Temecula Creeks. The main stem of the SMR flows within San Diego County through unincorporated areas, the community of Fallbrook, and MCB CamPen and ultimately drains into the Estuary. Urban and agricultural land uses in the more developed portions of the Santa Margarita River Watershed (SMR Watershed) have resulted in hydrological modifications to the Estuary which have led to increased nutrient loading (McLaughlin et al., 2013).

The ocean inlet at the mouth of the Estuary is not constricted by man-made structures, but inland from the mouth, tidal influence is constrained by rock jetties from Interstate-5 and the railroad crossings. Throughout the year, the ocean inlet of the Estuary may be open or closed to the Pacific Ocean for extended periods depending on the amount of rainfall and flow (McLaughlin et al., 2013). During periods when the Estuary is connected to the Pacific Ocean, the Estuary is flushed with seawater resulting in a brackish lagoon environment. However, salinity stratification in the water column often occurs when a sand berm develops at the ocean inlet. The combination of restricted tidal flushing and watershed loading of nutrients from upstream can result in excessive algal growth in the Estuary during the summer-dry season and winter-dry season (San Diego Water Board, 2018). As the macroalgae decayed, it reduced dissolved oxygen (DO) concentrations in the Estuary resulting in eutrophic conditions, which can degrade the aquatic habitat. In addition, excessive algal mats and floating algal scum are aesthetically unpleasant, reducing the public's opportunities for enjoyment of non-contact water recreation through activities such as bird watching.

Based on the San Diego Water Board's determination that eutrophic conditions in the Estuary limit its ability to support beneficial uses, the Estuary was placed on the 1986 Clean Water Act 303(d) List of Impaired Water Bodies (303(d) List) (State Water Resources Control Board [State Water Board], 2015) for eutrophic conditions during dry weather conditions in the summer and winter months. In 2006, the San Diego Water Board issued Investigation Order No. R9-2006-0076 (2006 Investigative Order), which established monitoring requirements for dischargers to impaired lagoons, including the Estuary, and required the dischargers to develop a monitoring program and submit monitoring program reports to aid in the development of a Total Maximum Daily Load (TMDL) (San Diego Water Board, 2006). In response to the 2006 Investigative Order, the Southern California Coastal Research Project (SCCWRP) assessed the Estuary from 2008-2009, which confirmed impairment of the Estuary due to eutrophication (McLaughlin et al., 2013). Further studies of eutrophication in the Estuary were conducted between 2010 and 2018 by the Naval Information Warfare Center Pacific (NIWC Pacific).[2] While monitoring results show that overall conditions are improving as massive rafting algal mats have not been observed since 2010, these studies continue to show evidence of eutrophic conditions

[2] Formerly known as NAVY Space and Naval Warfare Systems Pacific (SPAWAR).

manifested as macroalgal blooms, with higher levels of macroalgae heavily tied to closed mouth conditions. On behalf of MCB CamPen, NIWC Pacific also conducted monitoring on resurfacing groundwater (Leather et al., 2015; Leather et al., 2016; Leather et al., 2017). Results from this monitoring indicated that ongoing discharge of nutrients into the Estuary through resurfacing groundwater from former agricultural fields on MCB CamPen was still occurring. However, data indicated that a reduction of nutrient loading by as much as one to two orders of magnitude[3] had occurred since the monitoring of resurfacing groundwater first began (San Diego Water Board, 2019).

A loading analysis was drafted in July 2018, which identified total nitrogen and total phosphorus as the causative pollutants for eutrophication in the Estuary. In *Santa Margarita River Estuary, California Nutrients Total Daily Maximum Load Project* (Draft Staff Report) (San Diego Water Board, 2018), the San Diego Water Board outlined a TMDL of 13,246 pounds of delivered total nitrogen per year and 1,528 pounds of delivered total phosphorus per year during dry weather, meaning that the Estuary is able to assimilate this amount of total nitrogen and phosphorus during that time period without impairments of beneficial uses. This assimilative capacity corresponds to a 76% load reduction from loading levels measured in 2008 by SCCWRP.

The San Diego Water Board issued Investigative Order No. R9-2019-0007 (2019 Investigative Order) in May 2019. The basis for this order falls under California Water Code section 13267. The purpose of the 2019 Investigative Order is to "*assess the condition of the Santa Margarita River Estuary (Estuary) and to evaluate the linkage between the nutrient loading trends resulting from the implementation actions by the Cities of Murrieta, Temecula, and Wildomar, the Counties of San Diego and Riverside, the Riverside Flood Control and Water Conservation District, and the United States Marine Corps Base Camp Pendleton (collectively referred to hereafter as Dischargers) and the restoration of the water quality and beneficial uses of the Estuary*" (San Diego Water Board, 2019). The requirements were developed in collaboration with the Dischargers through the Santa Margarita River Estuary Watershed Nutrient Initiative Stakeholder Group. The 2019 Investigative Order requires the development of a Monitoring and Assessment Program Workplan (Workplan) that outlines a water quality monitoring and assessment program to track progress towards achieving the numeric targets listed in the Draft Staff Report and total nitrogen and total phosphorus loading reductions to the Estuary.

Surface water and groundwater monitoring in the Estuary and SMR Watershed will be conducted in order to evaluate whether required reductions in total nitrogen and total phosphorus loads are being attained and confirm that numeric targets are being achieved. Data will be collected for a four-year period from 2020 through 2023, with the beginning of monitoring intended to align with the beginning of the critical growth period in April 2020.

[3]Six-fold decrease (Kara Sorensen, personal communication)

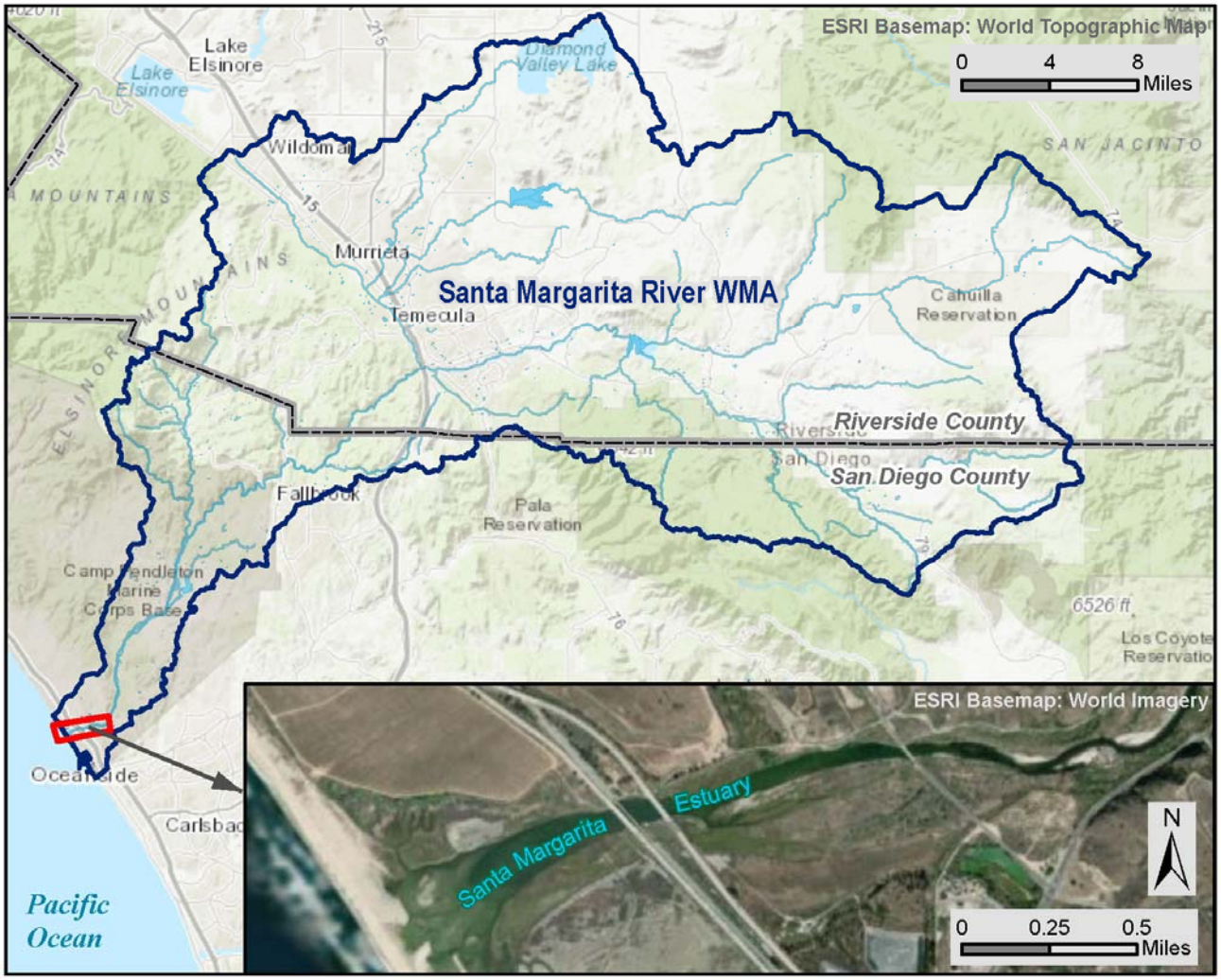


Figure 5-1. Santa Margarita River Estuary and Watershed Study Area

5.3 WATER QUALITY OR REGULATORY CRITERIA

The 2019 Investigative Order outlines the primary and secondary numeric targets for the Estuary as well as the calculated capacity of the Estuary to assimilate total nitrogen and total phosphorus in pounds per year in order to still meet the numeric targets necessary to restore the beneficial uses of the Estuary. Following the Nutrient Numeric Endpoints (NNE) approach, macroalgal biomass and DO were selected as primary numeric targets for the Estuary. The NNE approach provides a scientifically defensible methodology for interpreting the narrative WQOs for biostimulatory substances in the Water Quality Control Plan for the San Diego Basin (Basin Plan) (San Diego Water Board, 1994) and for controlling nutrient loads to levels such that the risk of impairing the designated beneficial uses is minimized (San Diego Water Board, 2019). To confirm that the Estuary beneficial uses are being supported, additional secondary numeric targets were selected for macroalgal biomass, DO, and benthic community condition. Nutrient concentrations within the water column were not selected as numeric targets for the Draft Staff Report because the macroalgal mats are most likely assimilating these nutrients from out of the water column, making measured concentrations of nutrients in the water column misleading.

Primary and secondary targets are shown in **Table 5-1**. Secondary numeric targets are to be used only if the primary numeric targets are not attained.

Table 5-1. Draft Staff Report Numeric Targets for Santa Margarita Estuary

Metric	Primary Target	Secondary Target	Season
Surface Water Macroalgal Biomass	< 57 g dry weight/m^2	< 70 g dry weight/m^2	Winter Dry and Summer Dry
Water Column Dissolved Oxygen	Daily minima ≥ 5.0 mg/L	7-day average of daily minimum measurements ≥ 5.0 mg/L	Winter Dry and Summer Dry
		10 percent allowable exceedance	
Benthic Community Condition Score	-	≤ 2.0 (Low Disturbance based on Sediment Quality Objectives (SQO) scale)	Winter Dry and Summer Dry

Source: San Diego Water Board, 2019

The Draft Staff Report calculated delivered Waste Load Allocations (WLAs) and Load Allocations (LAs) for the Estuary. The sum of delivered WLA and LA for total nitrogen is 8,226 pounds per year and the sum of delivered total phosphorus is 574 pounds per year (San Diego Water Board, 2018).

6. PROJECT/TASK DESCRIPTION

6.1 WORK STATEMENT AND PRODUCED PRODUCTS

Monitoring of the Estuary and SMR Watershed will be conducted during dry weather periods in both summer and winter for four years. Monitoring will begin within 60 days of receiving the Executive Officer's approval of the Workplan to be submitted November 8, 2019. The start of the monitoring program is intended to align with the beginning of the critical growth period in April. Monitoring locations are consistent with historical locations monitored between 2014 and 2018 in the Estuary and SMR Watershed and are provided in **Element 10**. Monitoring program components include the following:

- Estuary Resurfacing Groundwater Discharge Rates and Loading into the Estuary from the Santa Margarita Valley Groundwater Basin
- Estuary Continuous Monitoring
- Estuary Surface Water Quality and Algal Biomass Monitoring
- Estuary Sediment and Benthic Community Condition Monitoring
- Santa Margarita River Watershed Monitoring

Resurfacing groundwater and loading to the Estuary from the Santa Margarita Valley Groundwater Basin will be monitored biannually during winter and summer dry periods by sampling several piezometers and monitoring wells. Groundwater samples will be collected from three historic piezometer locations near the Stuart Mesa Agricultural Fields to confirm that resurfacing groundwater is no longer a significant source of nutrient loading to the Estuary. Piezometer locations were selected based on prior resurfacing groundwater work conducted between 2012 and 2017 (Chadwick et al., 2008; Leather et al., 2011; Leather et al., 2015; Stetson Engineers, 2011). In addition, seven historically monitored groundwater wells in the Lower Ysidora sub-basin will be monitored for nutrients biannually (wet and dry season). The Lower Ysidora sub-basin is located just upstream of the Estuary.

Continuous *in situ* water quality monitoring will be conducted at 15-minute intervals for seven months from April through October and during three months of the winter period (November, January, and March). Monitoring will be conducted at two locations in the Estuary, at the I-5 Bridge and Stuart Mesa Bridge. A multi-parameter data sonde with an optical sensor will be deployed at a depth of approximately 0.5 meter (m) at each location. Deployment will account for tidal range and depth such that the sonde probes remain submerged and do not contact the sediment surface. Because the sondes may need to be removed at times (e.g., due to severe weather in the winter months), data may not be collected for the entirety of each month; at least two weeks of continuous data will be collected during each monitored month. The sondes will continuously measure DO (mg/L and percent [%] saturation), water temperature (°C), pH (pH), salinity/conductivity (ppt; µS/cm), turbidity (NTU), and water depth (m). In addition, the degree of tidal muting or influence will be documented based on the current status of connectivity between the Estuary and the Pacific Ocean.

Algal biomass monitoring will be conducted monthly from April through October. During each monitoring event, sampling will be conducted in each of three Estuary regions: below the I-5 Bridge,

above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[4] and between the two bridges. Efforts will be made to align collection locations with Estuary sediment sampling and, where feasible, at similar sampling depths for subtidal sampling**,** so that relationships between the benthic community condition score and other parameters may be logically inferred.[5] Intertidal and subtidal protocols are available for algal biomass monitoring. Based on knowledge gained during previous monitoring in the Estuary, the subtidal protocol for macroalgal collection is more representative of conditions in the Estuary and is recommended.

Monthly surface water sampling will be conducted in the Estuary from April through October and during three events from November through March. During each monitoring event, sampling will be conducted at one location in each of the three Estuary regions. Ambient surface water grab samples will be collected at a depth of approximately 0.5 m, and will be analyzed for chlorophyll-a, total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus. Additionally, during each monitoring event, the status of connectivity between the Estuary and the Pacific Ocean will be documented.

