March 2009

FINAL DRAFT

Sacramento River Watershed

Regional Monitoring Program Investigation

Prepared for:

Sacramento River Watershed Program

Prepared by:

Larry Walker Associates

SACRAMENTO RIVER watershed PROGRAM

LARRY WALKER ASSOCIATES

Acknowledgements

This report represents the efforts of many individuals with the common goal of improving our collective ability to monitor and understand conditions in the Sacramento River watershed. SRWP staff members (Mary Lee Knecht, Kathy Russick and Natalie LaVan) and board members (particularly Bob Shanks, Fraser Sime, Dennis Heiman, and Butch Hodgkins) were supportive throughout the process and contributed to the effort.

Several individuals helped to organize an RMP stakeholder workshop in October 2008: Tina Lunt (NCWA and SVWQC); Stephen Clark (Pacific Ecorisk); Darcy Jones (CALFED Sci. Program); Dennis Bowker (Statewide Watershed Program); Thomas Jabusch (Aquatic Science Center); Karen Larsen, Adam Ballard and Susan Fregien (RWQCB); Linda Dorn and Vyomini Pandya (SRCSD); Sam Ziegler and Carolyn Yale (USEPA); Debbie Webster (CVCWA); Claus Suverkropp (LWA); and Toni Marshall and Dawit Tadesse (SWRCB SWAMP Unit).

This investigation was funded by the Sacramento Regional County Sanitation District, a long-time supporter of SRWP. In addition, SRWP received a grant from the California American Water's Environmental Grant Program. The grant was used to underwrite a stakeholder workshops focused on water quality issues and the development of a sustainable RMP.

List of Acronyms

BDCP	Bay-Delta Conservation Plan
CDEC	California Data Exchange Center
CDFG	California Department of Fish and Game
CMAP	California Monitoring and Assessment Program
CMARP	Comprehensive Monitoring, Assessment and Research Program
CMP	Coordinated Monitoring Program
DWR	Department of Water Resources
DO	dissolved oxygen
EMAP	Environmental Monitoring and Assessment Program
FERC	Federal Energy Regulatory Commission
IRWMP	Integrated Regional Water Management Plan
IEP	Interagency Ecological Program
ILRP	Irrigated Lands Regulatory Program
MGD	million gallons per day
MS4s	municipal separate storm sewer systems
WWTP	municipal wastewater treatment plants
MWQI	Municipal Water Quality Investigation
NPDES	National Pollutant Discharge Elimination System
POD	Pelagic Organism Decline
QAPP	Quality Assurance Program Plan
RMP	regional monitoring program
SRWP	Sacramento River Watershed Program
SVWQC	Sacramento Valley Water Quality Coalition
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
USBR	US Bureau of Reclamation
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service

Executive Summary

The Sacramento River watershed, covering approximately 27,000-square-miles, creates the state's largest and longest river. Land and water within the watershed are managed by a wide range of interests. The watershed's water bodies provide multiple beneficial uses, yet some of them are impaired by several pollutants. Currently, several entities monitor the watershed's health indicators for a wide range of interests, using an equally wide range of monitoring plans.

The Sacramento River Watershed Program (SRWP) has been monitoring water quality in the mainstem Sacramento River and its major tributaries since 1998. Grant funding for SRWP's monitoring program ended in 2007. This report summarizes the findings of an investigation into the issues associated with—and possible approaches to—developing a sustainable regional monitoring program (RMP) in the Sacramento River watershed.

The multi-faceted objectives of an RMP could include the following:

- Monitor ambient water quality, sediment, biota, and habitat within the Sacramento River watershed in a science-based, watershed approach.
- Communicate and coordinate with separate monitoring efforts to prioritize and focus efforts.
- Provide regular assessment reporting and program evaluation.
- Create and maintain a comprehensive monitoring database.

The overall benefit of an RMP would come from collectively understanding water quality problems. Challenges are also multi-faceted, fundamentally related to a loss of independence.

Concurrent with this investigation, other efforts throughout the state are generating supporting information and motivation. Several federal and state regulatory programs are encouraging RMPs, leading to improved communication, broad consistency, and a base of technical expertise.

Based in part on a review of the existing RMP models and region-specific considerations discussed above, this section summarizes critical logistical issues and options associated with implementing an RMP for the Sacramento River watershed. The strategy for developing and implementing an RMP should consider the following elements:

- Encompass a specific geographic area
- Include specific source and beneficial use categories and a critical mass of their stakeholders
- Identify specific monitoring needs (locations, constituents, schedules) and requirements (permits, certifications, California Environmental Quality Act mitigation measures)
- Coordinate with other monitoring efforts to leverage resources
- Secure funding to support the program's objectives
- Use sampling and analytical methods that produce data that are high quality and comparable to other monitoring programs
- Automate data storage and retrieval for a broad audience

- Assess and integrate monitoring data and report the findings to the public in an accessible and transparent process
- Keep the program design flexible enough to react to new information and tailored to local concerns

This report addresses these strategic elements either with recommendations or with questions to be answered later. Key recommendations include:

- The geographic focus of the Sacramento River watershed RMP should be the mainstem Sacramento River and its major tributaries. This program would be loosely coordinated at the Bay-Delta scale with other RMPs in the San Joaquin River watershed, Delta, and San Francisco Bay.
- The initial RMP effort should focus on water quality, subsequently expanding to include biota (macroinvertebrates, biosentinel and sport fish), sediment, and riverine and riparian habitat.
- Stakeholders may, in general, fall into any of three categories: participants (paying, leading), collaborators (coordinating, participating irregularly), and advisors (may provide helpful guidance).
- An RMP could continue to be one of SRWP's three program areas (the other two being public education and local watershed support). An RMP would be best served by having an individual RMP Manager to represent the program and to be responsible for implementing necessary activities. Three committees may best serve to support the program: Steering, Technical Advisory, and Coordination.
- An RMP's data should be compiled and managed in a SWAMP-compatible format to allow linkage with the SWAMP database with statewide consistency.

Details of the monitoring plan—what will be measured, when, where, and how—are beyond the scope of this report and better left as an early task for the program manager. Key considerations and questions to lead the decision-making process are provided. While an RMP's budget would depend on the monitoring plan, projections are in the range of $600,000 to $1 million per year for baseline monitoring.

The final section of this report provides general conclusions and then recommends several next steps to continue the RMP development process. The goal should be to organize a viable, committed group of program participants in 2009-2010, leading to initiating monitoring by water year 2011-2012.

Table of Contents

Figures **Page**

Tables **Page**

Introduction

The Sacramento River Watershed Program (SRWP) was founded in 1996 with the mission to sustain, restore, and enhance the resources of the Sacramento River watershed while promoting social and economic vitality of the region. In fulfilling that mission, SRWP has been monitoring water quality in the mainstem Sacramento River and its major tributaries since 1998. SRWP's three main programs are (1) watershed monitoring, (2) public education, and (3) local watershed support.

The SRWP Monitoring Committee was formed in 1996 with the goal "to develop a cost-efficient and well-coordinated long-term monitoring program within the watershed to identify the causes, effects and extent of constituents of concern that affect beneficial uses and to provide information to assess progress as control strategies are implemented." One early effort that supported the Monitoring Committee, funded by the US Environmental Protection Agency (USEPA) and the Sacramento Regional County Sanitation District, was a pilot study to integrate ambient and compliance monitoring programs in the Sacramento River basin[1]. At that time, however, development of a self-sustaining program was a moot point because USEPA had provided funds to implement the first phase of broad-scale watershed monitoring.

External funding for SRWP's monitoring program ended in 2007. The overwhelming recommendation for future monitoring in the Sacramento River watershed is that it should be continued, expanded, and integrated with other regional monitoring efforts. Regional monitoring is monitoring based on region-specific objectives, which should be conducted in a coordinated, compatible manner to effectively and efficiently address a broad range of issues and interests.

This report summarizes the findings of an investigation into the issues associated with developing a sustainable regional monitoring program (RMP) and outlines potential, alternative approaches for developing and implementing an RMP in the Sacramento River watershed. The findings in this report address questions that potential stakeholders in an RMP would have when considering developing and implementing an RMP. Such questions are given in **Table 1**, along with references to the section in this report where each question is addressed. A fact sheet was often distributed in meetings to summarize the relevant issues investigated (**Appendix 1**). Examples of successful RMPs are described in **Appendix 2**.

[1] Larry Walker Associates (1998). "Pilot Study To Integrate Ambient And Compliance Monitoring Programs In The Sacramento River Basin." Prepared for the Sacramento Regional County Sanitation District, May, 71 pp.