Sediment monitoring to assess benthic community condition will be conducted in the Estuary on an annual basis, in late summer. Monitoring will be conducted at three locations within each of the three Estuary regions, for a total of nine samples. Sampling locations and depths (where feasible) will align with macroalgal sampling so that relationships between the benthic community condition score and other parameters may be logically inferred. However, benthic samples must be collected in subtidal conditions for use of sediment quality objective (SQO) benthic community scoring. Samples will be analyzed for total organic carbon (TOC; %), grain size, total nitrogen (%), total phosphorus (%), and benthic infaunal analysis (i.e., sorting and taxonomic evaluation of benthic macroinvertebrates).

Monthly monitoring on the main stem of the Santa Margarita River will be conducted at three sites, one each within the jurisdictions of San Diego County, Riverside County, and MCB CamPen. Monitoring events will be conducted monthly from May through October and bi-monthly from November through April, in November, January, and March. MCB CamPen will conduct monitoring at the United States Geological Survey (USGS) gage at Ysidora, which is the most reliable location for measuring streamflow along that reach of the river. During each monthly monitoring event, water quality data (temperature and conductivity) will be measured using a multi-parameter water quality meter or sonde, and a grab sample will be collected and analyzed for total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus.

Monitoring events will be conducted so that they are preceded by a minimum of 72 hours of dry weather (< 0.2 inch of precipitation in 24 hours). This definition of ambient conditions is consistent with the criteria used in the watershed loading model informing nutrient management in the SMR Watershed (Sutula et al., 2016). Continuous flow data and continuous DO data collected during storm events and the following 72 hours will not be included in assessment and reporting, which focus on ambient dry conditions. However, continuous data collected during wet weather will be available for future watershed modeling efforts and will be submitted to the California Environmental Data Exchange Network (CEDEN).

[4] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).
[5] Benthic samples must be collected in subtidal conditions in order to determine SQO benthic community scores.

Annual reports will be produced to present the findings of the Estuary and SMR Watershed monitoring effort each year and address the questions presented in **Element 5.1**. The annual report for Year 4 will assess all four years of monitoring data.

6.2 CONSTITUENTS TO BE MONITORED AND MEASUREMENT TECHNIQUES

Estuary Resurfacing Groundwater and Loading from the Santa Margarita Valley Groundwater Basin

Resurfacing groundwater and loading to the Estuary from the Santa Margarita Valley Groundwater Basin will be monitored by sampling several piezometers and monitoring wells. Samples will be taken at three piezometers near the Stuart Mesa Agricultural Fields and seven groundwater wells in the Lower Ysidora sub-basin of the Santa Margarita Valley Groundwater Basin. Constituents sampled will include total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus. Total and dissolved phosphorus can be analyzed using either United States Environmental Protection Agency (USEPA) Method 365.1 or Standard Method (SM) 4500. Total nitrogen, and total and dissolved inorganic nitrogen, will be determined by calculation. Groundwater methods described here were approved by a State-certified Professional Geologist[6], and future groundwater sampling will be overseen by a State certified Professional Geologist to ensure procedures meet State standards.

Estuary Continuous DO Monitoring

Continuous *in situ* DO monitoring will be performed using multi-parameter data sondes with optical sensors at 15 minutes interval and 0.5 m water depth. Additional data collected by each sonde will include pH, water temperature, conductivity/salinity, turbidity, and water depth.

Estuary Algal Biomass Monitoring

Macroalgae will be collected for determination of biomass. Physical measurements of macroalgal biomass will be determined following Section 6.3 of the standard operating procedure (SOP) for Macroalgal Collection in Estuarine Environments (SCCWRP Technical Report #872, McLaughlin et al., 2019). This SOP is provided in **Appendix B** of the Workplan.

Estuary Surface Water Quality and Macroalgae Monitoring

Monthly surface water grab samples collected during macroalgae sampling will be analyzed for the following constituents: chlorophyll-a, total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus. Total and dissolved phosphorus can be analyzed using either USEPA Method 365.1 or SM 4500. Total nitrogen, and total and dissolved inorganic nitrogen, will be determined by calculation. Suspended chlorophyll-a will be analyzed by SM 10200.

Estuary Sediment and Benthic Community Condition Monitoring

Annual sediment grab samples will be analyzed for the following constituents: grain size, total nitrogen, total phosphorus, and TOC. Grain size can be analyzed using either ASTM D4464 (M), SM 2560 D, or ASTM D422. Total nitrogen will be determined by calculation; the calculated value is comprised of total Kjeldahl nitrogen (TKN), NO_3, and NO_2. Total phosphorus will be analyzed by SM 4500. TOC will be analyzed by EPA 9060A.

[6] See Professional Geologist certification page in front matter of Work Plan/QAPP, following the certification pages signed by the stakeholders

Annual benthic macroinvertebrate samples will be collected in the late summer. Benthic organisms will be removed from the samples and sorted into five major phyletic groups (polychaetes, crustaceans, molluscs, echinoderms, and miscellaneous minor phyla) for taxonomic identification. Qualified taxonomists will identify each organism to species level or to the lowest possible taxonomic level. Data for organisms that are incidental contaminants should not be included in the data analysis and should not be counted or included in the project data. Attached parasites and other epibionts should not be recorded or submitted in annual reports but may be noted as present on bench data sheets. Nomenclature and orthography should follow the usage in the SQO species list on the *Sediment Quality Assessment Tools* page of the SCCWRP website (www.sccwrp.org) as well as Edition 5 of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) taxonomic listing (available at www.scamit.org).

Santa Margarita River Watershed Flow Monitoring

A flowmeter will be installed and maintained at the County of San Diego monitoring location. MCB CamPen's surface monitoring site will use the Ysidora USGS gage (11046000). The Riverside County monitoring will also incorporate an existing USGS gage (11044000) at the Santa Margarita River near Temecula. Although monitoring events occur during nine months of the year, it is recommended that flow monitoring occur throughout the year, where equipment can remain in place, for flow volume calculations used in loading estimations. At a minimum, the equipment will be comprised of Hach (or comparable) flowmeters with a bubbler or submerged pressure transducer as the primary measuring device (level sensor). Sampling equipment may also include a solar panel for battery recharge and power resiliency. The primary sensor will continuously measure stage (i.e., stream height) and relay that information to the flowmeter, which will continually calculate flow rates by inserting the stage information into the preprogrammed discharge equation. Continual flow data will be downloaded periodically to verify equipment functionality and thus reduce data gaps, ensure accuracy, and identify maintenance and calibration needs. Flow data will be entered into the data management system.

Daily and monthly flow rates will be measured or estimated in accordance with the National Pollutant Discharge Elimination System (NPDES) Storm Water Sampling Guidance Document (EPA-833-B-92-001) (USEPA, 1992). Flow rating curves will be developed that correlate water surface levels (or stream heights) to flow rates.[7] To quantify flow rates based on stream stage, a relationship between flow and stage will be derived using standardized stream rating protocols developed by the USGS (Rantz, 1982; Oberg et al., 2005) and using an applicable hydraulic calculation formula(s), such as Manning's equation. If the monitoring station is found to have a steady dry weather base flow, it may be appropriate to install a flow sensor with the ability to measure instantaneous stream velocity. However, in an ephemeral stream that tends to be wet and dry out periodically, this type of sensor may not collect high quality data. A decision to use an area-velocity flow meter and/or a weir structure will be determined based on site hydraulic and flow conditions.

Instantaneous field level and flow measurements will be periodically taken to validate the rating curves. To measure instantaneous flows during low flow and base flow conditions, two types of field flow monitoring equipment may be used. To measure small flows, a handheld velocity measurement instrument, such as a Marsh-McBirney Model 2000 Portable Flowmeter connected by a cable to an

[7] At the MCB CamPen surface monitoring site at Ysidora and the Riverside County site associated with USGS gage 11044000, discharge, rating curves, and field flow measurements from the USGS will be used in lieu of a new flow measurement site. The USGS stations have real-time telemetry and report data at 15-minute intervals.

electromagnetic open channel velocity sensor, or equivalent may be used. To measure higher flows, the SonTek (YSI) FlowTracker Acoustic Doppler Velocimeter, or equivalent may be used.

Santa Margarita River Watershed Nutrient Water Quality Monitoring

Monthly and bi-monthly surface water grab samples will be analyzed for the following constituents: total and dissolved phosphorus and total nitrogen, total and dissolved inorganic nitrogen. Total and dissolved phosphorus can be analyzed using either EPA 365.1 or SM 4500. Total nitrogen, and total and dissolved inorganic nitrogen, will be determined by calculation.

In addition, water quality data, including temperature and specific conductivity, will be collected using a multi-parameter water quality meter or sonde.

6.3 PROJECT SCHEDULE

Table 6-1 details the project schedule for annual monitoring and reporting for the Estuary and SMR Watershed, including initiation and completion dates for major tasks, required deliverable(s), and the deliverable(s) due dates. Monitoring events will be conducted annually from 2020 through the 2022-2023 monitoring year (i.e., water years; October 1 to September 30). Initiation of data compilation, QA/QC, analysis and draft report preparation will begin prior to completion of monitoring to provide adequate time for these tasks given report deadlines. Submittal of Final Annual Reports to the San Diego Water Board will be on January 31st of the following calendar year[8] after each monitoring period. For Year 4, the Final Annual Report will be submitted by March 31, 2024.

[8] For Year 4, the report will be submitted by March 31, 2024.

Table 6-1. Estuary and SMR Watershed Annual Monitoring and Reporting Schedule

Task	Activity	Anticipated Date of Initiation	Anticipated Date of Completion
Task 1	Estuary and SMR Watershed Monitoring	October 1 of each year (for Year 1, within 60 days of Executive Officer Approval of Monitoring Plan)*	September 30 of each year
Task 2	Data Management and QA/QC	Ongoing throughout year	Ongoing throughout year
Task 3	Data Compilation, Analysis, Summary	September 1 of each year	November 1 of each year
Task 4	Draft Annual Report	September 1 of each year	November 1 of each year
Task 5	Review of Draft Annual Report	November 15 of each year	November 30 of each year
Task 6	Comment Response and Final Annual Report	December 1 of each year	January 15 of each year**
Task 7	Submittal of Annual Report to San Diego Water Board	January 31** of each year (for Year 4, the report will be submitted by March 31, 2024)	

* Per SMRNIG TAC, targeted start date of monitoring is April 2020 after approval of Workplan and QAPP.
** Following calendar year

6.4 GEOGRAPHICAL SETTING

The Estuary is located along the southern California coast in northern San Diego County. It is in the Ysidora Hydrologic Area (HA) (902.1) within the Santa Margarita River (SMR) Watershed Management Area (WMA), on the southwestern edge of MCB CamPen. The Estuary is one of the few remaining and largely unmodified coastal estuaries in southern California and encompasses 192 acres of valuable estuarine habitat including subtidal habitats, mudflats, salt marsh, and salt pannes. The Estuary provides important refuge, foraging areas, and breeding grounds for multiple threatened and/or endangered species, as well as coastal marine species (Staff Report; San Diego Water Board, 2018). The SMR Watershed, which drains into the Pacific Ocean, is comprised of an area of approximately 750 square miles (sq mi). Approximately 73% lies within Riverside County and includes all or portions of the Cities of Murrieta, Temecula, Wildomar, and Menifee in addition to approximately 457 sq mi of unincorporated area that also include federal, state, and tribal lands. The remaining 26.5% of the SMR Watershed land surface lies within San Diego County, which includes MCB CamPen and the unincorporated communities of Fallbrook and Rainbow.

6.5 CONSTRAINTS

Annual monitoring in the Estuary and SMR Watershed will occur during dry weather periods in both summer and winter for four years. Monitoring events will be conducted so that they are preceded by a minimum of 72 hours of dry weather (< 0.2 inch of precipitation in 24 hours). Continuous flow data and continuous DO data collected during storm events and the following 72 hours will not be included in assessment and reporting, which focus on ambient conditions. Monthly sampling will also be postponed until after a 72-hour dry period. This is consistent with the criteria used in the watershed loading model informing nutrient management in the SMR Watershed (Sutula et al., 2016).

Potential causes of equipment failure include extreme flooding, exposure to natural elements, and power failures due to the remote location.

Vandalism or theft of sampling equipment either in the Estuary itself (deployed multi-parameter data sondes) or at the receiving water stations in the watershed (flowmeters) could potentially affect the ability to collect complete data sets for the continuous monitoring portion of the program. Due to controlled access to MCB CamPen, vandalism and theft are unlikely.

7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Data quality for this monitoring program will be assessed using measurement quality objectives (MQOs), also known as data quality indicators, such as accuracy, precision, completeness, or representativeness. Acceptance criteria will be based on the implementation of acceptable and recognized QA/QC procedures. Acceptable data must have been collected and analyzed using proper sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols. The data quality indicators for both the field measurements and laboratory analyses are summarized in **Table 7-1**, followed by a brief discussion of the objectives of each indicator.

Table 7-1. Measurement Quality Objectives

Measurement or Analysis Type	Applicable Data Quality Indicator
Field: Dissolved Oxygen, Temperature, Conductivity, pH, Salinity, Turbidity	Accuracy, Completeness
Laboratory Analyses: Nutrients	Accuracy, Precision, Completeness, Representativeness
Laboratory Analyses: Water Column Chlorophyll-a	Accuracy, Completeness, Representativeness
Laboratory Analyses: Macroalgae Biomass	Completeness, Representativeness
Laboratory Analyses: Sediment TOC and nutrients	Accuracy, Precision, Completeness, Representativeness
Laboratory Analyses: Benthic Community	Accuracy, Completeness

QC for field collection and/or physical and chemical laboratory analyses will be conducted in accordance with Surface Water Ambient Monitoring Program (SWAMP) guidelines (State Water Board, 2017). The SWAMP QC guidelines for field measurements of DO, temperature, pH, salinity/conductivity, and turbidity are provided in **Table 7-2** (State Water Board, 2013). The SWAMP QC guidelines and associated MQOs for water column nutrients, water column chlorophyll-a, and sediment TOC, grain size, and nutrients are provided in
Table 7-3 (State Water Board, 2013). If a standard reference material is required for accuracy measurements but is not available for a specific analyte, then an LCS can be used as an alternative QC sample.

Field duplicates and equipment rinse blanks will be collected and analyzed at the frequency described for each monitoring program component in accordance with SWAMP QA sample requirements (i.e., field duplicates at a frequency of 5% of the sample count and a field or equipment rinse blank per method). Two field duplicates and one field blank will be collected for Estuary surface water nutrient analysis and for SMR Watershed nutrient analysis during each monitoring year, and one field duplicate and one equipment rinse blank will be collected for Estuary sediment chemistry analysis during each monitoring year.

7.1 Accuracy

Accuracy (bias) is a measure of how closely the analytical result or field measurement represents the true quantity found in the sample. To achieve accuracy in field measurements, the multi-parameter data sonde will be calibrated before starting the monitoring, and the sonde response will be verified to be within appropriate precision as shown in **Table 7-2**, after cleaning any biofouling, each time the sampling team visits the Estuary. Evaluation of the accuracy of laboratory samples in this study will be achieved through the preparation and analysis of standard reference materials or laboratory control samples (LCS), and matrix spike (MS) samples with each analytical batch. The accuracy of the laboratory samples is quantified as percent recovery.