Table 1. Relevant questions addressed in this RMP investigation report and where they are addressed.

Section	Questions Addressed
1. Introduction	• What would be the goals and objectives of an RMP? • What incentives/drivers and challenges exist for entities to participate in a feasible, sustainable RMP?
2. Regional Context	• What regional issues could be addressed by an RMP? • Who may be interested in participating in an RMP and what are their interests and concerns?
3. Supporting Efforts	• What existing programs and efforts could be leveraged to support an RMP? • What other efforts underway would provide information useful for developing an RMP?
4. Potential Program Logistics	• What should be the geographic scope of an RMP? • Who should participate in an RMP at various levels of involvement? • What business model (e.g., management structure, funding mechanism) could be successful? What resources could support an RMP? • Where should monitoring stations be located? How frequently should monitoring occur? What are the most important parameters and media to monitor? • What kinds of products should the program produce and at what frequency? • What is a reasonable budget expectation? • When should elements of an RMP be developed?

GOALS AND OBJECTIVES

Goals are the major purposes of a program. An RMP ultimately could have several goals, including the following (approximately in order of highest priority first):

- Answer basic questions from the public and legislature about the beneficial uses of the water bodies, such as:
    - Is the water safe to drink?
    - Are the fish safe to eat?
    - Is it safe to swim?
    - Are aquatic and riparian habitats degraded? If so, where and by how much?
- Establish baseline conditions and identify trends in:
    - Water quality,
    - Sediment quality,
    - Biological diversity and integrity, and
    - Overall ecological health.
- Determine the extent and magnitude of background pollutant concentrations used to assess compliance with water quality standards and to conduct analyses to determine whether there is a reasonable potential to cause or contribute to exceedances of water

quality objectives for National Pollutant Discharge Elimination System (NPDES) permits. Confirm that permit limitations are effectively protecting downstream water quality.

- Determine the effects of events in the watershed, including restoration projects, land development projects (especially urbanization), and natural events (e.g., forest fires, anomalous water years).
- Understand pollutant fate and transport, linking
    - Water quality to beneficial uses,
    - Pollution sources to impairment,
    - Impacts of watershed projects on receiving water quality,
    - Surface water and groundwater interactions, and
    - Effects of atmospheric deposition and groundwater flux to water quality.
- Evaluate emerging contaminants.

Objectives are more specific efforts that help the program achieve its goals. The multi-faceted objectives of an RMP could include the following.

- Monitor ambient water quality, sediment, biota, and habitat within the Sacramento River watershed in a science-based, watershed approach.
- Communicate and coordinate with separate monitoring efforts to prioritize and focus efforts.
- Provide regular assessment reporting and program evaluation.
- Create and maintain a comprehensive monitoring database.

An important purpose to recognize in many of the above goals and objectives is that an RMP would do more than simply collect the data—it would also serve as a technical resource for assessing those data and disseminating the knowledge gained from that assessment. For example, an RMP should serve to aid in the development and implementation of TMDLs[2].

INCENTIVES

The overall benefit of an RMP would come from collectively understanding water quality problems. Specific incentives that an RMP could provide include:

- Coordinating with regulators to prioritize and adaptively manage pollution issues based on a watershed-scale perspective
- Satisfying NPDES permit receiving water compliance monitoring
- Providing actual (rather than conservatively assumed) background concentration data to use in Reasonable Potential Analyses during NPDES permit renewals

[2] TMDL stands for "Total Maximum Daily Load". TMDLs are a regulatory program to address impairments to waters of the US by identifying sources and quantifying necessary load reductions to attain beneficial uses.

- Establishing standards for sampling and analysis to generate comparable, high-quality data
- Leveraging other monitoring efforts to minimize redundancy and overlap
- Improving access to data through a centralized data source

Table 2 summarizes the various drivers and constituent categories in the Sacramento River watershed and the downstream Delta that could be addressed by an RMP.

Table 2. Drivers and constituent categories that could be addressed in an RMP.

Drivers	Constituent Categories
NPDES permits with receiving water monitoring requirements (stormwater and wastewater)	Field measures, priority pollutants
Irrigated Lands Regulatory Program	Field measures, nutrients, pathogen indicators trace metals, pesticides, sediments, organic carbon, salinity, toxicity
Drinking water quality policy	pathogens, organic carbon, salinity, nutrients
Sediment quality objectives	Sediment, toxicity
303(d) list, TMDLs, and 305(b) reports	Trophic level 2-4 fish, mercury, salinity, pesticides
Pelagic Organism Decline (POD) in the Delta leading to the State Board Strategic Work Plan, POD Resolution, Delta Actions Resolution	Pelagic organisms, ammonia, pyrethroids, toxicity
Construction of alternative conveyance to Southern California	Drinking water constituents of concern, priority pollutants, effects of increased San Joaquin River flow through Delta, and effects of increased Sacramento River withdrawals upstream of the Delta
Effects of climate change	Temperature, flow rates
Coastal impacts of freshwater inflows	Unknown

CHALLENGES

The main challenges to address in organizing, developing and implementing an RMP include the following:

Move from Independence to Interdependence

- Participants will lose some measure of self-determination and independence in negotiating their ambient monitoring requirements. In so doing, the mitigating factor will have to be a high level of confidence that an RMP will be led by an independent, respected group and will address their concerns and monitoring needs.
- Private land owners may be unwilling to allow access to key monitoring stations for a regional organization.

Pay to Play

- Key participants may have to commit financially for the long-term via permits or other legally-binding documents. Additional participants may commit completely voluntarily. Funding agreements may be varied and thus more difficult to track and compare for equitability.
- Non-profit organizations may be largely grant-funded (thus unable to commit long-term), locally focused (thus unable to participate in-person at distant, regional meetings), and volunteer-based (thus unable to commit funds).

Be Consistent and Reliable

- Coordination with local groups conducting their own monitoring would require periodic, specialized training to use consistent sampling, analyzing and reporting protocols.

Stay Relevant

- NPDES permittees with no dilution credit may be less inclined to participate if they have no meaningful ambient monitoring requirements. Other stakeholders with limited or no mainstem monitoring needs may also perceive that they have less incentive to support an RMP.
- Dischargers may be concerned that high concentration from a distant ambient monitoring site may incorrectly implicate the discharger, thus nearby stations monitored by plant staff may be beneficial. Conversely, regulators may be concerned that low concentrations at a distance would not hold dischargers accountable for potential hot spots.
- Different pollutants of concern may emerge for different areas of the watershed. Dischargers may be reluctant to pay for monitoring pollutants less relevant to their specific monitoring requirements.
- Beneficial uses are designated for a high number of water bodies. Regional monitoring may forego monitoring many water bodies that are currently monitoring by NPDES dischargers.
- Various source categories often have divergent water quality interests (pollutants of concern, seasonality, water bodies), which require different expertise and would not be addressed by a single set of monitoring protocols. Data assessment and resulting recommendations for addressing problem areas would be different for each source category.

Regional Context

This section describes the Sacramento River watershed and downstream Delta, focusing on existing monitoring efforts.

SACRAMENTO RIVER WATERSHED

The Sacramento River watershed, covering approximately 27,000-square-miles, consists of a major valley (Sacramento Valley) bounded by several mountain ranges: the Coast Range to the west, the Cascade and Klamath Ranges to the north and the Sierra Nevada Mountains to the east. The Sacramento River is the largest river in California, with an annual average stream flow volume of 22 million acre-feet (27 km^3/yr). The river is also the longest in the State, extending over 327 miles (526 km). Major tributaries to the Sacramento River include the Feather, American, and Pit Rivers. Although it is not a tributary nor is it in the watershed, some of the Trinity River flow is diverted into the Sacramento River. Dams have been constructed over the past century on the Sacramento River downstream of the confluence with the Pit River (Shasta Dam) and on each of the other major tributaries (Oroville Dam on the Feather River and Folsom Dam on the American River). In total, there are over one thousand lakes and reservoirs throughout the watershed. River diversions are also common for transferring water to users and for flood control in the Central Valley.

Land Uses

Major land uses in the watershed are shown in **Figure 1**. Total areas for major land use categories are as follows:

Land Use Category	Acres	Miles^2	% of Total
Agriculture	2,531,612	3,956	15%
Urban	498,846	779	3%
Open-Space/Other	13,723,221	21,443	80%
Wetland	163,689	256	1%
Water	335,357	524	2%
Total Watershed	17,252,725	26,957	100%

Predominant open space land uses are forests and rangeland, comprising 59% and 17% of the land area, respectively. Agricultural uses (predominantly rice in poorly drained clayey soils, along with orchards, field crops, and vineyards) comprise another 17% of the land area and are located primarily in the floor of the Sacramento Valley. There are about 2.5 million people living in the watershed, with over half of the urbanized population located at the downstream end in Yolo, Placer, and Sacramento Counties.

Water Body Impairments

The 2006 303(d) list[3] includes approximately 40 surface water bodies (including lakes and streams) throughout the Sacramento River watershed impaired by 45 different pollutants or stressors. Many more are proposed in the draft 2009 update. Mercury, nutrients (leading to

[3] Summaries in various formats of the state's list of impaired waters can be found at http://www.swrcb.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml.

eutrophication) and salinity generally receive higher priority for developing TMDLs in the Sacramento River watershed. An RMP needs to collect sufficient discharge and pollutant concentration data in major sources and tributary watersheds to support TMDL development.

Regional Monitoring Activities

SRWP monitoring collaborated through the SRWP Monitoring Committee with other monitoring efforts by the Central Valley Regional Water Quality Control Board, US Geological Survey (USGS), California Department of Water Resources (DWR), and the California Department of Fish and Game (CDFG). The contacts list for the committee stands at over 400 individuals. Associated with this effort, SRWP developed a water quality monitoring compendium[4] of major monitoring programs in the watershed. Known monitoring stations within the Sacramento River watershed, including SRWP's, are identified in **Figure 2**. Major programs are described in this section. Publicly-owned treatment works (POTWs) identified in the map typically monitor just upstream and downstream of their outfalls. Additional program's monitoring stations that could be added to this map in the future include USGS NAWQA program's integrator and indicator stations, US Bureau of Reclamation (USBR) ambient monitoring stations, and DWR Central District's ambient monitoring stations.

Sacramento River Watershed Program Monitoring

SRWP has been monitoring the Sacramento River and its major tributaries since 1998. SRWP's monitoring program was started because there was a need to better understand water quality in the Sacramento River watershed. The monitoring program intended to have the following characteristics:

- Stakeholder driven process
- Cost-efficient and well coordinated
- Useful for establishing baseline conditions, determining attainment of beneficial uses, and quantifying the sources, effects and extent of pollution
- Tracks effectiveness of management strategies

Collaborating entities included SFEI, the Regional Water Board, the Fish Mercury Project, Department of Water Resources Tributary Monitoring, various mercury projects for the Delta Tributaries Mercury Council, City and County of Sacramento, the Sacramento Regional County Sanitation District, the Irrigated Lands Regulatory Program, and some tributary watershed projects.

SRWP initiated a Watershed Health Indicator study, but progress stalled when state grant funds were frozen in early 2009.

[4] See http://www.sacriver.org/monitoring/compendium/.

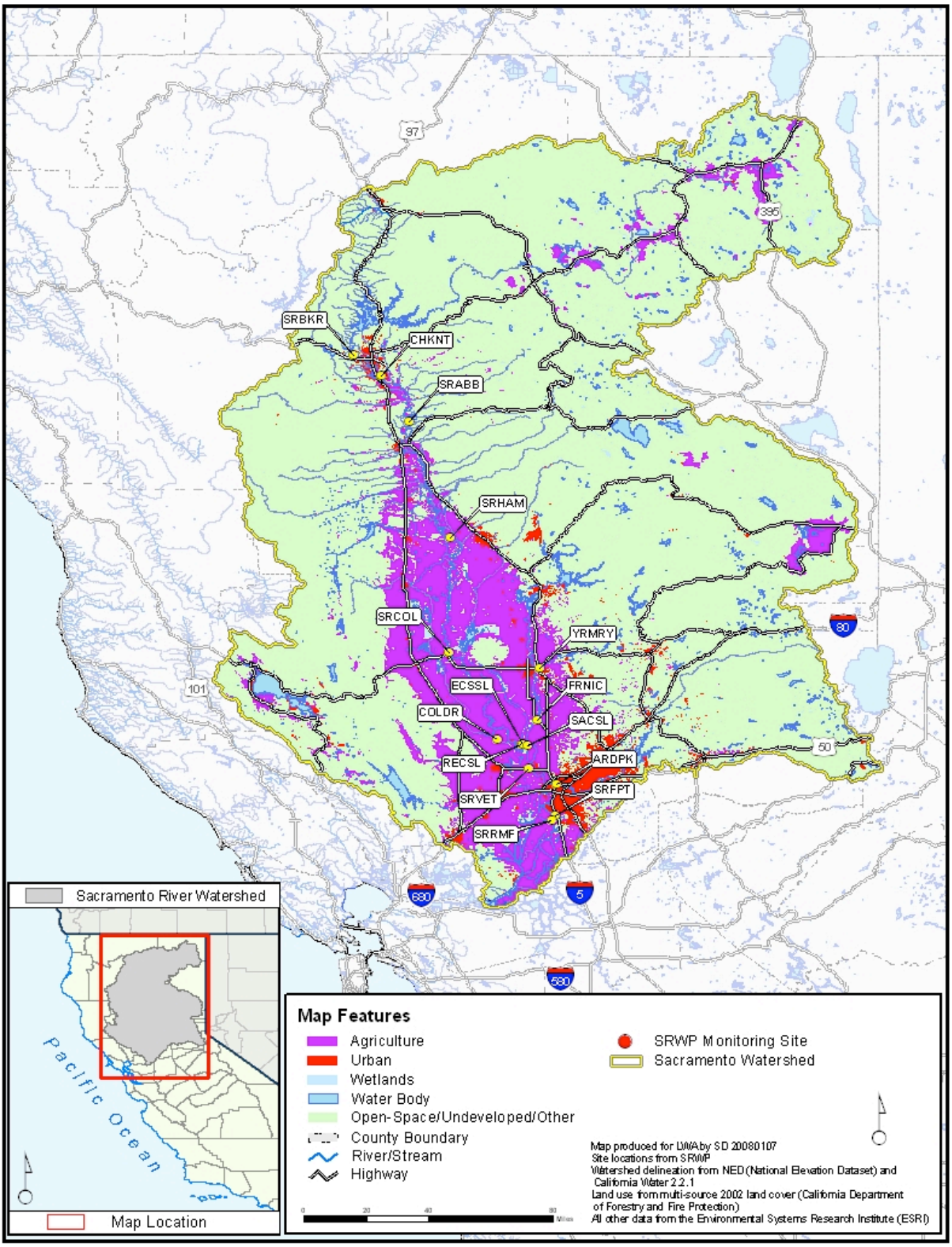


Figure 1. Major land uses in the Sacramento River Watershed.