7.2 Precision

Precision is the measure of agreement among repeated measurements of the same property under identical or substantially similar conditions calculated as either the range or as the standard deviation. The precision of field measurements will be controlled by measuring field duplicates or replicates. The precision of laboratory measurements will be controlled by comparison of the sample to either a laboratory duplicate or a laboratory matrix spike/matrix spike duplicate (MS/MSD). Results of the duplicate analysis are evaluated by calculating the relative percent difference (RPD) as shown in the following equation.

$$RPD = (X_1-X_2)/[(X_1+X_2)/2]*100$$

Where:
X_1= larger of two concentrations, and X_2 = smaller of two concentrations

The MQO for field and laboratory duplicate RPDs for each of the physical and chemical analytes is <25% (
Table **7-3**).

7.3 Representativeness

Representativeness is a qualitative term that describes how characteristic a sample is of the actual environmental condition from which it was collected. Determining appropriate sampling locations, sampling frequency, and use of approved/documented SOPs and analytical methods will control to the greatest extent possible that the measurement data represent the conditions at the monitoring site.

7.4 Completeness

Completeness is a measure of the percentage of sample results that are collected and analyzed and determined to be valid. Field personnel and the analytical laboratory will strive for 90% data completeness, which accounts for unexpected field conditions, equipment problems, and laboratory error.

7.5 MQOs for Benthic Macroinfaunal Samples

The MQOs for benthic macroinfaunal sorting and taxonomy will be evaluated based on guidance from the Sediment Quality Assessment Technical Support Manual, SCCWRP Technical Report 777 (Bay et al., 2014) and those utilized for the Southern California Bight 2018 Regional Marine Monitoring Survey (Bight '18). An accuracy MQO for benthic infaunal sample sorting will be evaluated by ensuring a 95% removal efficiency during the sorting process. Using the aliquot method, a minimum of 10% of all material in each benthic infaunal sample will be re-sorted to monitor sorter performance and to determine achievement of the MQO of 95%. Percent sorting efficiency using the aliquot method is calculated as follows:

$$\%_{Efficiency} = 100 * [\#\ Organisms_{sorted} \div (\#\ Organisms_{sorted} + \#\ Organisms_{from\ Re\text{-}sort} * \%_{aliquot})]$$

When the sorting efficiency of the sample is below 95%, the remainder of the sample (90%) will be re-sorted.

An accuracy MQO for taxonomic analysis of the benthic macroinfaunal community will be evaluated via two QC procedures. The first QC procedure will be to re-identify 10% of the samples by taxonomists other than those who originally analyzed the samples. Taxonomic discrepancies between the original and secondary QC taxonomists will be resolved by comparing results of the two sets of identifications through the completion of a Discrepancy Resolution Report (Bay et al., 2014). Further detail on how to complete this re-analysis process is provided in the Bay et al., 2014 document. The second QC procedure will be for the primary taxonomists to establish a voucher collection of all macroinfaunal organisms identified during the first year of monitoring. Following the first year of monitoring, only new specimens not included in the original voucher collection will be added. The purpose of the voucher collection is to provide the means of resolving questions regarding nomenclature between the primary and secondary taxonomists.

Table 7-2. Quality Control for Field Measurements in Fresh and Marine Water

Water Quality Parameter	Recommended Device	Units	Resolution	Instrument Accuracy Specs	Points per Calibration	Pre-Sampling Calibration Check Frequency	Post-Sampling Calibration Check Frequency	Allowable Drift
Dissolved Oxygen	Polarographic or luminescence quenching probe	mg/L	0.01	±0.2*	1	Before every monitoring day or prior to long-term deployment	After every monitoring day or retrieval from long-term deployment (within 24 hours)	±0.5 or 10%
pH	Electrode	pH	0.01	±0.2	2	Per manufacturer	Per manufacturer	±0.2 units
Salinity	Refractometer of conductivity cell	ppt	0.01	±2%	Per manufacturer	Per manufacturer	Per manufacturer	Per manufacturer
Specific Conductance	Conductivity cell	µS/cm	1	±0.5%	Per manufacturer	Per manufacturer	Per manufacturer	±10%
Temperature	Thermistor or bulb	°C	0.1	±0.15%	Per manufacturer	Per manufacturer	Per manufacturer	±0.5
Turbidity	Portable turbidimeter or optical probe	NTU	0.1	±1% up to 100 NTU; ±3% from 100-400 NTU; and ±5% from 400-3000 NTU	2	Per manufacturer	Per manufacturer	Per manufacturer

Reference: State Water Board, 2017
* Calibration checks on DO sensors have indicated that variations in measured DO values may be greater than this instrument accuracy specification (Kara Sorensen, personal communication).

Table 7-3. Measurement Quality Objectives for Laboratory Measurements

Group	Parameter	Frequency	Accuracy	Precision	Recovery	Completeness
Water Samples						
Laboratory Analyses	Total and Dissolved Phosphorus, and Inorganic Nitrogen	Per 20 samples or per analytical batch, whichever is more frequent	Standard Reference Materials (SRM, CRM) within 95% confidence interval stated by provider of material. If not available, then an LCS with 90–110% of true value	Laboratory duplicate, blind field duplicate, or MS/MSD ±25% RPD	Matrix Spike 80% to 120%	90%
Laboratory Analyses	Chlorophyll-a	Per 20 samples or per analytical batch, whichever is more frequent	LCS with 80–120% of true value	Blind field duplicate ±25% RPD	–	90%
Sediment Samples						
Laboratory Analyses	Total Phosphorus, Total Nitrogen, Grain Size, and TOC	Per 20 samples or per analytical batch, whichever is more frequent	Total organic carbon only: Standard Reference Materials (SRM, CRM) within 95% confidence interval stated by provider of material. If not available, then an LCS with 80–120% of true value	Laboratory duplicate or blind field duplicate ±25% RPD	–	90%

8. SPECIAL TRAINING NEEDS/CERTIFICATION

8.1 SPECIALIZED TRAINING OR CERTIFICATIONS

Field personnel will have current and relevant experience in the aspects of standard field monitoring, including use of relevant field instruments and monitoring equipment, experience in the collection and handling/storage of samples, and chain-of-custody (COC) procedures. Training in techniques for proper field sampling and sample-handling will be reviewed prior to each sampling event, and only those staff with proficiency will be permitted to conduct field work.

All laboratory analysts will be proficient in the use of analytical equipment, conducting analytical protocols, and other general laboratory processes. The QA Officer is responsible for distributing the most up-to-date QAPP for this monitoring project to the respective laboratory staff and ensuring that the staff understand and follow all SOPs and the QAPP for the duration of this study.

All samples must be analyzed by laboratories accredited by the Environmental Laboratory Accreditation Program (ELAP) using methods approved by the USEPA for the type of analysis to be performed.

8.2 TRAINING AND CERTIFICATION DOCUMENTATION

Personnel are responsible for complying with QA/QC requirements that pertain to their organizational/technical function. Technical staff members must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and a general knowledge of laboratory operations, test methods, QA/QC procedures, and records management. The analytical laboratory QA officer will ensure that all laboratory staff is proficient at analyses applicable to this project. Training and certification documents for laboratory staff will be maintained by the laboratory QA officer, or their designee.

8.3 TRAINING PERSONNEL

The Consultant PM and/or Field Task Lead will provide training for field personnel in proper field sampling techniques prior to work initiation to ensure consistent and appropriate sampling, sample handling/storage, and chain of custody (COC) procedures. The analytical laboratory QA officer will ensure that training is provided to the laboratories' personnel for implementing standard laboratory procedures and maintaining proper documentation.

9. DOCUMENTS AND RECORDS

The Consultant will document and track the aspects of the sample collection process, including generating field logs at each site and COC forms for the samples collected. An example COC form is provided in **Attachment A**. COC forms will accompany samples to the analytical laboratory. The consultant and analytical laboratory will document and track the aspects of receipt and storage, analyses, and reporting related to their respective samples. Minimum documentation of sample handling and custody will include the following:

- Sample identification
- Sample collection date and time
- Any special notations on sample characteristics
- Initials of the person collecting the sample
- Date the sample was sent to the laboratory
- Type of sample analysis
- Shipping company and waybill information
- Sample container size, type, and preservative (if applicable)

Sample container labels will include the sample ID, date and time of collection, sampler's initials, and type of analysis. The Consultant will maintain a database of information collected during this project. The database will include field observations, data sheets, COC records, and analytical results. The original data sheets, statistical worksheets, and reports produced will be accumulated into project-specific files maintained by the Consultant after the report has been submitted. Data from outside contractors are kept exactly as received. Records will be maintained for at least five years or transferred according to agreement between the Consultant and the client.

The Consultant's PM will be responsible for maintaining records for this project, overseeing the operations of the project, maintaining the sample collection, sample transport, COC, field analysis forms, and laboratory data. The Consultant's PM will also arbitrate any issues relative to records retention and any decisions to discard records.

Copies of this QAPP will be distributed to the parties identified previously in **Element 3**. Updates to this QAPP will be distributed in like manner, and previous versions will be discarded from the project file. The Consultant PM under the direction, supervision, and review of the Consultant's QA Officer, will be responsible for distributing an updated version of the QAPP.

Electronic copies of the final report, including laboratory results and field records, will be maintained for a minimum of five years after project completion. A summary of document and record retention, archival information, and disposition of documents is provided in
Table 9-1.

Table 9-1. Summary of Document and Record Retention, Archival, and Disposition

	Type of Document	Retention	Archival	Disposition
Field Sampling Documentation	Field Notebook containing logs, data sheets, etc.	Paper or electronic	Notebook/Electronic	5 years
Sample Collection Records	Chain of Custody	Paper or electronic	Notebook/Electronic	5 years
Analytical Records	Lab notebooks, bench sheets, and sorting forms	Paper	Notebook	5 years
	Lab Results QA/QC	Paper and electronic	Notebook/Database	5 years
	Electronic data deliverables	Electronic	Database	5 years
Data Records	Data Entry	Electronic	Database	5 years
Assessment Records	QA/QC Assessment	Electronic	Database	5 years
	Final Report	Electronic	Database	5 years

GROUP B: DATA GENERATION AND ACQUISITION

10. SAMPLE PROCESS DESIGN

Sampling events will be conducted during dry weather in both summer and winter. Monitoring will be conducted for four years, beginning within 60 days of receiving the Executive Officer's approval of the Workplan to be submitted November 8, 2019. The start of the monitoring program is intended to align with the beginning of the critical growth period in April. The sampling program includes Estuary resurfacing groundwater discharge rate and nutrient loading, Estuary continuous water quality monitoring, Estuary algal biomass monitoring, Estuary surface water quality, and SMR Watershed flow and water quality monitoring, as described in the following subsections. The sampling design designates the following:

- Three piezometer sites near the Stuart Mesa Agricultural Fields and seven groundwater wells in the Santa Margarita Valley Groundwater Basin for discharge and nutrient monitoring;
- Two Estuary continuous water quality monitoring stations (I5 and Stuart Mesa Bridges);
- Three sub-segments in each Estuary segment for macroalgal biomass monitoring;
- One location in each Estuary segment for surface water quality monitoring;
- Three locations in each Estuary segment for sediment and benthic community condition monitoring;
- One location on the main stem of the SMR for each of three jurisdictions (Riverside and San Diego Counties and MCB CamPen).

10.1 ESTUARY RESURFACING GROUNDWATER DISCHARGE RATES AND LOADING INTO THE ESTUARY FROM THE SANTA MARGARITA VALLEY GROUNDWATER BASIN

Bi-annual groundwater sampling will be conducted (once in wet weather and once in dry weather conditions). During each monitoring event, sampling will be conducted at ten locations: three piezometers near Stuart Mesa Agricultural Fields and seven wells in the Lower Ysidora sub-basin. Proposed station locations are shown in **Table 10-1** and **Figure 10-1**. During each monitoring event, site conditions and sample information will be recorded on field data sheets. All groundwater work will be performed per Standard Methods and be overseen by a State Certified Geologist per the Investigative Order.

Groundwater discharge estimates and chemical identification will be conducted at each of the piezometer sites. Qualitative assessment of seepage near the Stuart Mesa Agricultural field will be performed by measuring temperature and conductivity in the upper two feet of the ground surface. Quantitative assessment of seepage will be performed by measuring hydraulic head difference in the groundwater surface. Grab samples at all piezometers will be collected for nutrient analysis so mass-loading calculations can be performed using quantitative and qualitative analysis of groundwater seepage.

At the seven monitoring wells, nutrient grab samples will be collected. The groundwater level and sampling depth in each well will be recorded on field sheets. Sampling depths at groundwater wells will be selected to best characterize subflow, corresponding to recognized coarse-grained lithologic layers within the screened intervals of the wells. Groundwater flow at monitoring wells in the Lower Ysidora sub-basin will not be directly measured, but will be estimated using existing data and tools, including prior groundwater modeling data.

Table 10-1. Station Identifications and Coordinates for Estuary Resurfacing Groundwater Monitoring

Station ID	Latitude (NAD83)	Longitude (NAD83)
Santa Margarita Valley Groundwater Basin Locations		
MW 2201	33.28539	-117.37663
Well #C (SDSU)	33.26846	-117.37276
Well #B (SDSU)	33.25792	-117.37314
11/5-2D3	33.25500	-117.37865
7W-09A	33.23914	-117.38174
11/5-11D4 (7W-09B)	33.23913	-117.38175
7W-08A	33.23728	-117.38458
Stuart Mesa Agricultural Field Piezometer Locations		
DA1	33.235497	-117.407642
DA2	33.236041	-117.404666
DA3	33.236443	-117.402449