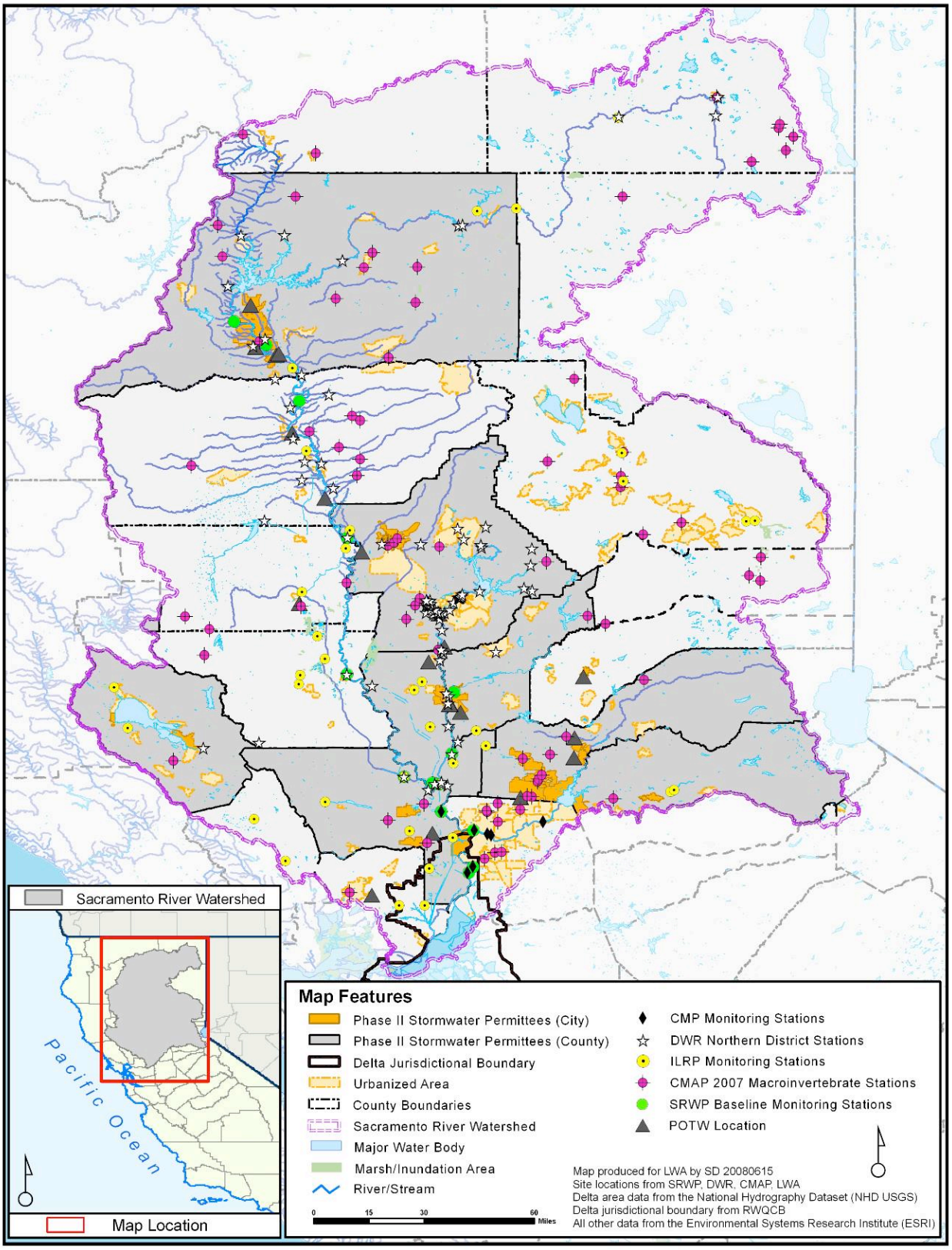


Figure 2. Ambient monitoring stations identified in the Sacramento River Watershed.

Thus far, the SRWP Monitoring Program has spent over $5 million through grant funding from the USEPA and more recently a Proposition 50 Watershed Program grant. SRWP monitoring stations included in the 2005-2007 monitoring cycle are shown in **Figure 3**. Most sites were along the mainstem of the Sacramento River and were sampled monthly. Monitoring included a broad set of measures:

- Water column three-species chronic toxicity testing
- Water column mercury, nutrients, pesticides, pathogens and pathogen indicator organisms
- Fish tissue mercury and trace organics
- Field measures

The data generated by the SRWP monitoring program formed the basis for monitoring reports. The results can be summarized in general terms by beneficial uses:

Use	Finding
Drinking Water	Drinking water quality is high
Recreation	Bacteria concentrations rarely above levels considered unsafe for contact recreation
Fish	Mercury levels in fish are a concern but are lower than mercury loadings in the watershed would suggest
Aquatic Life	* Toxicity is most prevalent at urban runoff sites * Toxicity very rare in mainstem river * Metals are generally not a problem despite historic mining contamination

Central Valley Irrigated Lands Regulatory Program

Senate Bill 390, signed into law on October 6, 1999, required the Regional Water Boards to review their existing waivers and to renew them or replace them with Waste Discharge Requirements. Under Senate Bill 390, waivers not reissued automatically expired on January 1, 2003. To comply with Senate Bill 390, the Regional Water Boards adopted revised waivers. The most controversial waivers were those for discharges from irrigated agriculture. The Sacramento Valley Water Quality Coalition (SVWQC) was formed in 2003 in response to this program[5]. The Coalition is comprised of more than 7,500 farmers and wetlands managers encompassing more than one million irrigated acres and supported by more than 200 agricultural representatives, natural resource professionals and local governments throughout the region.

Ten subwatershed groups comprise SVWQC, which is administered by the Northern California Water Association. SVWQC also coordinates with Ducks Unlimited, the Coalition for Urban Rural Environmental Stewardship and the California Rice Commission to implement a

[5] See more information on-line at http://www.svwqc.org/ and http://www.waterboards.ca.gov/centralvalley/programs/irrigated_lands/.

watershed-wide Monitoring and Reporting Program Plan. Today, the Coalition includes over 8,600 participants owning about 1.3 million irrigated acres. With the subwatershed groups, SVWQC is responsible for most Irrigated Lands Regulatory Program (ILRP) related monitoring in the watershed. The California Rice Commission conducts additional ILRP monitoring independently.

Stations monitored by SVWQC are identified in **Figure 2**. The monitoring data includes field measurements, non-pesticide chemistry, pesticide chemistry, metals and toxicity results for water and sediment for monitoring conducted by coalition groups, individual dischargers and by the Regional Board.

To date, SVWQC has produced two major program documents: (1) a Watershed Evaluation Report, which provides detailed descriptions of the ten subwatershed areas, and (2) a Monitoring and Reporting Program Plan. The monitoring plan includes field measures (e.g., pH, temperature, DO), nutrients, flow, sediments, salts, trace metals, pesticides, pathogen indicators, and water column and sediment toxicity. These program documents, updated to address the requirements of the revised Monitoring and Reporting Program adopted by the Central Valley Regional Board in January 2008, were approved in Fall 2008.

To date, ILRP monitoring requirements have been premised on a strategy of identifying upstream sources of significant toxicity or exceedances of relevant water quality objectives *in irrigated land runoff*. ILRP monitoring does not include receiving water stations or constituents of broad (but non-agriculture) concern. The initial strategy was to, expand monitoring activities upstream to identify the "general source" of toxicity or cause(s) of exceedances, to work with growers to implement practices intended to improve water quality, and to implement Management Plans to address repeated exceedances. The revised Monitoring and Reporting Program Plan will allow for greater focus on implementation.

The Sacramento Valley Integrated Regional Water Management Plan (IRWMP) was published in 2006 to provide a framework and forum to guide the development of water resources policies, programs, and projects at the local, regional, and state level. The comprehensive IRWMP mentions water quality monitoring with no details, referring to the ILRP monitoring efforts.

Municipal Wastewater Treatment Plants

Many municipal wastewater treatment plants (WWTPs) throughout the watershed are required to monitor pollutant levels in their effluent receiving waters. All of the WWTPs discharging more than 1 million gallons per day (MGD) are included in **Figure 2** and listed in **Table 3**. As tabulated, some WWTPs are required to monitor only basic water quality conditions (typically monthly), while others also are required to monitor priority pollutants at least once during their five-year permit term. All WWTPs monitor only in the vicinity of their outfalls and only during periods of discharge. The Sacramento Regional Wastewater Treatment Plant participates in the Coordinated Monitoring Program along with the City and Countywide stormwater programs. In addition, five other WWTPs discharge to the mainstem Sacramento River. All five WWTPs are required by their NPDES permits to monitor weekly or monthly for basic measures and annually for priority pollutants, at one upstream station and one downstream station.

Table 3. WWTPs in the Sacramento River Watershed >1 MGD as Average Dry Weather Flow and with Receiving Water Monitoring Requirements.