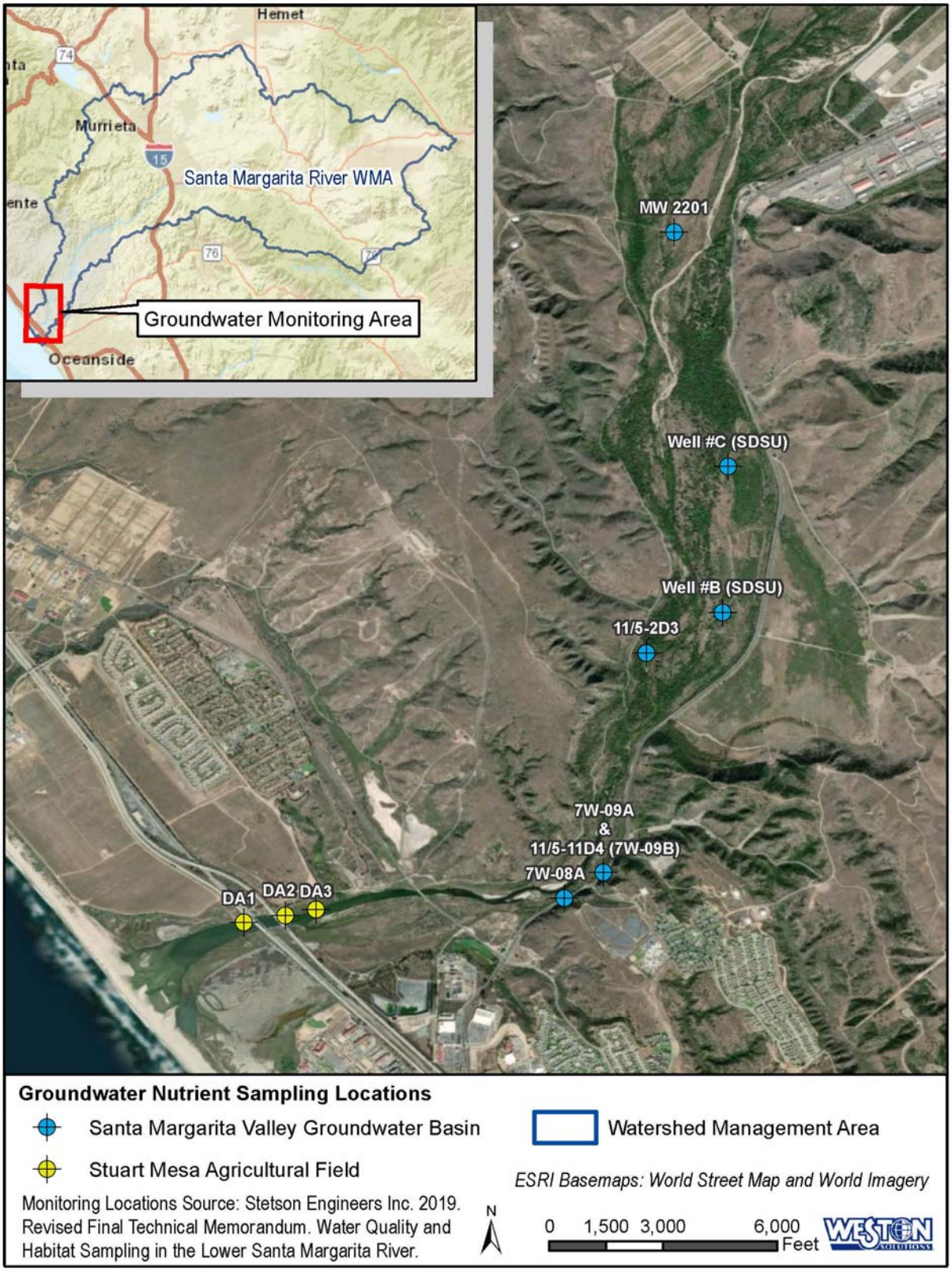


Figure 10-1. Groundwater Monitoring Station Locations

10.2 ESTUARY CONTINUOUS MONITORING

Each year, continuous water quality monitoring will be conducted by MCB CamPen for seven months from April through October and during three months of the winter period (November, January, and March). Because the sondes may need to be removed at times (e.g., due to severe weather in the winter months), data may not be collected for the entirety of each month; at least two weeks of continuous data will be collected during each monitored month.

Data sondes will be deployed at two locations in the Estuary, I-5 Bridge and Stuart Mesa Bridge. Sampling locations are shown in **Table 10-2** and **Figure 10-2**; station IDs are consistent with historical monitoring. DO (mg/L and % saturation), water temperature (°C), salinity/conductivity (ppt; µS/cm), turbidity (NTU), and water depth (m) will be continuously monitored *in situ* at 15-minute intervals. In addition, the degree of tidal muting or influence will be documented based on the current status of connectivity between the Estuary and the Pacific Ocean.

Table 10-2. Station Identifications and Coordinates for Estuary Continuous Monitoring

Station Location	Station ID	Latitude (NAD83)	Longitude (NAD83)
I-5 Bridge	I-5 (Axial 4)	33.235317	-117.406883
Stuart Mesa Bridge	SMB	33.237620	-117.395290

10.3 ESTUARY ALGAL BIOMASS MONITORING

Monthly algal biomass monitoring will be conducted in the Estuary from April through October. During each monitoring event, sampling will be conducted in each of three Estuary regions: below the I-5 Bridge, above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[9] and between the two bridges (**Figure 10-2**). Algal biomass monitoring will be conducted in accordance with the SOP for Macroalgal Collection in Estuarine Environments (SCCWRP Technical Report 872; McLaughlin et al., 2019) (**Appendix B** of the Workplan).

Effort should be made to align collection location with Estuary sediment sampling described in **Element 10.5**; and, where feasible, at similar sampling depths for subtidal sampling**,** so that relationships between the benthic community condition score and other parameters may be logically inferred.[10]

The SOP includes protocols to sample two habitat types, intertidal (mud or sand) flats and shallow subtidal (<10 m). Based on knowledge gained during previous monitoring in the Estuary, data generated by the subtidal protocol is more representative of conditions in the Estuary and is recommended. The subtidal protocol is discussed herein and detailed in Section 4 of SCCWRP

[9] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).
[10] Benthic samples must be collected in subtidal conditions in order to determine SQO benthic community scores.

Technical Report 872. The intertidal protocol can be found in Section 3 of SCCWRP Technical Report 872.

Based on several years of monitoring, NIWC Pacific has recommended sampling location options for macroalgal monitoring in the three segments of the Estuary (**Figure 10-2**). Shown in **Table 10-3** are the identifications and approximate geographic coordinates for these historical stations. A minimum of three samples will be collected from each of five sampling locations within each of the three Estuary segments, for a minimum of 15 samples per Estuary segment. The sampling approach requires that all macroalgae found within a defined surface area two meters in depth or less is comprehensively sampled from surface to bottom. As feasible, selected sites should include macroalgal sampling stations that have been sampled historically during 2008 to 2018, which are identified with a "✓" in **Table 10-3**. Also shown are recommended sites for Estuary Sediment and Benthic Community Condition Monitoring in order to align station sampling. While the table provides six options for macroalgal biomass monitoring per sub-segment, a list of 30 sites (10 per sub-segment) with some historical data are available from NWIC if additional location options are needed. Monitoring at historical locations will facilitate analysis of trends.[11]

Sampling locations should be the same for each sampling period, and site conditions recorded on field data sheets. Due to scouring and deposition events that may occur between monitoring periods, it may not be feasible to conduct sampling at the same locations year to year. In this case, additional sites will be selected, attempting to stay as close to the original sites as possible.

NWIC conducted a sampling number power analysis using 2017 and 2018 data (~630 samples) and prior model output to conservatively estimate a need for 160/200 samples total (all three segments). Collection of data as proposed at five locations in triplicate in each sub-segment (i.e., a total of 15 samples) at a frequency of seven times per year will result is 105 sample/section or 315 data points for analysis and ensure that dataset is large enough data to characterize the estuary and assess trends.

[11] This targeted sampling approach based on historical monitoring information was discussed and agreed upon during the July 8, 2019 Conference Call with Cynthia Gorman of the San Diego Water Board.

Table 10-3. Recommended Locations for Estuary Algal Biomass Monitoring

Estuary Segment	Station ID	Recommended Historical MA Site	BCA/ Sediment Site	Latitude (NAD83)	Longitude (NAD83)
Below the I-5 Bridge	W1 (MA1)	✓	✓	33.233980	-117.413111
	W8 (MA2)	✓	✓	33.235393	-117.408846
	W7 (MA3)	✓		33.234386	-117.408510
	W3	✓	✓	33.232895	-117.411361
	W4	*		33.233801	-117.409878
	W5	*		33.234402	-117.409978
Between the I-5 and Stuart Mesa Bridges	M6 (MA4)	✓	✓	33.236959	-117.399899
	M10 (MA5)	✓	*	33.237478	-117.395339
	M4	✓		33.236079	-117.402070
	M9	✓ (old MA site)		33.237657	-117.397121
	M1	*	✓	33.235302	-117.405803
	M8	*	✓	33.237211	-117.397786
Above the Stuart Mesa Bridge	E7 (MA5.5)	✓	✓	33.237630	-117.388060
	MA6	✓	*	33.238350	-117.384817
	E3	✓	✓	33.237580	-117.392260
	E5	✓		33.236980	-117.389900
	E8	✓	✓	33.238030	-117.387060
	E10	*(old ambient WQ site)		33.238600	-117.383770

10.4 ESTUARY SURFACE WATER QUALITY MONITORING

Monthly surface water sampling will be conducted in the Estuary from April through October and during three events from November through March. During each monitoring event, sampling will be conducted at one location in each of three Estuary regions: below the I-5 Bridge, above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[12] and between the two bridges. Sampling locations are shown in **Table 10-4** and **Figure 10-2**, with station IDs consistent with historical monitoring. Ambient surface water grab samples will be collected at a depth of approximately 0.5 m, and will be analyzed for chlorophyll-a, total nitrogen, and total and dissolved inorganic nitrogen and phosphorus, as described in **Element 6.2**.

[12] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).

Table 10-4. Station Identifications and Coordinates for Estuary Surface Water Monitoring

Estuary Segment	Station ID	Latitude (NAD83)	Longitude (NAD83)
Below I-5 Bridge	SMRE 1	33.2330	-117.4123
Between Bridges	SMRE 2	33.2369	-117.4001
Above Stuart Mesa Bridge*	SMRE 3	33.2373	-117.3878

*Alternative upstream location for sampling above Stuart Mesa Bridge is AX10.5 located at: 33.24116, -117.38232

10.5 ESTUARY SEDIMENT AND BENTHIC COMMUNITY CONDITION MONITORING

Sediment monitoring to assess benthic community condition will be conducted in the Estuary on an annual basis, in late summer. Monitoring in marine subtidal areas of the estuary (salinity ≥ 27 ppt) will be conducted in accordance with the Sediment Quality Assessment Technical Support Manual, SCCWRP Technical Report 777 (Bay et al., 2014).[13] Sampling locations and depths (where feasible) will align with macroalgal sampling so that relationships between the benthic community condition score and other parameters may be logically inferred. However, benthic samples must be collected in subtidal conditions for use of SQO benthic community scoring. In areas of the estuary where the criteria for assessing benthic infaunal condition using the SQO tool cannot be met (i.e., brackish areas with a salinity of < 27 ppt), an alternative sampling protocol is recommended based on protocols developed for Bight '18. The types of equipment used for sampling in either the marine or brackish subtidal areas of the Estuary are described in detail in **Element 11.5**. If salinity was determined to be < 27 ppt and SQO calculated, the results should be qualified.

Monitoring will be conducted at three locations within each of the three Estuary segments, for a total of nine samples. Based on historical sampling, NWIC Pacific has provided the recommended sampling locations shown in **Table 10-5** and **Figure 10-2**. Surficial benthic sediment samples will be collected and analyzed for TOC, grain size, total nitrogen (NO_3 + NO_2), TKN, total phosphorus, and benthic infaunal analysis.

[13]Available at: http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/777_CASQO_TechnicalManual.pdf. Once accepted methods are available to estimate the effect of sediment organic matter (eutrophication) upon benthic macro invertebrate communities, they may be considered for use (San Diego Water Board, 2019).

Table 10-5. Station Identifications and Coordinates for Estuary Sediment Monitoring

Estuary Segment	Station ID	Latitude (NAD83)	Longitude (NAD83)
Below I-5 Bridge	W1 (MA1)	33.233980	-117.413111
	W3	33.232895	-117.411361
	W8 (MA2)	33.235393	-117.408846
Between Bridges	M1	33.235302	-117.405803
	M6 (MA4)	33.236959	-117.399899
	M8	33.237211	-117.397786
Above Stuart Mesa Bridge	E3	33.237580	-117.392260
	E7 (MA5.5)	33.237630	-117.388060
	E8	33.238030	-117.387060

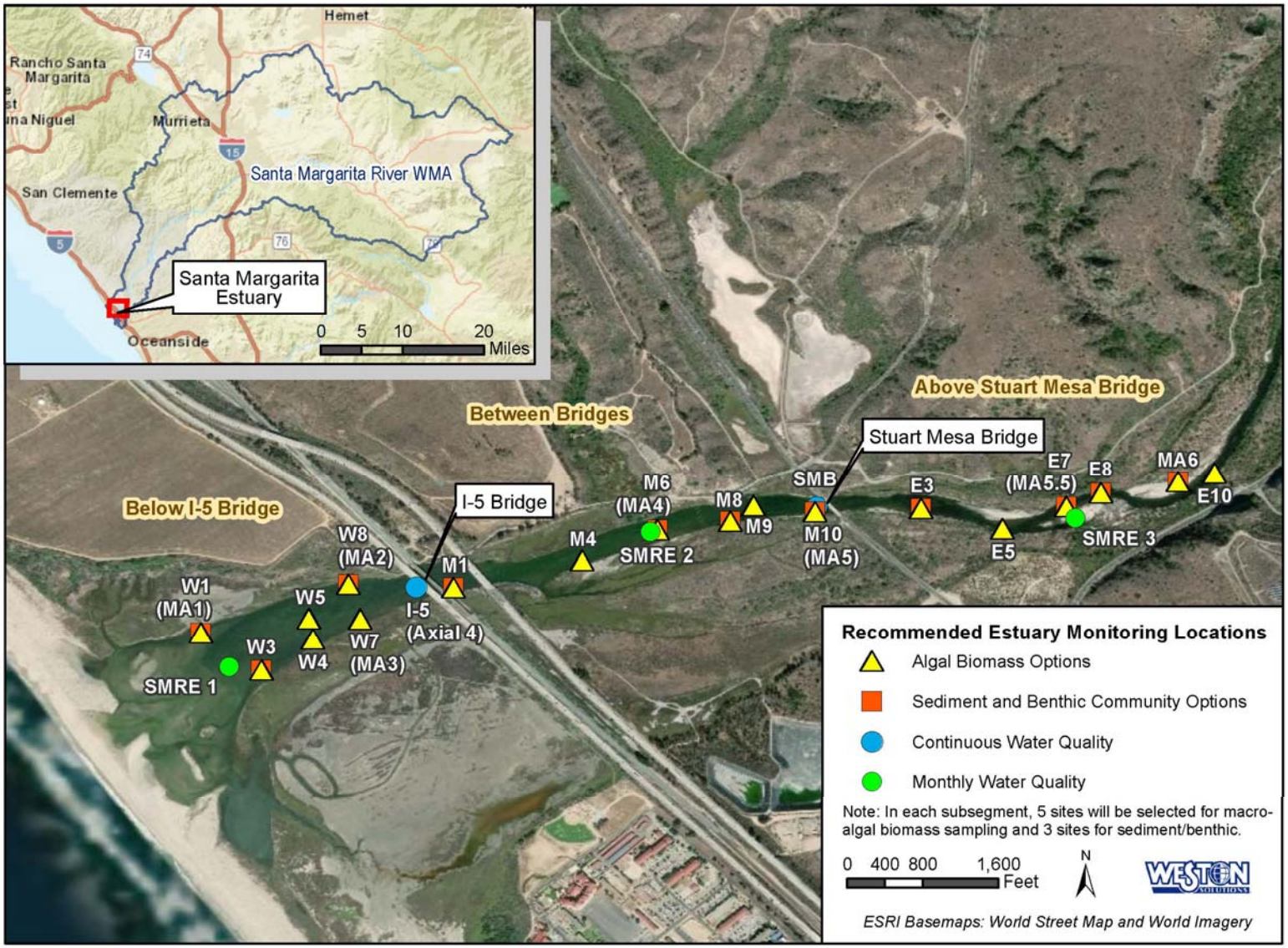


Figure 10-2. Proposed Santa Margarita Estuary Monitoring Locations

10.6 SANTA MARGARITA RIVER MONITORING

Monitoring will be conducted on the main stem of the Santa Margarita River to determine flow and ambient water quality conditions upstream of the Estuary. Methods will be consistent with relevant sections (i.e., Sections 1-3) of the *Standard Operating Procedures for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat* (Bioassessment SOPs) (Ode et al., 2016).