Agency Name	Facility Name	NPDES Permit No.	ADWDF (MGD)	Receiving Water	Receiving Water Monitoring[1,2]
Anderson, City of	Anderson Water Pollution Control Plant	CA0077704	2.0	Sacramento River	PP
Auburn, City of	Wastewater Treatment Plant	CA0077712	1.67	Auburn Ravine (trib. to Sacramento River)	Basic
Chico, City of	Chico Water Pollution Control Plant	CA0079081	9.0	Sacramento River	PP
City of Corning & ECO Resources Inc.	Corning Wastewater Treatment Plant	CA0004995	1.40	Sacramento River	PP
Davis, City of	Wastewater Treatment Plant	CA0079049	7.5	Willow Slough (trib. to Sacramento River)	Basic
Grass Valley, City of	Wastewater Treatment Plant	CA0079898	2.78	Wolf Creek	Basic
Linda County Water District	Wastewater Treatment Plant	CA0079651	1.8	Feather River	PP
Live Oak, City of	Wastewater Treatment Plant	CA0079022	1.4	Reclamation District 777 Lateral Drain No. 1 (trib. to Sutter Bypass)	Basic
Olivehurst PUD	Wastewater Treatment Plant	CA0077836	5.1	Western Pacific Interceptor Drainage Canal (trib. to Feather River)	Basic
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 1 Wastewater Treatment Plant	CA0079316	2.18	Rock Creek (trib. to Sacramento River)	Basic
Red Bluff, City of	Red Bluff Wastewater Reclamation Plant	CA0078891	2.5	Sacramento River	PP
Redding, City of	Stillwater Wastewater Treatment Facility	CA0082589	4.0	Sacramento River	PP
Redding, City of	Clear Creek Wastewater Treatment Plant	CA0079731	8.8	Sacramento River	PP
Roseville, City of	Dry Creek Wastewater Treatment Plant	CA0079502	18	Dry Creek	PP
Roseville, City of	Pleasant Grove Wastewater Treatment Plant	CA0084573	12	Pleasant Grove Creek	PP
Sacramento Regional County Sanitation District	Sacramento Regional Wastewater Treatment Plant	CA0077682	181	Sacramento River	PP
Sewerage Commission-Oroville Region	Wastewater Treatment Plant	CA0079235	6.5	Feather River	PP
Shasta Lake, City of	City of Shasta Lake Wastewater Treatment Facility	CA0079511	1.3	Churn Creek (trib. to Sacramento River)	PP
Vacaville, City of	Easterly Wastewater Treatment Plant	CA0077691	15	Old Alamo Creek	Basic
Willows, City of	Willows Wastewater Treatment Plant	CA0078034	1.2	Agricultural Drain C, Colusa Basin Drain	PP
Yuba City, City of	Wastewater Treatment Facility	CA0079260	10.5	Feather River	PP

1: PP - indicates that the POTW is required to do priority pollutant sampling in the receiving water at least once during its permit term.
2: Basic - indicates that the POTW is only required to complete conventional constituent sampling at receiving water locations.
3: SRCSD participates in the CMP. See text for details.

In 1991, the Sacramento Regional County Sanitation District (SRCSD) partnered with the City of Sacramento and Sacramento County's Water Resources Division to form the Coordinated Monitoring Program (CMP). The CMP is led by SRCSD. The CMP demonstrates an effective regional monitoring effort through its goals of collaboration, coordination and communication. CMP researchers collect water samples 6-8 times per year at three locations on the Sacramento River and two locations on the American River. This monitoring satisfies permit requirements for both the wastewater and stormwater programs. Regulatory agencies use CMP data to develop policies whereas other public agencies and private stakeholders track changes in ambient water quality and watershed trends. CMP monitoring stations are also shown in **Figure 2**. The annual budget for this program is approximately $300,000.

Stormwater Management Programs

In 1990, USEPA promulgated "Phase I" regulations, permitting storm water discharges from industrial sites (including construction sites that disturb five acres or more) and from municipal separate storm sewer systems (MS4s) serving a population of 100,000 people or more. In 1999, USEPA promulgated "Phase II" regulations, requiring permits for storm water discharges from Small MS4s and from construction sites disturbing between one and five acres of land and from designated MS4s. This permit refers to MS4s that operate throughout a community as "traditional MS4s" and MS4s that are similar to traditional MS4s but operated at a separate campus or facility as "non-traditional MS4s." Traditional MS4s include any city with a population of greater than 50,000 and other areas that may be designated for various reasons such as high population density or growth, significant contributor to another MS4's system, discharges to a sensitive water body, or discharges significant amounts of pollution.

Urbanized areas within the Sacramento River watershed are shown in **Figure 1** and **Figure 2**. The only Phase I municipalities in the watershed are the co-permittees joined in the Sacramento Stormwater Quality Partnership (County of Sacramento and the Cities of Sacramento, Citrus Heights, Elk Grove, Folsom, Galt, and Rancho Cordova). The Partnership monitors major receiving water stations through the CMP (see previous section). While the City of Roseville is a Phase II municipality, it tends to have a higher level of effort in stormwater management than other Phase II programs.

A draft of the statewide General Permit for Storm Water Discharges Associated Construction and Land Disturbance Activities (or the "Construction General Permit") is currently being reviewed[6]. Under the most recent draft permit, issued in March 2008, all dischargers subject to the General Permit will be required to develop and implement a Construction Site Monitoring Program. Requirements by designated risk levels are provided in **Table 4**.

The discharger would have to obtain any required receiving water samples from a representative location as close as possible and upstream/downstream from the effluent discharge point. Thus, there would seem to be little opportunity to include these temporary project areas in an RMP for the mainstem Sacramento River. Nonetheless, the draft permit's conditions allow dischargers to participate in watershed-based monitoring programs in lieu of some receiving water monitoring requirements. The Regional Water Board may approve such proposals, provided the watershed-based monitoring program will provide substantially similar monitoring information in

[6] See http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml.

evaluating discharger compliance with the requirements of the general permit. While it remains to be seen what receiving water monitoring may be required of construction sites in the final permit (anticipated by summer 2009), it is possible that the construction and development community may be interested in participating in an RMP.

Table 4. Receiving Water Monitoring Requirements by Risk Level for Construction Permittees

Risk Level[1]	Trigger	Receiving Water Monitoring Parameters
1	Not required	Not required
2	If No Effect Level exceeded, next sampling event shall include monitoring	Turbidity, pH, and suspended sediment concentration (if turbidity No Effect Level exceeded)
3	No trigger—all sampling events shall include effluent and receiving water monitoring	Turbidity, pH, SSC and bioassessment (before and during construction)

[1] Risk level is determined based on results of a Construction Project Risk Worksheet, which takes into account parameters such as poximity of the project to receiving waters, size of project, rainfall erosivity during mass grading, soil erodibility, runoff potential of soils, sheet flow length and slope steepness, and proposed sediment basin design.

Traditional MS4s in the Sacramento River watershed (including areas draining to the Yolo Bypass) are shown in **Table 5**. The state's Phase II MS4 general permit expired 30 April 2008 but is continued while the new permit is being developed. Receiving water monitoring was not required in the original 2003 permit and receiving water monitoring requirements have not yet been determined for the reissued permit. In general the Phase II community has argued against receiving water monitoring requirements, which is consistent with USEPA's approach to the first round of Phase II MS4s permits.

In addition, there are approximately 130 non-traditional MS4s in the Sacramento River watershed designated in the current permit, although essentially no action has been taken to regulate them to date. The Regional Board has the discretion to prioritize and issue permits to the non-traditional MS4s. At the current time, there is a low probability that non-traditional MS4s would be interested in participating in an RMP in the near future. However, this may change based on the requirements of the Phase II permit once it is reissued.

Table 5. Phase II Municipal Separate Storm Sewer Systems (MS4s) in the Sacramento River Watershed.

MS4 Area	Type [1]	Population [2]	Urbanized Area (mi^2) [3]
Anderson	City	9,022	3.1
Auburn	City	12,462	4.8
Butte	County	203,171	73.8
Chico	City	59,954	14.6
Clearlake	City	13,142	5.2
Davis	City	60,308	8.9
El Dorado	County	156,299	31.9
El Dorado Hills	CDP	18,016	4.8
Granite Bay	CDP	19,388	9.9
Grass Valley	City	10,922	3.4
Lake	County	58,309	30.2
Lakeport	City	4,820	2.1
Lincoln	City	11,205	4.6
Linda	CDP	13,474	3.6
Loomis	Town	6,260	2.8
Marysville	City	12,268	2.7
North Auburn	CDP	11,847	4.2
Olivehurst	CDP	11,061	2.8
Placer	County	248,399	80.0
Placerville	City	9,610	4.2
Redding	City	80,865	33.7
Rocklin	City	36,330	9.6
Roseville	City	79,921	19.9
Shasta	County	163,256	69.4
Shasta Lake	City	9,008	4.3
South Yuba City	CDP	12,651	2.2
Sutter	County	78,930	18.2
West Sacramento	City	31,615	10.8
Woodland	City	49,151	9.6
Yolo	County	168,660	47.8
Yuba	County	60,219	25.7
Yuba City	City	36,758	7.4

[1] CDP = Census-designated place

[2] Urbanized Area Calculated from:
Census 2000 Census “Place Polygon” layer
Department of Conservation 1996 “County Boundary” layer
CA Dept. of Forestry and Fire 2002 “Land Use” layer
LWA edited State Water Resources Control Board

[3] Source: US Census Bureau, 2000 Census, www.census.gov

California Monitoring and Assessment Program (CMAP)

The California Monitoring and Assessment Program (CMAP) for wadeable perennial streams[7] was initiated in 2004. This program builds on USEPA’s Environmental Monitoring and

[7] See on-line at http://www.swrcb.ca.gov/swamp/docs/swa_nwqmc.pdf.