A total of three sites will be monitored; one each within the jurisdictions of San Diego County, Riverside County, and MCB CamPen (**Table 10-6**, **Figure 10-3**). The monitoring stations should be located at the most downstream feasible location above the Estuary within each of the three jurisdictions. MCB CamPen will conduct monitoring at the USGS gage at Ysidora, which is the most reliable location for measuring streamflow along that reach of the river. The Riverside County monitoring will also incorporate an existing USGS gage (11044000) on the Santa Margarita River near Temecula. Monitoring events will be conducted monthly from May through October and bi-monthly from November through April, in November, January, and March. At each location, equipment will consist of an automated flow meter and sensor, solar panel, cellular line (where coverage is available), and rain gauge. Remote Automatic Weather Station (RAWS) or ALERT system rainfall gauges will be used where available. The Lake O'Neill rain gage will be used to monitor rainfall at the sampling location at Ysidora.

Flowmeters will be installed and maintained at the County of San Diego monitoring location. MCB CamPen's surface monitoring site will use the Ysidora USGS gage (11046000) and Riverside County river monitoring will use USGS gage 11044000 near Temecula. During each monthly monitoring event, water quality parameters (temperature and conductivity) will be measured using a multi-parameter water quality meter or sonde, and a grab sample will be collected and analyzed for total nitrogen, total and dissolved inorganic nitrogen and total and dissolved phosphorus, as described in **Element 6.2** .

Table 10-6. Station Identifications and Coordinates for Santa Margarita River Monitoring

Jurisdiction	Station ID	Latitude (NAD83)	Longitude (NAD83)
San Diego County	SMR-MLS-2	33.398142	-117.26273
Riverside County	Upper Santa Margarita River 902USM828	33.47335	-117.14344
MCB CamPen	Ysidora (SMR 3)	33.31165	-117.34570

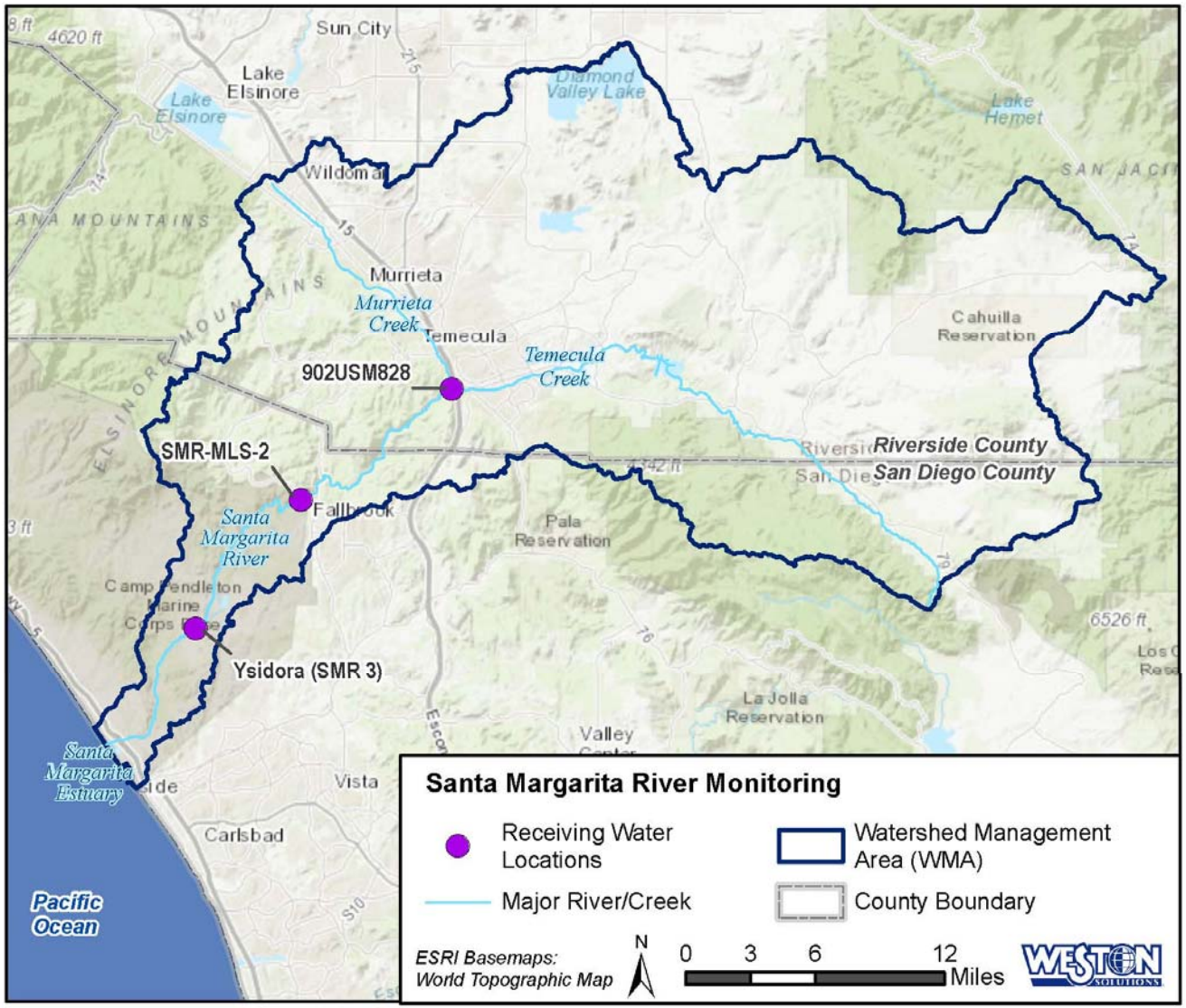


Figure 10-3. Proposed Santa Margarita River Monitoring Locations

11. SAMPLING METHODS

All equipment (waders, boots, sampling equipment, and other aquatic gear) used for monitoring described in the following sections that intentionally comes into contact with surface waters on MCB CamPen must be disinfected either through chemical treatment (generally with a dilute solution of formula 409, or equivalent) or freezing. Boat hulls and trailers should be power-washed and inspected for signs of quagga mussel, zebra mussel, and New Zealand mud snail, especially if coming from surface waters associated with the lower Colorado River. No foreign ballast or other waters shall be introduced into any surface water on MCB CamPen.

11.1 ESTUARY RESURFACING GROUNDWATER DISCHARGE RATES AND NUTRIENT LOADING

Bi-annual groundwater sampling will be conducted once during the dry season (April through October) and once during the wet season (November through March). During each monitoring event, sampling will be conducted at ten locations: three piezometers near the Stuart Mesa Agricultural Fields and seven wells in the Lower Ysidora sub-basin, as listed in **Element 10.1**. All groundwater sampling will be overseen by a State Certified Geologist.

Groundwater discharge to the estuary will be estimated based on hydraulic gradients, measured at the piezometers, and the Darcy equation. In the vicinity of the Stuart Mesa Agricultural fields, previously developed relationship between hydraulic head and groundwater seepage may be relied upon (Leather, 2016). All historic data and relationships previously developed by others will be checked and verified by a State-certified professional geologist. Nutrient grab samples will be taken at the piezometers using a peristaltic pump and sampling depth will be noted on the field sheets.

At the seven groundwater wells, nutrient samples will be taken using a peristaltic pump. The groundwater level in the well and the sampling depth will be noted on field sheets.

For nutrient grab samples at all ten sites; analytical methods, sample container requirements, and analytical holding times will be in accordance with the SCCWRP QAPP for Monitoring in Support of Nutrient Management in the Lower Santa Margarita River (SCCWRP, 2014).

Samples will be placed into appropriate bottles and preserved and transported as described in **Element 12**. Two field duplicates and one field blank will be collected for nutrient analysis per monitoring year in order to achieve the SWAMP QA sample requirements (i.e., field duplicates at a frequency of 5% of the sample count and a field blank per method).

11.2 ESTUARY CONTINUOUS MONITORING

Each year, continuous water quality monitoring will be conducted for seven months from April through October and for up to one month during each of three winter periods (November, January, and March). A multi-parameter data sonde with an optical sensor will be deployed on a stationary structure at a depth of approximately 0.5 m at two locations in the Estuary, I-5 Bridge and Stuart Mesa Bridge. Deployment will account for tidal range and depth such that the sonde probes remain submerged and

do not contact the sediment surface. Methodology will be consistent with applicable SCCWRP Southern California Bight Regional Monitoring Program protocols (e.g., SCCWRP Technical Report 711 [McLaughlin et al., 2012]).[14] DO (mg/L and % saturation), water temperature (°C), salinity/conductivity (ppt; µS/cm), turbidity (NTU), and water depth (m) will be continuously monitored *in situ* at 15-minute intervals. In addition, the degree of tidal muting or influence will be documented based on the current status of connectivity between the Estuary and the Pacific Ocean.

11.3 ESTUARY ALGAL BIOMASS MONITORING

Monthly algal biomass monitoring will be conducted in the Estuary from April through October. During each monitoring event, sampling will be conducted in each of three Estuary regions: below the I-5 Bridge, above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[15] and between the two bridges (**Figure 10-2**).

During each monthly monitoring event, site conditions and sample information will be recorded on field data sheets. Additionally, during each monitoring event, the status of connectivity between the Estuary and the Pacific Ocean will be documented. Effort should be made to align collection location with Estuary sediment sampling described in **Element 11.5**; and, where feasible, at similar sampling depths for subtidal sampling**,** so that relationships between the benthic community condition score and other parameters may be logically inferred.[16]

Algal biomass monitoring will be conducted in accordance with the SOP for Macroalgal Collection in Estuarine Environments (SCCWRP Technical Report 872; McLaughlin et al., 2019) (**Appendix B** of the Workplan). The SOP includes protocols to sample two habitat types, intertidal (mud or sand) flats and shallow subtidal (<10 m). Based on knowledge gained during previous monitoring in the Estuary, data generated by the subtidal protocol is more representative of conditions in the Estuary and is recommended. The subtidal protocol is discussed herein and detailed in Section 4 of SCCWRP Technical Report 872. The intertidal protocol can be found in Section 3 of SCCWRP Technical Report 872.

SCCWRP Technical Report 872 provides procedures for subtidal sampling using either a multi-SUBstrate Subtidal sampler (SUBS sampler) or a combination of a bottomless mesh basket/collapsible hamper or a similar device to collect algae in the water column and a box core to collect benthic macroalgae. The SUBS sampler, which has the capacity to collect water column and benthic sediment in one sample, is advantageous due to time and cost savings associated with more efficient sampling, minimal site disturbance compared to the use of a box core, and comparability with recent data collected using this method. For these reasons, the SUBS sampler will be used for collection of macroalgal biomass samples. The SUBS Sampler may also be used to collect benthic sediment (**Element 11.5**). Local temperature and salinity will be measured with a hand-held meter and recorded on field data sheets. A kayak should be used to access water covered areas in the Estuary, in order to limit disturbance to sampling areas and avoid walking on the shoreline and impacting birds. If water depth is too shallow to allow for deployment of the SUBS sampler (i.e., < 1 ft), the SUBS core tube

[14] Available at: http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/711_B08EE_AppendixC.pdf
[15] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).
[16] Benthic samples must be collected in subtidal conditions in order to determine SQO benthic community scores.

will be used to collect the sample. If floating algae is present, the basket/hamper should be used to augment the SUBS sampling procedure and collect the floating algae. At each sampling point, macroalgal biomass will be collected from the surface to bottom within a defined surface area. Specific sample collection procedures for both methods are provided in Section 4.6 of SCCWRP Technical Report 872 (**Appendix B** of the Workplan). Examples of a mesh basket/hamper and a SUBS sampler are shown in **Figure 11-1.** Samples should be kept refrigerated at 4°C in the dark until they are processed. Laboratory processing will be completed within 48 hours.

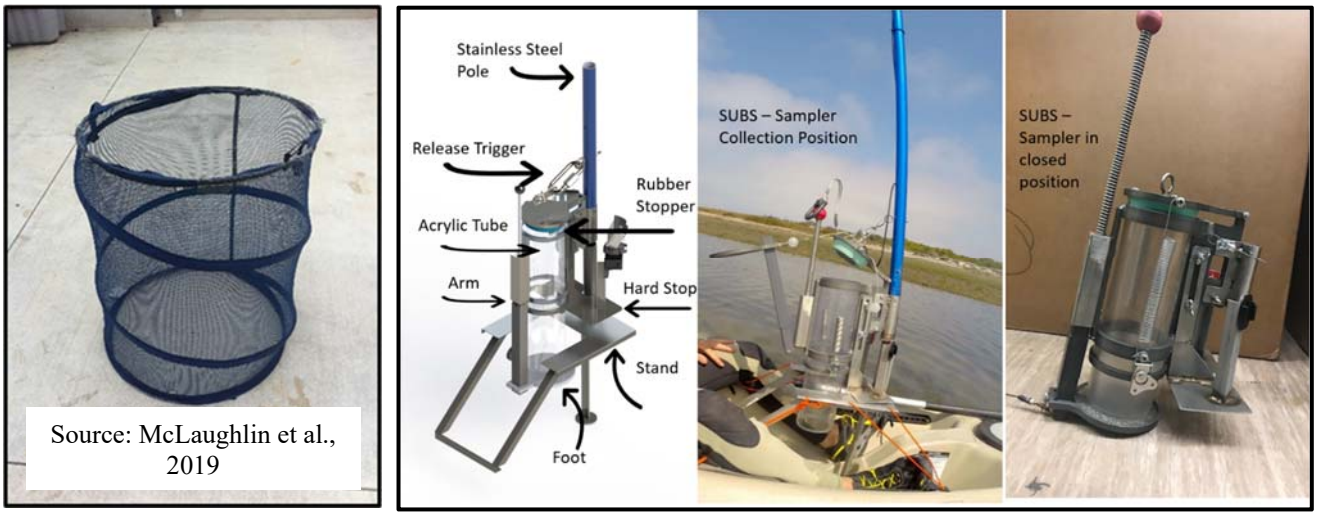


Figure 11-1. Collapsible Hamper (Left) and SUBS Sampler (Right) for Macroalgae Collection

11.4 ESTUARY SURFACE WATER QUALITY MONITORING

Monthly surface water sampling will be conducted in the Estuary from April through October and during three events from November through March. During each monitoring event, sampling will be conducted at one location in each of three Estuary regions: below the I-5 Bridge, above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[17] and between the two bridges (**Figure 10-2**).

During each monthly monitoring event, site conditions and sample information will be recorded on field data sheets. Additionally, during each monitoring event, the status of connectivity between the Estuary and the Pacific Ocean will be documented.

Estuary surface water quality monitoring will be conducted in accordance with SWAMP and Standard Methods (SM) for the Examination of Water and Wastewater (American Public Health Association [APHA], 2012). Ambient surface water grab samples will be collected at a depth of approximately 0.5 m, and will be analyzed for chlorophyll-a, total nitrogen, total and dissolved inorganic nitrogen and phosphorus. Water samples will be collected using a sampling pole or peristaltic pump, and samples will be placed into appropriate bottles and preserved and transported as described in **Element 12**. Two

[17] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).

field duplicates and one field blank will be collected for nutrient analysis per monitoring year in order to achieve the SWAMP QA sample requirements (i.e., field duplicates at a frequency of 5% of the sample count and a field blank per method).

11.5 ESTUARY SEDIMENT AND BENTHIC COMMUNITY CONDITION MONITORING

Sediment monitoring to assess benthic community condition will be conducted in the Estuary on an annual basis, in late summer. Monitoring marine subtidal areas of the estuary (salinity ≥ 27 ppt) will be conducted in accordance with the Sediment Quality Assessment Technical Support Manual, SCCWRP Technical Report 777 (Bay et al., 2014).[18] Sampling locations and depths (where feasible) will align with macroalgal sampling so that relationships between the benthic community condition score and other parameters may be logically inferred. However, samples must be collected in subtidal conditions for use of SQO benthic community scoring. In areas of the estuary where the criteria for assessing benthic infaunal condition using the SQO tool cannot be met (i.e., brackish areas with a salinity of < 27 ppt), an alternative sampling protocol is recommended based on protocols developed for Bight '18. If salinity was determined to be < 27 ppt and SQO calculated, the results should be qualified. Monitoring will be conducted at three locations within each of the three Estuary segments, for a total of nine samples (**Figure 10-2**).

Benthic sediments will be collected as surface grabs for the analysis of TOC, grain size, total nitrogen, total phosphorus, and benthic infaunal analysis (i.e., sorting and taxonomic evaluation of benthic macroinvertebrates). Prior to sampling, it is recommended that a salinity measurement be taken above the sediment-water interface to determine if the sampling site is located in marine (≥ 27 ppt) or brackish (< 27 ppt) waters. It is recommended that salinity measurements be taken as close to Mean Lower Low tide (MLLW), less than or equal to 0.5 feet on a tide chart, in order to get the most accurate measurement (SCCWRP, 2018).

A Van Veen or equivalent grab sampler with a 0.1 square meter (m^2) surface area is recommended for the collection of biology and chemistry samples in marine areas of the estuary in order to calculate the SQO benthic condition line of evidence (LOE). Equivalent grab samplers can be used with a smaller surface area as long as the sediment samples are equivalent in quality to the Van Veen grab (Bay et al., 2014). An appropriate sampler for the collection of benthic sediments will have the following characteristics:

- Constructed of a material that does not introduce contaminants.
- Causes minimal surface sediment disturbance.
- Does not leak or mix during sample retrieval.

[18] Available at: http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/777_CASQO_TechnicalManual.pdf. Once accepted methods are available to estimate the effect of sediment organic matter (eutrophication) upon benthic macro invertebrate communities, they may be considered for use (San Diego Water Board, 2019).

- Has a design that enables safe/easy sample verification that samples meet all applicable sampling criteria (e.g., collects sediments to at least five cm below the sediment surface, has access doors allowing visual inspection and removal of undisturbed surface sediment).

In brackish areas of the estuary, a 4-inch diameter plastic core tube (diameter refers to inner diameter) that is a minimum of 10 cm in length is recommended for the collection of chemistry and benthic infaunal samples (e.g., the SUBS Sampler developed by NIWC Pacific can be utilized as an alternative to constructing a core tube since the SUBS Sampler is 4-inches in diameter and 16-inches in length). At each site, two 4-inch diameter core samples will be collected for benthic infauna. These two core samples will then be composited into a single sample. Options for sample collection at intermediate depths include the following: 1) using a SUB Sampler, 2) using core tubes attached to an extension pole, 3) inserting core tubes into the sediment grab collected with a Van Veen, or 4) inserting the core tubes by hand if collection sites are in wadeable areas. The top of each core will be sealed with a rubber cap. A vacuum will be created when the core is removed from the sediment holding the contents in place; however, the bottom should be covered if the contents are not held in place (i.e., sediment is loose). For more detailed information regarding determination of salinity at a site, sample collection protocols using the cores, or construction of the cores refer to the Bight '18 Sediment Quality Assessment Field Operations Manual (SCCWRP, 2018). For more information on using the SUB Sampler as the coring device refer to the Standard Operating Procedure for Macroalgal Collection in Estuarine Environments (McLaughlin et al., 2019).

A sample will be considered acceptable if the surface of the grab is even and there is minimal surface disturbance. For marine samples, the penetration depth of the grab sampler should be a minimum of 5 cm in compact sediments (i.e. hard packed sand). Penetration depths of 7-10+ cm should be obtained in silty sediments (fine sand to clay) and whenever possible, infaunal samples should be a minimum of 7 cm, but target 10+ cm. Benthic infaunal samples collected at brackish sites must have a minimum penetration depth of 10 cm. Rejected grabs will be discarded, and the station will be re-sampled. Acceptable sediment grabs to be utilized for chemistry and grain size will have the overlying water carefully drained from the sediment surface prior to removing the sediment to be placed in the appropriate sample containers. Overlying water will not be drained from sediment samples collected for benthic infaunal analysis.

Between sampling stations, the grab sampler will be rinsed with station water. Stainless steel scoops will be rinsed with seawater and rinsed with de-ionized water between stations. During each annual monitoring event, information to be recorded on field data sheets includes station identification, date, time of arrival, coordinates and navigation system used, water depth, weather conditions, and other pertinent observations. Information about the sediment sample will also be recorded, including the sample time, depth of penetration of sediment grab, sediment composition, sediment color, sediment odor, and presence of shell hash.

11.5.1 Benthic Community Condition Sampling

The entire contents of one grab sample (equal to 0.1 m^2 surface area) will be utilized for benthic infaunal analysis in marine areas of the Estuary (salinity ≥ 27 ppt) (e.g., using a Van Veen grab sampler). If using a grab sampler with a smaller surface area (e.g., SUB Sampler), then multiple benthic infaunal samples will need to be collected to be equivalent to a surface area of 0.1 m^2. Samples

collected for benthic infaunal analysis from marine areas will be rinsed through a 1.0-millimeter (mm) mesh screen.

In brackish areas of the Estuary (salinity <27 ppt), two 4-inch diameter cores with a minimum penetration depth of 10 cm will be utilized for benthic infaunal analysis (e.g., two cores collected using a SUB Sampler). Samples collected for benthic infaunal analysis from brackish areas will be rinsed through a 0.5-mm screen.

The material retained on the screen will be transferred to a labeled glass or plastic sample container. A 7% Epsom salt ($MgSO_4$) solution will be added to the sample container to 85-90% of its volume to relax the collected specimens. The sample container will be inverted several times to distribute the relaxant solution. After 30 minutes, add enough sodium borate buffered formaldehyde to top off the sample container and gently invert the container several times to ensure the sample is mixed. This will make a 10% formalin solution. Laboratory processing procedures are described in **Element 13.3**.

11.5.2 Sediment Chemistry Sampling

Sediment samples for chemistry and grain size analysis from marine areas of the Estuary will be collected from the top 5 cm of the grab sample using a pre-cleaned stainless-steel scoop. Sediment within 1 cm of the sides of the grab will be avoided to prevent interaction of any contaminants and the sampling device. For chemistry and grain size analysis, equal portions of sediment will be aliquoted from a single grab.

In brackish areas of the Estuary, the 4-inch diameter core tubes utilized for benthic infaunal sampling can be used to collect sediment for chemistry analysis. Insert the core 5 cm into the sediment, then dump the sediment into a clean pan to remove overlying water. Scoop the sediment into the appropriate sampling container using a pre-cleaned stainless-steel scoop or spoon.

Sediment will be placed into the appropriate samples' containers, preserved, and transported as described in **Element 12**. Physical and chemical laboratory analysis procedures are described in **Element 13.2**. One field duplicate and one equipment rinse blank will be collected for chemical analysis per monitoring year in order to achieve the SWAMP QA sample requirements (i.e., field duplicates at a frequency of 5% of the sample count and an equipment rinse blank per method).

11.6 SANTA MARGARITA RIVER MONITORING

Monitoring will be conducted on the main stem of the Santa Margarita River to determine flow and ambient water quality conditions upstream of the Estuary. A total of three sites will be monitored; one each within the jurisdictions of San Diego County, Riverside County, and MCB CamPen (**Figure 10-3**). Monitoring events will be conducted monthly from May through October and bi-monthly from November through April, in November, January, and March. At each location, equipment will consist of an automated flow meter and sensor, solar panel, cellular line (where coverage is available), and rain gauge. Remote Automatic Weather Station (RAWS) or ALERT system rainfall gauges will be used where available. The Lake O'Neill rain gage will be used to monitor rainfall at the sampling location at Ysidora.

11.6.1 Flow Monitoring

Flowmeters for continuous flow monitoring will be installed and maintained at each location. Flowmeters will be installed and maintained at the County of San Diego and Riverside County monitoring locations. MCB CamPen's surface monitoring site will use the Ysidora USGS gage (11046000). Although monitoring events occur during nine months of the year, it is recommended that flow monitoring occur throughout the year, where equipment can remain in place, for flow volume calculations used in loading estimations. At a minimum, the equipment will be comprised of Hach (or comparable) flowmeters with a bubbler or submerged pressure transducer as the primary measuring device (level sensor). The primary sensor will continuously measure stage (i.e., stream height) and relay that information to the flowmeter, which will continually calculate flow rates by inserting the stage information into the preprogrammed discharge equation. Continual flow data will be downloaded from each location periodically to verify equipment functionality and thus reduce data gaps, ensure accuracy, and identify maintenance and calibration needs. Flow data will be entered into the data management system.

Daily and monthly flow rates will be measured or estimated in accordance with the National Pollutant Discharge Elimination System (NPDES) Storm Water Sampling Guidance Document (EPA-833-B-92-001) (United States Environmental Protection Agency [USEPA], 1992). Flow rating curves will be developed that correlate water surface levels (or stream heights) to flow rates.[19] To quantify flow rates based on stream stage, a relationship between flow and stage will be derived using standardized stream rating protocols developed by the USGS (Rantz, 1982; Oberg et al., 2005) and using an applicable hydraulic calculation formula(s), such as Manning's equation. If the monitoring station is found to have a steady dry weather base flow, it may be appropriate to install a flow sensor with the ability to measure instantaneous stream velocity. However, in an ephemeral stream that tends to be wet and dry out periodically, this type of sensor may not collect high quality data. A decision to use an area-velocity flow meter and/or a weir structure will be determined based on site hydraulic and flow conditions.

Instantaneous field level and flow measurements will be periodically taken to validate the rating curves. To measure instantaneous flows during low flow and base flow conditions, two types of field flow monitoring equipment may be used. To measure small flows, a handheld velocity measurement instrument, such as a Marsh-McBirney Model 2000 Portable Flowmeter connected by a cable to an electromagnetic open channel velocity sensor, or equivalent may be used. To measure higher flows, the SonTek (YSI) FlowTracker Acoustic Doppler Velocimeter, or equivalent may be used.

11.6.2 Water Quality Monitoring

During each monthly monitoring event, water quality parameters (temperature and conductivity) will be measured using a multi-parameter water quality meter or sonde. Water quality measurements and site conditions will be recorded on field data sheets. A grab sample will be collected in an appropriate container using a sampling pole or similar method. The sample will be analyzed for total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus, as described in **Element 13.2**.

[19] At the MCB CamPen surface monitoring site at Ysidora, discharge, rating curves, and field flow measurements from the USGS will be used in lieu of a new flow measurement site. The USGS station at Ysidora has real-time telemetry and reports data at 15-minute intervals.

12. SAMPLE HANDLING CUSTODY

12.1 SAMPLE COLLECTION

Samples for water, sediment, and macroalgal analysis will be uniquely identified with sample labels in indelible ink. All sample containers will be identified with the project title, appropriate ID number, date and time of sample collection, and preservation method. All samples collected in glass or high-density polyethylene (HDPE) bottles will be kept on ice from the time of sample collection until delivery or transport to the analytical laboratory. All samples will be transferred to the designated analytical laboratories and analyses initiated within the method specified holding time (**Table 12-1**).

Table 12-1. List of Analytes with Sample Volume, Container Type, Holding Time, and Preservation Method

Analyte	Recommended Container	Holding Time	Recommended Preservation
Estuary Field Measurements			
Dissolved Oxygen	*In situ*		
pH			
Salinity/Conductivity			
Temperature			
Turbidity			
River Field Measurements			
Conductivity	*In situ*		
Temperature			
Estuary Macroalgal Measurements			
Macroalgal Biomass	Plastic Bag	NA	Refrigerate at 4°C in dark; do not freeze
Groundwater, Estuary, and River Water Measurements[1]			
Ammonia	Plastic	48 hours; 28 days if acidified[4]	H_2SO_4, cool to ≤6°C
Ammonia, Dissolved	Plastic	48 hours; 28 days if acidified[4]	Filter before adding H_2SO_4, cool to ≤6°C
Chlorophyll-a, Suspended	per method	Samples must be frozen or analyzed within 4 hours of collection; filters can be stored frozen for 28 days	Filter as soon as possible after collection; if sample processing must be delayed, keep samples on ice or at ≤6°C; store in the dark
Inorganic Nitrogen, Dissolved[2] (calculation)	N/A	N/A	N/A
Inorganic Nitrogen, Total[2] (calculation)	N/A	N/A	N/A
Nitrate (NO3) + Nitrite (NO2), Dissolved	Plastic	48 hours; 28 days if acidified[4]	Filter before adding H_2SO_4, cool to ≤6°C

Table 12-1. List of Analytes with Sample Volume, Container Type, Holding Time, and Preservation Method

Analyte	Recommended Container	Holding Time	Recommended Preservation
Nitrate (NO3) + Nitrite (NO2), Total	Plastic	48 hours; 28 days if acidified[4]	H_2SO_4, cool to ≤6°C
Nitrogen, Total[3] (Calculation)	NA	NA	NA
Phosphorus, Dissolved	Plastic	28 Days	Filter before adding H_2SO_4, cool to ≤6°C
Phosphorus, Total	Plastic	28 Days	H_2SO_4, cool to ≤6°C
Estuary Sediment Measurements			
Grain Size	Glass or Plastic	1 year	Wet ice to ≤6°C in the field, then refrigerate at ≤6°C
Nitrate (NO3) + Nitrite (NO2)	Glass	14 days[4]	Cool to ≤6°C
Nitrogen, Total[4] (Calculation)	NA	NA	NA
Nitrogen, Total Kjeldahl	Glass	14 days[4]	Cool to ≤6°C
Phosphorus, Total	Glass	14 days[4]	Cool to ≤6°C
Total Organic Carbon	Glass	28 Days at ≤6°C; 1 year at ≤-20°C	Cool to ≤6°C or freeze to ≤-20°C
Estuary Benthic Community Condition Measurements			
Benthic Macroinfaunal Community	Glass or Plastic	NA	Minimum of 72 hours to maximum of 2 weeks in formalin fixative, then transfer to 70% ethanol[5]

[1]Groundwater samples will include each of the analytes shown in this section except chlorophyll-a.

[2]Total and dissolved inorganic nitrogen is a calculated value comprised of NH3 and NO3 + NO2

[3]Total nitrogen in sediment is a calculated value comprised of total Kjeldahl nitrogen (TKN), NO3, and NO2

[4]Holding time may vary depending on the analytical method

[5]Start with 95% ethanol solution, not denatured ethanol. If ethanol is produced by industrial distillation rather than fermentation, buffer with marble chips (Bay et al., 2014); for preparation of 70% ethanol solution refer to Bay et al., 2014.