Assessment Program (EMAP). A probabilistic monitoring design incorporating land use classes will allow for assessments of status and trends in aquatic life beneficial use protection in streams. The program's goals are to:

- Provide a framework for producing valid condition assessments for perennial streams in California,
- Develop tools to facilitate these assessments, and
- Evaluate associations between stream condition and nonpoint source land use categories.

EMAP and CMAP are mainly based on benthic macroinvertebrate assessments. Algae collected at some CMAP sites were analyzed for Chlorophyll *a*. Water column analytes included major nutrients. Sediment samples were not collected during this study—only physical habitat conditions such as thalweg, channel and riparian cross-sections, and pebble embeddiness. Historic EMAP data were analyzed to produce assessments of the condition of streams statewide and in special study areas in northern and southern coastal California.

CMAP was completed in 2007. The present Perennial Streams Study, which is an extension of the EMAP and CMAP studies, includes additional indicators such as California Rapid Assessment Method for riparian corridors and periphyton assessment to work on an Indices of Biotic Integrity development. This effort, aimed at developing a coordinated and comprehensive statewide monitoring design, would integrate bioassessment efforts currently funded through the State's Surface Water Ambient Monitoring Program (SWAMP) and the Nonpoint Source Program with existing local and regional bioassessment efforts.

A key feature of the design would be to identify relationships between land-use stressors and response indicators. SWAMP is beginning long-term trends assessment in large watersheds. This assessment consists of 100 sites at the bottom of large watersheds for a minimum five-year study. Some of the assessments include sediment toxicity and chemistry, but no bioassessment. The Nonpoint Source Program is contemplating supporting a long-term assessment (sediment toxicity and chemistry) with SWAMP in smaller watersheds with only 1 or 2 land uses to look at Best Management Practices effectiveness and trends.

Also, SWAMP and CDFG have been working on establishing the data needed for bioassessment programs in California for many years. The goal is to eventually have biocriteria integrated into water quality objectives. For various reasons, this process has been very slow-going for the Central Valley region.

Department of Water Resources

The California Department of Water Resources (DWR) has been conducting basic water quality data collection for about 40 years, as part of its legislative mandate and pursuant to requirements of water rights and take permits. Hundreds of surface water and groundwater stations have been sampled over the years[8]. Currently, DWR monitors water quality at approximately 45 surface water stations in the Sacramento River watershed, not including additional Feather River stations associated with the State Water Project. All stations have continuous temperature loggers, and

[8] Available data can be accessed at http://wdl.water.ca.gov/.

most are sampled for a broad suite of constituents quarterly. In addition, DWR monitors hundreds of groundwater wells throughout the watershed.

DWR is currently working with the Regional Water Board SWAMP staff to configure a joint monitoring program for the Sacramento River watershed, combining their funding and addressing their respective programmatic goals and objectives. This effort will run through 2010. All of these data will be available in a SWAMP-compatible database.

FERC Relicensing

The Federal Energy Regulatory Commission (FERC) regulates and oversees energy industries. With respect to hydroelectric projects, FERC safeguards the environment by requiring that all hydropower license applicants communicate with federal and state natural resources agencies, Indian tribes, and state water quality agencies prior to submitting an application to FERC; ensuring that all license applicants perform the necessary studies to base an informed decision on the project; issuing draft Environmental Assessments or draft Environmental Impact Statements for comment; and incorporating license requirements designed to reduce environmental impacts. Several FERC relicensing efforts[9] have potential overlap with an RMP:

- Placer County Water Agency Middle Fork Project (http://relicensing.pcwa.net/): relicensing just beginning; ongoing recreational/water quality investigations and planning including fish mercury and stream temperature.
- El Dorado Irrigation District Project 184 South Fork American River (http://www.project184.org/): relicensing complete, ongoing recreational/water quality requirements; monitoring efforts focus on maintaining minimum water levels in lakes and flows in downstream creeks.
- Conjunctive a) Sacramento Municipal Utility District Upper American River Project on Rubicon River and South Fork American River and b) Pacific Gas & Electric Chili Bar Project South Fork American River (http://hydrorelicensing.smud.org/project.htm): relicensing complete, ongoing recreational/water quality requirements.
- Nevada Irrigation District's Yuba-Bear Hydroelectric Project
- Pacific Gas & Electric's Drum-Spaulding Project and various Feather River projects (e.g., Poe, North Fork Feather River)

A key point is that the monitoring requirements are all negotiated, both for relicensing applications and for post-licensing compliance.

Finally, Pacific Gas & Electric's stewardship council[10], created as part of their bankruptcy, resulted in management plans being developed throughout Northern California. The council's 2007 Land Conservation Plan does not address water quality monitoring, even though the plan is organized by watershed. Nonetheless, monitoring could be done in conjunction with some project areas.

---

[9] All FERC projects in the Southwest (including CA) are listed at http://www.ferc.gov/for-citizens/projectsearch/SearchProjects.aspx?Region=Southwest.

[10] See http://lcp.stewardshipcouncil.org/

Other Monitoring Activities

The California Department of Fish and Game (CDFG) operates six hatcheries in the watershed, none of which are on the mainstem Sacramento River[11]. Each of these facilities has an NPDES permit for its discharges. Their permits require water quality monitoring monthly of inflows, discharges, and at one station 100-300 yards downstream in the receiving water for conventional parameters (TSS, pH, temperature, dissolved oxygen, total dissolved solids, chloride).

The CA Department of Pesticide Regulations (pers. comm., S. Gill to S. McCord, 11/20/08) does not conduct any long-term monitoring currently, because the Irrigated Lands Regulatory Program is responsible for such activities. Instead, they perform targeted monitoring of high-use pesticides in specific agricultural areas, none of which are currently in the Sacramento River watershed. Also, some focus has shifted to urban monitoring, including the Sacramento urban area. The Department has contributed to other monitoring efforts in the past, but would generally be more amenable to participating with in-kind services such as providing laboratory analysis of samples for pesticide concentrations.

The US Army Corps of Engineers monitors water quality as a mitigation measure for its dredging projects. The only such project in the watershed at this time is in the Sacramento Deep-water Shipping Channel (pers. comm., S. McCord to B. Schlenker, 12/10/08).

US Forest Service staff indicated that any monitoring associated with their operations would be done by the US Fish and Wildlife Service (USFWS). USFWS has signed a Memorandum of Agreement with USEPA and the National Marine Fisheries Service addressing interagency coordination under the Clean Water Act and Endangered Species Act. But monitoring appears to be done for special studies rather than as a consistent, baseline component of their operations.

The US Bureau of Reclamation's (USBR's) Mid-Pacific Regional office monitors water quality in the Sacramento River watershed to address specific objectives: create a historical record of baseline water quality for USBR-managed surface waters; monitor water delivered from USBR reservoirs within the Mid-Pacific Region; and assess suitability for applicable downstream uses by comparing analyte concentrations with applicable water quality criteria. Monitoring stations within the watershed have typically been located below the USBR-operated reservoirs: Shasta, Whiskeytown, Keswick and Red Bluff Forebay on the Sacramento River, and Clementine, Folsom and Natoma on the American River. Analytes typically include all priority pollutants and conventional measures. USBR's monitoring program over the past 10 years has not been well coordinated with other similar efforts in the watershed, and its database is not currently accessible to the public. However, USBR is planning to make its monitoring data more accessible. In addition, USBR's Shasta office maintains a set of continuous sensors for temperature, dissolved oxygen and turbidity that upload data automatically to the California Data Exchange Center (CDEC) (pers. comm., S. Angerer and L. Benninger to S. McCord, 12/16/08).

SACRAMENTO-SAN JOAQUIN RIVERS' DELTA

At its downstream end, the Sacramento River drains into the Sacramento-San Joaquin Rivers' Delta (Delta), a series of hundreds of miles of interconnected channels and sloughs that comprise the tidally-influenced, brackish water element of the San Francisco Estuary. The Delta covers

[11] A map indicating all hatcheries in the state is available at http://www.dfg.ca.gov/fish/Hatcheries/HatList.asp.

approximately 738,000 acres in Alameda, Contra Costa, Sacramento, San Joaquin, Solano and Yolo counties. The Delta and surrounding region include the following discharges:

- Sacramento, Tracy, and Stockton urban areas and other smaller urbanized areas (municipal stormwater and wastewater discharge permittees)
- Yolo Bypass (federal/regional flood control structure, managed wildlife area, agricultural area, urban areas)
- Major tributary inflows (Sacramento, Cosumnes, Mokelumne, and San Joaquin Rivers)
- Delta islands agricultural discharges

Approximately 1,800 agricultural water diversions divert in excess of 10% of mean annual Delta inflow in an average dry year. Surface waters of the Delta and upstream watersheds provide drinking water supplies for more then 65% of California's population. Remaining water discharges through the Delta into San Francisco Bay and on to the Pacific Ocean under the Golden Gate Bridge. The Sacramento River connects along the northern portion of the Delta and comprises the major freshwater input to the Delta and larger San Francisco Estuary. Other major rivers contributing flows to the estuary include the Cosumnes, Mokelumne, and San Joaquin Rivers, which connect to the Delta from the east and south. In total, over $7 million is spent annually for water quality monitoring in the Delta.