12.2 CHAIN-OF-CUSTODY PROCEDURES

Samples will be considered to be in custody if they are retained as follows (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a container and secured with an official seal such that the sample could not be reached without breaking the seal. The principal documents used to identify samples and to document possession will be COC records, field logbooks, and field tracking forms. COC procedures will be used for samples throughout the collection, transport, and analytical process.

COC procedures will be initiated during sample collection. A COC record will be provided with each sample or group of samples. Each person who will have custody of the samples will sign the form and ensure the samples will not be left unattended unless properly secured. Documentation of sample handling and custody on the COC includes the following:

- Sample identifier.
- Sample collection date and time.
- Any special notations on sample characteristics or analysis.
- Initials of the person collecting the sample.
- Date the sample was sent to the analytical laboratory.
- Shipping company and waybill information.

Field staff will verify sample container labels include the sample ID, date and time of collection, sampler's initials, and type of analysis during the completion of the COC. Completed COC forms will be placed in a plastic envelope and kept inside the cooler containing the samples. Once delivered to the analytical laboratory, the COC form will be signed by the person receiving the samples. The condition of the samples will be noted and recorded by the receiver. COC records will be included in the final reports prepared by the analytical laboratories and are considered an integral part of the report.

12.3 SAMPLING TRANSPORT, SHIPPING, AND STORAGE PROCEDURES

Prior to shipping or transport, field staff will verify samples were preserved properly and stored at the required temperature and light conditions. COC forms will be filled out and the original signed COC forms will be inserted in a sealable plastic bag and placed inside the coolers. The cooler lids will be securely taped shut before shipment. All samples collected in the field will be delivered or shipped overnight via coolers to the analytical laboratory for analysis. Transport of the samples will be coordinated by the appropriate Field Task Lead to ensure that all samples are sent at the appropriate temperature and light conditions, and within designated holding times. The analytical laboratory will properly and safely dispose of the samples after the analyses are complete and analytical QA/QC procedures have been reviewed and accepted.

13. ANALYTICAL METHODS

13.1 FIELD ANALYTICAL METHODS

In situ water quality measurements of DO (mg/L and % saturation), pH (pH), temperature (°C), conductivity/ salinity (µS/cm; ppt), and turbidity (NTU) will be determined using multi-parameter data sondes at two sites within the Estuary (I-5 Bridge and Stuart Mesa Bridge). Sondes will be set up to continuously collect data at 15-minute intervals for the duration of the monitoring period (April – October) and up to one month during each of three winter periods (November, January, March). Data sondes will need to be removed from the water to download the data and for maintenance (e.g., removal of biofouling, verification of precision, re-calibration, replacement of batteries) at least once a month. Summer months may require weekly maintenance. A telemetry system may be used to check data in real-time.

Continual flow data will be downloaded from the three sites located on the main stem of SMR periodically to verify equipment functionality and thus reduce data gaps, ensure accuracy, and identify maintenance and calibration needs. The MCB CamPen surface monitoring site at Ysidora will use the USGS station at Ysidora for flow data, which has real-time telemetry and reports data at 15-minute intervals. In situ water quality measurements of temperature and specific conductivity will be determined at these three sites using a multi-parameter water quality meter (or sonde).

Analytical methods for water quality parameters are provided in **Table 13-1**. Operation of all field equipment will be conducted as per manufacturer instructions. Calibrations will be performed and recorded to ensure accurate functionality. Maintenance will include removing biofouling to ensure the sondes are operating correctly.

Table 13-1. Analytical Methods for Water Quality Parameters

Parameter	Method	Units	Accuracy	Resolution
Dissolved oxygen	Polargraphic or luminescence quenching probe	mg/L	±0.2*	0.01
pH	Electrode	pH units	±0.2	0.01
Salinity	Refractometer of conductivity cell	ppt	±2	0.01
Specific Conductance	Conductivity cell	µS/cm	±0.5%	1
Temperature	Thermistor or bulb	°C	±0.15%	0.1
Turbidity	Portable turbidimeter or optical probe	NTU	±1% up to 100 NTU; ±3% from 100-400; and ±5% from 400-3000 NTU	0.1

Reference: State Water Board, 2017

*Calibration checks on DO sensors have indicated that variations in DO values may be greater than this instrument accuracy specification (Kara Sorenson, personal communication).

13.2 LABORATORY ANALYTICAL METHODS

The specific analyses and target reporting limits are outlined in **Table 13-2** for water, sediment, and macroalgal samples. All analytical methods utilized should follow the USEPA, American Society for Testing and Materials (ASTM), or Standard Methods (SM) for the Examination of Water and Wastewater. Analytical laboratories should provide results within standard turn-around time. Before the analytical laboratory disposes of any samples, authorization is required from the Consultant PM.

In addition to the chemical analyses listed in **Table 13-2**, physical measurements of macroalgal biomass will be determined following Section 6.3 of the SOP for Macroalgal Collection in Estuarine Environments (SCCWRP Technical Report #872) (McLaughlin et al., 2019). Macroalgal biomass samples must be processed within 48 hours of collection. Biomass samples will be cleaned of all mud, bugs, and debris; weighed wet; dried in an oven at 60°C for two to three days; and weighed dry. Samples should be kept refrigerated at 4°C in the dark until they are processed. If the amount of biomass in each sub-sample (from the five sites along each transect or within each sub-segment) is small, the SOP states that they may be composited into a single sample representative of that transect/sub-segment, resulting in three biomass composites per Estuary segment. If the biomass from each sub-sample is large (i.e., enough to fill the Ziploc bag), each sub-sample will be weighed individually and added.

Table 13-2. Analytes, Analytical Methods, and Target Reporting Limits

Analyte	Method	Units	Target Reporting Limit[3]
Estuary Macroalgal Samples			
Macroalgal Biomass	McLaughlin et al., 2019 SOP	g dry weight/m^2	0.001
Ground Water, Estuary, and River Water Samples[1,2]			
Ammonia (as N)[4]	EPA 350.1	mg/L	0.02
Ammonia (as N)[4], Dissolved	EPA 350.1	mg/L	0.02
Chlorophyll-a, Suspended	SM 10200	mg/L	0.002
Inorganic Nitrogen, Dissolved[4]	By Calculation	mg/L	NA
Inorganic Nitrogen, Total[1,4]	By Calculation	mg/L	NA
Nitrate (NO_3) + Nitrite (NO_2) [4]	SM 4500-NO3 E/SM 4500-NO2 B	mg/L	0.01
Nitrate (NO_3) + Nitrite (NO_2), Dissolved[4]	SM 4500-NO3 E/SM 4500-NO2 B	mg/L	0.01
Nitrogen, Total[5]	By Calculation	mg/L	NA
Phosphorus, Dissolved	SM 4500 or EPA 365.1	mg/L	0.05
Phosphorus, Total	SM 4500 or EPA 365.1	mg/L	0.05
Estuary Sediment Samples[1]			
Grain Size	ASTM D4464 (M) or SM 2560 D or ASTM D422	%	NA
Nitrate (NO_3) + Nitrite (NO_2)	SM 4500 or EPA 300.0	mg/kg	0.5/1.0
Nitrogen, Total[5]	By Calculation	mg/kg	NA
Nitrogen, Total Kjeldahl	SM 4500	mg/kg	10
Phosphorus, Total	SM 4500	mg/kg	0.12
Total Organic Carbon	EPA 9060A	%	0.05

[1] Recommended analytical methods; alternative methods may be used; however, methods should follow USEPA, ASTM, or Standard Methods

[2] Groundwater Samples will include each of the analytes shown in this section except chlorophyll-a.

[3] Target reporting limits; reporting limits may vary based on the actual analytical method and method detection limits utilized by the laboratory selected to perform the analysis. Lower reporting limits may be available.

[4]Total and dissolved inorganic nitrogen in water is a calculated value comprised of NH_3 + NO_3 + NO_2. Additional water samples are identified to be collected and filtered to analyze for dissolved NH_3 + NO_3 + NO_2.

[5]Total nitrogen is a calculated value comprised of total Kjeldahl nitrogen (TKN), NO_3, and NO_2

NA = Not applicable

13.3 BENTHIC INFAUNAL ANALYSIS

The benthic infaunal samples will be transported from the field to the laboratory and stored in a formalin solution for a minimum of 72 hours and no longer than 14 days. The samples will then be transferred from formalin to 70% ethanol for laboratory processing. The organisms will initially be sorted using a dissecting microscope into five major phyletic groups: polychaetes, crustaceans, molluscs, echinoderms, and miscellaneous minor phyla. While sorting, technicians will keep a count of organisms for quality control purposes, as described in **Element 14.4**. After initial sorting, samples will be distributed to qualified taxonomists who will identify each organism to species level or to the lowest possible taxonomic level. Data for organisms that are incidental contaminants should not be included in the data analysis and should not be counted or included in the project data. Attached parasites and other epibionts should not be recorded or submitted in annual reports but may be noted as present on bench data sheets. Nomenclature and orthography should follow the usage in the SQO species list on the *Sediment Quality Assessment Tools* page of the SCCWRP website (www.sccwrp.org) as well as Edition 5 of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) taxonomic listing (available at www.scamit.org).

13.4 SAMPLE DISPOSAL

After completion of analysis and QA/QC protocols, samples will be disposed according to procedures outlined in each laboratory's SOPs. The minimum required storage time for sample components of benthic infaunal samples before disposing are as follows:

- Vials of taxonomically identified organisms: 5 years
- Unsorted remainder of sample: 2 years
- Residue from sorted sample: 1 year

14. QUALITY CONTROL

14.1 FIELD MEASUREMENTS

QA/QC for sampling processes begins with proper collection of the samples to minimize the possibility of contamination. Water samples will be collected in laboratory-certified, contaminant-free bottles. Calibration of the flow monitoring and sampling equipment will be conducted immediately prior to deployment or use and will be field verified during each data download or sample event. Field instruments will be recalibrated if data quality is suspect or instruments are compromised in between downloads or sampling events, after cleaning the sensor surfaces from biofouling. All field instruments will be calibrated and deployed in accordance with manufacturer specifications.

Field measurements for DO, pH, conductivity/salinity, turbidity, and temperature will be made using a multi-parameter water quality meter or sonde according to the manufacturer's specifications. The meter or sonde will be calibrated with calibration solutions, and it will be verified that the expiration date has not been exceeded. Proper storage and maintenance procedures of field equipment will be followed.

14.2 WATER, SEDIMENT, AND MACROALGAE SAMPLING

Water, sediment, and macroalgae samples will be collected in appropriate containers, kept on wet ice at 4°C during the sampling event, and placed into coolers along with completed COC for transfer to the analytical laboratory. Sample containers for applicable constituents will be laboratory-certified. Samples requiring preservation will either be collected in pre-preserved laboratory containers or preservative will be added as soon as possible after collection. Field crews will ensure that sampling containers are being filled properly and the requirement to avoid contamination of samples at all times is met. A field log will be completed at each site for each event. The field data log sheets will include empirical observations of the site and water quality characteristics.

Field duplicates and equipment rinse blanks will be collected and analyzed at the frequency described for each monitoring program component in accordance with SWAMP QA sample requirements. Two field duplicates and one field blank will be collected for Estuary surface water nutrient analysis and for SMR Watershed nutrient analysis during each monitoring year, and one field duplicate and one equipment rinse blank will be collected for Estuary sediment chemistry analysis during each monitoring year.

14.3 LABORATORY ANALYSES

All samples must be analyzed by laboratories accredited by ELAP using methods approved by the USEPA for the type of analysis to be performed. Efforts will be made to ensure analytical techniques are consistent with those utilized in historic monitoring efforts. The laboratory quality control of all samples will be performed under the guidelines of this QAPP and the designated analytical laboratory SOPs. Quality control samples, frequency, and control limits specific to this project are discussed in **Element 7** and listed in **Table 7-2** through Error! Reference source not found.. Laboratory quality control checks will include the use of method blanks, laboratory control samples, matrix spikes, and matrix spike duplicates. These checks are performed to identify possible contamination problem(s), to facilitate the ability to duplicate results, and to assess the magnitude of matrix interference and bias

that may be present in the samples. If control limits are exceeded, the Laboratory QA Officer will perform corrective actions to determine the cause of the exceedance. Analytical procedures based on laboratory SOPs will be reviewed with appropriate laboratory staff; and errors will be identified, documented, corrected, and reported. Samples will be re-analyzed, if available and within their respective holding times, and deemed necessary. All laboratories must maintain and provide QA/QC records for the San Diego Water Board's review.

14.4 BENTHIC INFAUNAL ANALYSIS

The QA/QC procedure for benthic macroinfaunal sorting and taxonomy will be evaluated based on guidance from the Sediment Quality Assessment Technical Support Manual, SCCWRP Technical Report 777 (Bay et al., 2014) and those utilized for Bight '18. A QA/QC procedure will be performed on each of the sorted samples using the aliquot method to ensure a 95% sorting efficiency (see **Element 7**). QA/QC on taxonomic samples will be conducted by re-identifying 10% of the benthic infaunal samples by taxonomists other than those who originally analyzed the samples and by establishing a voucher collection.

15. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

15.1 FIELD EQUIPMENT

Prior to conducting field sampling, field technicians will be responsible for preparing sampling kits that include field logs, COC forms, sample labels, sampling containers, and tools. Field measurement equipment will be checked for operation in accordance with the manufacturer's specifications. Equipment will be inspected prior to use and when returned from use for damage. The Consultant Field Task Lead will be responsible for implementing the field maintenance program.

Instrumentation malfunctions are immediately noted in the instrument logbook, and the Consultant PM is notified. Senior technical staff with specific in-depth knowledge of the particular instrument will then review the problem and attempt to fix the instrument. Major problems may require trained field service personnel and/or spare parts from the manufacturer to be brought in to fix the problem. If a critical measurement is found to be out of compliance during analysis, the results of that analysis will not be reported, corrective action will be taken and documented, and the analysis will be repeated. Effectiveness of the corrective action will be assessed by repeating the measurement, recording the corrected result, and documenting the chain of events and actions taken in field logs.

15.2 ANALYTICAL LABORATORY

The contract analytical laboratory is responsible for maintaining their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the method. Laboratory analysts are responsible for equipment testing, inspection, and maintenance. Corrective actions will be taken to repair equipment, document the issue, and reanalyze the sample if necessary.

16. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

The field equipment and instruments used should be operated and calibrated according to manufacturer recommendations as well as by criteria defined in the Consultant's individual SOPs. Operation and calibration are performed by properly trained personnel. The multi-parameter water quality meters or sondes used for instantaneous readings will be calibrated prior to and following use. The multi-parameter water quality sondes used for long-term deployment in the field will be calibrated prior to deployment and following final retrieval. Precision of the sonde will be verified after biofouling cleaning of the sensors. When sondes are pulled for calibration during deployment periods, data will be downloaded, and the sensors cleaned from biofouling prior to calibration. A response to an appropriate standard will be verified to be within QA/QC. If the QA/QC passes, then the sensor will not be recalibrated and will be redeployed. If the QA/QC fails, then the sensor will be re-calibrated before re-deployment. Documentation of calibration information will be recorded in appropriate logbooks. If calibration is unsuccessful, then the instrument will be cleaned and parts replaced until a successful calibration can occur.[20] If the instrument fails to calibrate after several attempts, then that instrument will be replaced. If a critical measurement is found to be out of compliance during the deployment of the sondes, then the Consultant PM will be notified. Results of that measurement will either not be reported, or data will be flagged. Corrective action will be taken to recalibrate the equipment and document the issue.