The Sacramento River connects along the northern portion of the Delta and comprises the major freshwater input to the San Francisco Estuary. The Delta is listed as impaired for a variety of toxic contaminants. Surface waters of the Delta and upstream watersheds provide drinking water supplies for more then 65% of California's population.

The Delta is listed as impaired for a variety of toxic contaminants including pesticides, mercury, unknown toxicity, and oxygen demanding substances that cause critically low dissolved oxygen (DO). In addition, there is concern that a number of emerging contaminants could impact beneficial uses such as heavy metals and other naturally occurring elements, pharmaceuticals and endocrine disrupting compounds, and blue-green algae blooms. Potential constituents of concern for assessing impacts to the pelagic organisms in the Delta are noted to be ammonia/nutrients, toxicity, pesticides, mercury, and metals[12].

There are several ongoing programs that address water quality in the Delta, including[13]:

- Governor Schwarzenegger's "Action Plan for California's Environment" includes protection for California's water supply and water quality through watershed management efforts that foster accountability and action.

[12] State Water Resources Control Board, Central Valley Regional Water Quality, Control Board, and San Francisco Bay Regional Water Quality Control Board (2008). "Strategic Workplan for Activities in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary." June 2008 draft.

[13] Much of this information was taken directly from Central Valley Regional Water Board Resolution No. R5-2007-0161, "Water Boards' Actions to Protect Beneficial Uses of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary".

- The Governor signed Executive Order S-17-06 to require development of a durable vision for sustainable management of the Delta (Delta Vision). The Water Boards will respond to changes in Delta management proposed through this process and will establish appropriate balancing of water supply and other beneficial uses of water.
- The CALFED Record of Decision proposed completion of a Delta Risk Management Strategy that would look at sustainability of the Delta, and that would assess major risks to Delta resources from floods, seepage, subsidence, and earthquakes. The Strategy would also evaluate the consequences, and develop recommendations to manage the risk.
- In October of 2006 water users (including DWR) plus USBR, CDFG, USFWS, the National Marine Fisheries Service (NOAA Fisheries), and other interested persons began an effort to develop a comprehensive conservation plan for the Bay-Delta referred to as the Bay-Delta Conservation Plan (BDCP). The BDCP is a voluntary mechanism to provide water users in the Delta with compliance with Federal Endangered Species Act, California Endangered Species Act or the Natural Community's Conservation Plan Act. The BDCP Steering Committee is currently evaluating conservation strategy options that include changing water conveyance methods in the Delta.
- The Interagency Ecological Program (IEP) for the Bay-Delta consists of ten member agencies: three State agencies (DWR, CDFG, and the State Water Board); six Federal agencies (USFWS, USBR, Geological Survey, Army Corps of Engineers, NOAA Fisheries, and USEPA); and one non-government organization (SFEI). The IEP was initially established to investigate the impacts of the State Water Project and Central Valley Project, and became the vehicle to meet the environmental monitoring requirements placed on the State and Central Valley Projects by the State Water Board in its water right decisions. IEP has since expanded its role to conduct additional research, monitoring and analyses. In the past few years, IEP has taken on primary responsibility for conducting POD research.
- The CALFED Bay-Delta Program (see calwater.ca.gov) was formed in 2000 as a 30-year cooperative effort between 25 State and federal agencies to improve the quality and reliability of California's water supplies while restoring the Bay-Delta ecosystem. The CALFED agencies are currently developing performance measures and a comprehensive monitoring, assessment, and research plan to meet the monitoring needs of CALFED and evaluate the success of its programs. Dr. Sam Luoma initiated the development of a monitoring framework for the Bay-Delta.
- In December 2006 the State Water Board adopted a Water Quality Control Plan for the Bay-Delta (Bay-Delta Plan) to protect beneficial uses. This Bay-Delta Plan identified four emerging issues that all require additional action by the State Water Board: (1) Delta and Central Valley salinity, (2) San Joaquin River flows, (3) pelagic organism decline, and (4) climate change.
- The Water Boards' Water Quality Control Plans include objectives for many constituents that threaten drinking water sources. However, some constituents are not addressed, specifically pathogens, organic carbon, and bromide. The Central Valley Regional Water Board is currently developing a drinking water policy to address these issues.

- The State Board, Central Valley and Bay Area Regional Board's co-developed a "Strategic Workplan for Activities in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary" to guide their efforts in the Delta over the next several years.

DWR's Municipal Water Quality Investigation (MWQI) program actively monitors Delta water quality for drinking water interests. Consequently, the data are largely for nutrients, organic carbon, pathogen indicators, and salinity. The current annual budget for the MWQI program is $3.1 million, which is funded by the State Water Contractors. MWQI and its associated funding are separate from the IEP monitoring conducted under the Environmental Monitoring Program. While MWQI maintains monitoring stations at Contra Cost Pumping Plant, H.O. Banks Pumping Plant and the Delta-Mendota Canal intake, there are also stations distributed across the Delta and other locations. The monitoring conducted by the Environmental Monitoring Program (IEP) is mandated by water rights decision 1641; the MWQI program has no such requirements.

Discharge points and monitoring stations identified in the Delta are shown in **Figure 3**. In addition to those withdrawal and discharge points shown, there are approximately 260 agricultural discharges in the Delta. The Water Board's ILRP requires monitoring to characterize agricultural-related drainage in the Delta but does not specifically require monitoring of all the drainage discharged from islands directly into Delta waterways *or of receiving water quality*. To comply with the ILRP requirements, the San Joaquin County and Delta Water Quality Coalition monitors agricultural drains on several Delta islands; however, only two of those drains discharge directly to Delta waterways.

A number of monitoring programs are not represented on this figure, including the San Joaquin County and Delta Water Quality Coalition, IEP Environmental Monitoring Program (both discrete and continuous), USGS flow stations, USGS NAWQA, San Francisco RMP (two stations in Delta), DWR Central District surface water monitoring, and Contra Costa Water District surface water monitoring. The Central Valley Watershed Monitoring Directory (www.centralvalleymonitoring.org) will contain information regarding these programs. The Aquatic Science Center is currently preparing a report that summarizes existing water quality monitoring programs in the Delta, due for public release in the spring of 2009.