The laboratory equipment used at the contract analytical laboratory will be operated and calibrated according to manufacturer recommendations as well as by criteria defined in individual SOPs. Operation and calibration will be performed by properly trained personnel. Documentation of calibration information will be recorded in appropriate logbooks. If calibration is unsuccessful, then the equipment will be cleaned, and parts replaced until a successful calibration can occur. If the equipment fails to calibrate after several attempts, then the Consultant PM will be notified that analyses have stopped until functional equipment is available. Affected data will be flagged with appropriate qualifiers. Once equipment is functioning again, the samples will be reanalyzed. Issues with an instrument will be documented and corrective actions will be recorded by the laboratory. The Consultant PM will be notified if data are affected by the documented issue.

[20] Calibration checks on DO sensors have indicated that variations in measured DO values may be greater than the instrument accuracy specification of ± 0.2 mg/L listed in the QAPP (Kara Sorensen, personal communication).

17. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

It is the duty of each staff member responsible for equipment ordering to inspect equipment and materials for quality and report any equipment or materials that do not meet acceptance criteria to the appropriate Laboratory Manager and/or QA Officer. Upon receipt of materials or equipment, a designated employee will receive and sign for the materials. The items will be reviewed to ensure the shipment is complete, then they will be delivered to the proper storage location. Chemicals will be dated upon receipt. Supplies will be stored appropriately and discarded on the expiration date. The equipment and supplies purchased for use in field sampling activities will be inspected for damage as they are received.

Sample containers will be provided by the contract analytical laboratory. They will be shipped to and stored at the Consultant's facility prior to use in the field. Confirmation that sample bottles are laboratory-certified clean will be made when received from the laboratory. The Field Task Lead will oversee this element.

18. NON-DIRECT MEASUREMENTS

Historical data in the watershed may be used to support loading calculations to the Estuary. Surface water and groundwater data collected and published by the USGS as part of their National Water Information System (NWIS; https://waterdata.usgs.gov/nwis) may be used to supplement the loading calculations. Historical or current USGS data may be used. Any data that are designated as 'provisional' by the USGS will be noted.

Modeling work previously performed by Camp Pendleton may be used to support the loading calculations. This includes the Lower Santa Margarita River Groundwater Model (LSMR Model), which has been previously used to study groundwater flow and nutrient loading (e.g., Stetson, 2007; Stetson, 2012; Sutula et al., 2016).

Historical and current groundwater level and groundwater quality data collected by MCB CamPen and others may be used to supplement loading calculations (e.g., Stetson, 2019). The well locations, collection methods, and data quality will be described for any measurements used to support the loading calculations. Historical data collected by NIWC, the USGS, MCB CamPen, and others will be technically reviewed by the State-certified Professional Geologist and appropriately referenced if used for assessing and describing loading calculations. Raw and processed historical data, and relevant descriptive QA/QC data will be collected and stored in appropriate file formats on a computer. Such historical data may be used to develop empirical relationships between flow and concentration.

19. DATA MANAGEMENT

The Consultant PM will document and track the aspects of the sample collection process, including generating field logs at each site and COC forms for the samples collected. COC forms will accompany samples to the laboratory for analysis. The analytical laboratory will document and track the aspects of sample receipt and storage, analyses (including lab QA/QC data), and reporting pertaining to all laboratory analyses. The analytical laboratory's results will be stored in a database system at their office and will be provided to the Consultant PM both electronically and in hard copy. Further details of the analytical laboratory's data management protocols can be found in their respective quality manuals.

The Consultant's PM and QA officer will maintain and control the database of information and documents collected during this project. Data will be maintained as described in **Element 9**. Field and laboratory data will be entered into the Consultant's database based on nomenclature developed specifically for this project. Data entry oversight will be the responsibility of the Consultant's QA Officer. All data records, including field-generated data and laboratory data, will be accumulated into project-specific files that are maintained at the Consultant's office. All continuous monitoring raw data will be kept in the original files and stored in an electronic database. Data endpoints (e.g. hourly or daily averages) can be calculated and maintained in separate files or spreadsheets. Records will be maintained for at least five years or transferred according to agreement between the Consultant and the client.

All surface water data, including laboratory and field QC results, collected under the QAPP must be submitted to CEDEN. CEDEN data templates and documentation are available at: http://ceden.org.

GROUP C: ASSESSMENT AND OVERSIGHT

20. ASSESSMENTS AND RESPONSE ACTIONS

Data collected and analyzed for this monitoring program need to be consistently assessed and documented throughout the project to determine whether the project objectives are being met. Field staff will review sampling procedures prior to conducting sampling to ensure that all methods of collection are understood and that equipment/instruments used for sample collection and analysis are functioning and ready for use. Field data sheets will be reviewed prior to leaving the sample location to ensure that all samples were collected, and field observations were documented. If the field staff encounters any issues related to sample collection or equipment failure that cannot be immediately corrected at the sample site, they will notify the Consultant PM. Either re-sampling will occur on another day or errors will be noted on field data sheets and reported in the annual report.

The laboratory technicians are responsible for following the procedures and operating analytical equipment, including conducting instrument maintenance, calibration of equipment/instruments, and performing laboratory QC sample analyses at the required frequency stated in this QAPP. The laboratory QA Officer is responsible for reviewing the associated QC results that are reported with all of the sample results to evaluate the analytical process performance, verifying that the performance criteria of this QAPP were met, recommending or approving proposed corrective actions, and verifying that corrective actions have been completed.

The need for corrective action comes from several sources, including equipment malfunction, failure of internal QA/QC checks, failure of follow-up on performance or system audit findings, and noncompliance with QA requirements. When measurement equipment or analytical methods fail QA/QC requirements, the problem(s) will be brought immediately to the attention of the laboratory supervisor and QA Officer. Corrective measures will depend entirely on the type of analysis, the extent of the error, and whether or not the error is determinant. Final approval of what the corrective measure will be is the responsibility of the QA Officer and/or Consultant Project Manager. If failure is due to equipment malfunction, the equipment will not be used until repaired. Precision and accuracy will be reassessed, and the analysis will be rerun. Attempts will be made to reanalyze the affected parts of the analysis so that in the end, the product is not affected by failure of QC requirements. When a result in a performance audit is unacceptable, the laboratory will identify the problem(s) and implement corrective actions immediately. A step-by-step analysis and investigation to determine the cause of the problem will take place as part of the corrective action program. If the problem cannot be controlled, the laboratory will analyze the impact on data. The client will be notified if their data are affected.

21. REPORTS TO MANAGEMENT

The Consultant PM is responsible for preparation and submittal of all project deliverables. The analytical laboratory's QA Officer is responsible for the preparation of all data packages and laboratory reports originating from their laboratory. Draft and final reports will be provided for review. **Table 21-1** presents the proposed schedule for management reporting.

Table 21-1. Management Report Schedule

Type of Report	Frequency	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Draft Monitoring Plan	Once	August 27, 2019	Responsible Parties Contact[3]	County of Riverside, Riverside Flood Control and Water Conservation District, County of San Diego, United States Marine Corps Base Camp Pendleton, City of Murrieta, City of Temecula, City of Wildomar, San Diego Water Board[2]
Draft QAPP	Once	August 27, 2019		
Final Monitoring Plan/QAPP to Dischargers	Once	November 6, 2019		
Final Monitoring Plan/QAPP to San Diego Water Board	Once	November 12[4], 2019		
In-Stream River Monitoring Data Submittals to NWIC Pacific	Quarterly[5]	July 31 October 31 January 31 April 30		
Draft Annual Report to Dischargers	Annually (Years 2020-2022)	November 15[6]		
Final Annual Report to Dischargers	Annually (Years 2021-2023)	January 15[1]		
Final Annual Report to San Diego Water Board	Annually (Years 2021-2023)	January 31[1]		
Draft Four-year Report to Dischargers	Once	January 15, 2024		
Final Four-year Report to Dischargers	Once	March 15, 2024		
Final Four-year Report to San Diego Water Board	Once	March 31, 2024		

1 – Following calendar year

2 –The San Diego Water Board will receive the final versions of the Monitoring Plan, QAPP, Annual Reports, and Four-year Report.

3 – The agency(s) designated to lead contract management and development of reports will be identified in the MOU.

4 – The Workplan and QAPP are due six months from May 9, 2019 when Investigative Order was issued, which is Saturday, November 9. Due to Veteran's Day holiday on November 11, the first business day is Tuesday, November 12, 2019. This date was agreed upon with the San Diego Water Board at the SMRNIG TAC meeting on October 2, 2019.

5 – Target interim data submittals to NWIC Pacific for annual assessment. Schedule may be modified as agreed upon by dischargers.

6 – Target draft report date may be modified as agreed upon by dischargers.

GROUP D: VALIDATION AND USABILITY

22. DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

All data generated by this project's activities will be reviewed against the MQOs presented in **Element 7** of this QAPP. The field and laboratory personnel, including QA Officers, will be responsible for verifying that the sample collection, handling, and analytical procedures were in accordance with the approved QAPP. The Field Task Lead will review all COC forms to ensure adherence to collection, transport to analytical laboratory, and receipt requirements are completed within appropriate holding times.

Laboratory technicians generating the data have the prime responsibility for the accuracy and completeness of data. The laboratory supervisor and QA Officer are responsible for reviewing laboratory data forms and sample logs to ensure that all requirements for sample preservation, sample integrity, data quality assessments, and equipment calibration have been met. Data that do not meet these requirements will be reanalyzed, not reported, or will be reported with qualifiers which provide adequate explanations for the data discrepancies. If data cannot be reported, then the Consultant's PM will be notified.

23. VERIFICATION AND VALIDATION METHODS

After each survey, the field data sheets will be removed from the field logbooks, and sheets will be checked for completeness and accuracy (including sample location, sample date and time, and sample type) by the Consultant's Field Task Lead or PM. Any field changes or discrepancies will be noted on the field sheets. Any changes to the COCs in the field should be indicated by a single line through the error, a revised value/change next to the original, and an initial of the field technician responsible. Copies of the COC forms with signatures from laboratory personnel showing that the laboratory has received the samples will be kept with field data sheets in a designated folder. If there are any questions, clarification from the Field Task Leader will be obtained as soon as possible. Data collected from field instruments, such as DO, will be validated and verified by the Consultant's PM or QA Officer.

Verification and validation of the laboratory data are the responsibility of the laboratory. All sample preparation and analytical activities will be documented in bound laboratory notebooks or on bench sheets. The laboratory technician generating the data has the prime responsibility for the accuracy and completeness of the data. Laboratory technicians and the laboratory QA Officer will review the analytical data to ensure that the following information is correct and complete: sample description information, analysis information, instrument calibration, analytical results, QC samples meet performance criteria, and documentation. The laboratory supervisor will maintain analytical reports and QA/QC documentation for this project in a database format. All corrective actions required during the analytical process that may affect sample results will be recorded by the laboratory's QA Officer and reported to the Consultant's PM and QA Officer.

In addition to the laboratory performing verification and validation of laboratory data, the Consultant's QA Officer will review all laboratory analytical reports and electronic data deliverables when they are received from the laboratory to ensure that the data provided are complete and MQOs in this QAPP have been met. Laboratory reports/electronic data deliverables (EDDs) that do not meet the Consultant's QC check will be returned to the laboratory with requests for correction.

The Consultant's PM will be responsible for final review of data analysis and rough drafts of annual reports prior to submission to the client for their review.

24. RECONCILIATION WITH USER REQUIREMENTS

The goal of this monitoring program is to conduct surface water and groundwater monitoring in the Estuary and SMR Watershed in order to assess progress toward attainment of numeric targets in accordance with the 2019 Investigative Order (San Diego Water Board, 2019). Data collected in each year of the monitoring program will aid in addressing the questions outlined in **Element 5.1**.

In order to answer Question 1, watershed and resurfacing groundwater nutrient loading data will be evaluated to quantify concentrations of total nitrogen and phosphorus entering the SMR Watershed and Estuary, and to estimate dry weather loads on an annual basis. Determining the annual loading of nutrients will also help answer Question 2 as to whether the Discharger's existing NPDES permits are enough to bring about the necessary nutrient load reductions to restore the Estuary and to confirm that resurfacing groundwater is no longer a significant source of nutrient loading to the Estuary.

In order to answer Question 3, macroalgal biomass, DO, and benthic community condition data will be assessed to determine whether numeric targets are being met (see **Element 5.3**). Results of the continuous DO monitoring and Estuary nutrient samples will be used as an indicator of the eutrophication status of the Estuary.

Data analysis for the Estuary and SMR Watershed will consist of tabulation of results, load estimates, DO summary, macroalgal biomass calculations, and assessment of the benthic community condition of the Estuary. Results will be compared to the Draft Staff Report numeric targets (see **Element 5.3**) to determine progress toward addressing the eutrophication impairments. In addition, statistical analyses and data interpretation will be conducted as related to observed trends in watershed nutrient loading and Estuary macroalgae levels across monitoring years after at least three years of monitoring have been conducted. The usability of the verified data will be assessed by comparing the data to verification criteria and MQOs in **Element 7**. Data that have been rejected will not be used in the data analyses. Data that have been flagged will be carefully evaluated for inclusion in the final analyses. If flagged data are used, then they will be documented in the final report.

25. REFERENCES

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Attachment A

Example Chain of Custody Form

CHAIN OF CUSTODY

Company Name: _____ Task Order Number: _____

Address: _____ Project Name: _____

City / State / Zip: _____ Project Location: _____

Project Manager: _____ Activity: _____

Phone/Fax Number: _____ Lab Destination: _____

Client Contact: _____ Lab Contact: _____

Phone/Fax Number: _____ Lab Phone #: _____

SDG Number: _____

Special Instructions:

Collection Information							Preservation Code / Bottle Type	Requesting Testing Program/ Contract Elin
LAB_SAMPLE_ID	SAMPLE_NAME	Date	Time	Matrix	Method/ SOP#:	No. of Bottles	H3	
							1	

Sampler(s) Name(s):

Turnaround Time:

Hours Sampling:

Condition upon Receipt
Cooler Temp _____ °C Received on Ice Y N Correct Container Y N
Preserved Y N

Associated Forms BAC-T Form Y N
Field Notes Y N

Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:

Matrices / Regulatory Programs

HAZ/GW (RCRA) WW (NPDES/CWA)
DW (SDWA) Solid (HUD) LIQ / Other

Bottle Type/Preservative Codes

1 = HCl	7 = $C_6H_8O_6$	C=50 ml
2 = $Na_2S_2O_3$	8 = $NaHSO_4*H_2O$	D=100 ml
3 = H_2SO_4	9 = HNO_3	E=250 ml
4 = NaOH	10 = Ice	F=500 ml
5 = NH_4Cl	A=Glass	G=1 Liter
6 = NaOH + ZoAC	B=HDPE	H=1L Amber