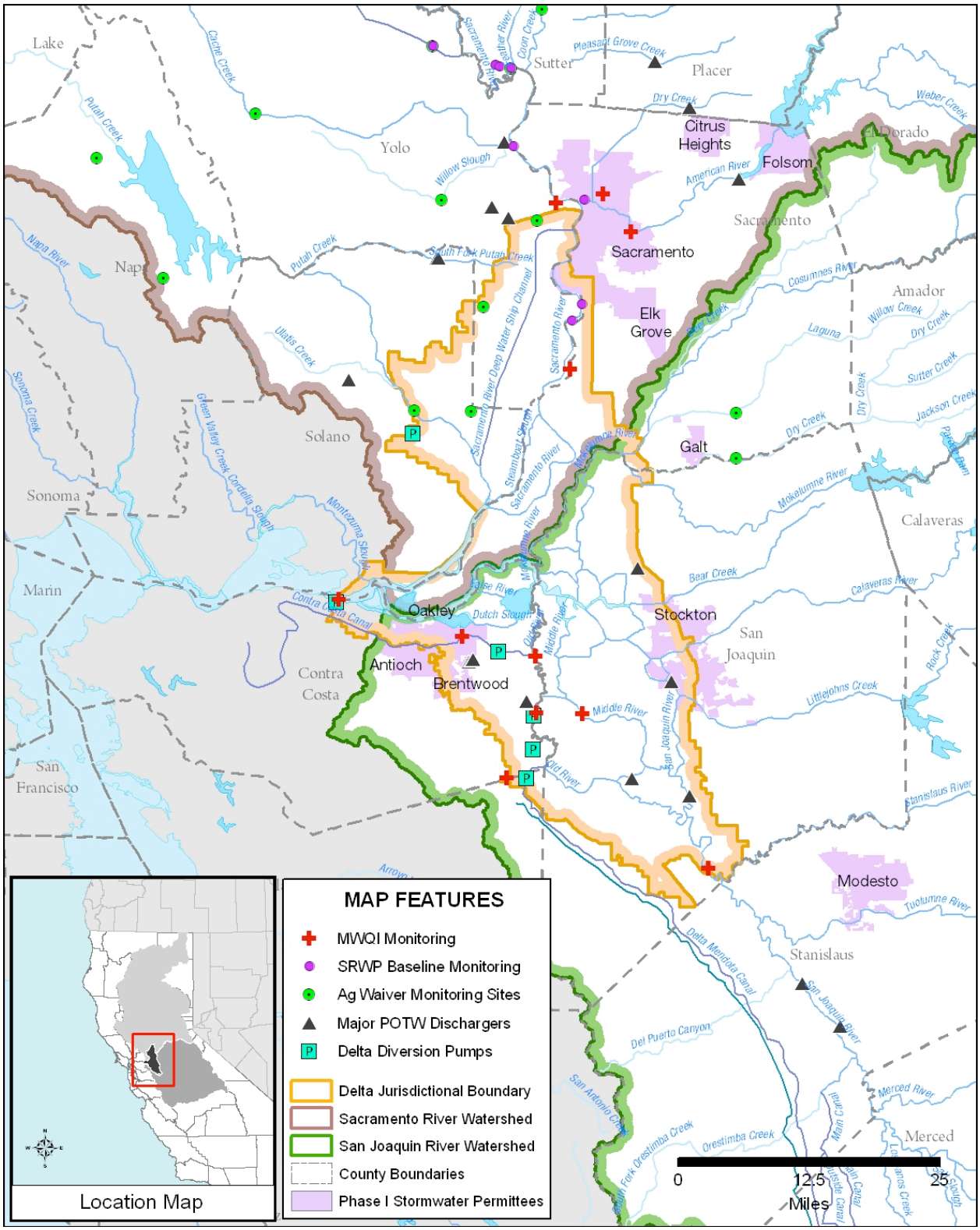


Figure 3. Representative Delta monitoring stations. "Ag Waiver" is now referred to as the Irrigated Lands Regulatory Program.

Supporting Efforts

Several ongoing efforts support the development of an RMP for the Sacramento River watershed. Such efforts are described in this section, drawing particular attention to opportunities for collaboration or use in developing and implementing an RMP for the Sacramento River watershed.

Several ongoing efforts support the development of an RMP for the Sacramento River watershed: Central Valley Regional Water Board's Delta RMP Strategy, CALFED, various State Board Actions, Statewide Watershed Program, Aquatic Science Center, San Joaquin River Basin Monitoring Partnership Project, and NWQMC Bay-Delta Pilot Study.

CENTRAL VALLEY REGIONAL WATER BOARD'S DELTA RMP STRATEGY

The Regional Water Board is focusing on improving the regulation and management of water and sediment quality in the Delta. Central Valley Regional Water Board Resolution R5-2007-0161 recognized the relatively poor understanding of water quality conditions in the Delta relative to its importance in stating:

> Many agencies and groups monitor water quality, water flows, and ecological conditions in the Bay-Delta, but there is no comprehensive contaminants monitoring assessment program. IEP, CALFED, and other organizations, including the Water Boards, conduct some of these analyses, but due to their specific mandates, information gaps may exist. Emerging concerns with contaminants related to the POD, waste water treatment plant discharges, agricultural discharges, pesticides, blue-green algae toxicity, and unknown toxicity events all highlight the need to improve contaminants monitoring. A system is needed for coordinating among monitoring programs and integrating contaminants monitoring into existing monitoring efforts whereby all data are is synthesized and assessed on a regular basis. An example of such a program is the San Francisco Bay Regional Monitoring Program (RMP).

On July 16, 2008, the State Water Board adopted Resolution 2008-0056 approving the "Strategic Workplan for Activities in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary". Towards this end, the State Water Board has already executed a $150,000 contract with UC Davis to compile the contaminants synthesis report, which will be completed in spring 2009. The Central Valley Regional Water Board initiated a $200,000 contract with the Aquatic Science Center to gather information, coordinate stakeholder and expert panel review, and develop recommendations for a Delta RMP.

Initially, the geographic scope of the Delta RMP is the legal Delta—including those portions of the Sacramento and San Joaquin Rivers within the legal Delta—and the entire Yolo Bypass. Although tributaries upstream of the legal Delta are not the initial focus, they may become important elements of a Delta RMP to the extent that Delta water quality issues are affected by or linked to upstream tributaries. Similarly, the Delta RMP will be designed to coordinate monitoring that is being conducted within the legal boundaries of the Delta. The workplan proposes a timeline for developing a "phase 1" RMP by the end of 2009, to be implemented in early 2010. The purpose of phase 1 (pilot phase) is to:

- Build interest, involvement, and momentum by answering interesting and important questions that require a comprehensive, regional view;
- Develop capabilities for regularly compiling, synthesizing, and reporting data from existing, ongoing monitoring efforts; and
- Use this effort as a proof of concept that sets the stage and creates capabilities needed for the longer-term regional monitoring.

CALFED

Developed for the CALFED Bay-Delta Program, the Comprehensive Monitoring, Assessment and Research Program (CMARP) is designed to provide understanding of the processes in the Bay-Delta and its watershed relevant to CALFED program actions. The CMARP Inventory[14] identifies existing environmental monitoring programs in the CALFED regions. Information about programs in the inventory includes program objectives, questions addressed through monitoring, spatial coverage, parameters monitored, and primary contact.

In the late 1990s and again in the early 2000s, agencies and stakeholders attempted to develop an RMP for the Delta under CMARP. However, these efforts failed to establish a sustainable and fundable program primarily because the program was too ambitious.

The CALFED Science Program is currently considering a proposal to develop a strategic plan for monitoring in the Delta. Once contracts are in place, the project is scheduled to be complete in 18 months. The focus of the strategy is on agencies to answer broad questions from the public and legislature, but there is the potential for bringing dischargers into the program. SRWP has pointed out to the project proponents that they should add a task to summarize regulatory program requirements (i.e., what permitted dischargers and project proponents have to monitor now that could be folded into a regional program) and then propose regulatory options that provide for participation in an RMP.

STATE BOARD ACTIONS

The State Board has been extremely active recently in developing and revising policy and programs with RMP elements. Relevant activities are described in this section.

SWAMP Database

The Surface Water Ambient Monitoring Program (SWAMP) was proposed in a report to the state legislature to integrate existing water quality monitoring activities of the State Water Board and the Regional Water Boards, and to coordinate with other monitoring programs[15].

There is a renewed effort to make that task a routine process for most environmental monitoring projects in the state. The following surface water monitoring programs were included as part of SWAMP: State Mussel Watch, Toxic Substance Monitoring Program, Toxicity Testing Program, Perennial Streams Assessment, and Coastal Fish Contamination Program. The Citizen Monitoring Program is also being increasingly coordinated with SWAMP. SWAMP also hopes

[14] The inventory is available at http://www.sfei.org/cmarpquery/.

[15] See www.swrcb.ca.gov/swamp/.

to capture monitoring information collected under other State and Regional Board Programs such as the State's TMDL, Nonpoint Source, and Watershed Project Support programs.

Recently, the California State Grants Program and SWAMP have been required to make their results publicly available in standardized formats, with specific quality assurance/quality control (QA/QC) documentation. SWAMP has been working with other state, scientific, and educational agencies for several years to develop a distributed data management system whereby systematically formatted ambient monitoring data will be loaded into distributed data management systems and routed to the California Environmental Data Exchange Network, which is currently functioning under the Bay Delta and Tributaries Project[16]. The Project contains environmental data relevant to the San Francisco Bay-Delta, including biological, water quality, and meteorological data, and provides public access to that data. Over 50 organizations contribute data voluntarily to this project.

California Water Quality Monitoring Council

Senate Bill 1070 required the California Environmental Protection Agency and the Resources Agency, on or before December 1, 2007, to enter into a memorandum of understanding for the purposes of establishing the California Water Quality Monitoring Council[17]. The Council recently reported its recommendations for maximizing the efficiency and effectiveness of existing water quality data collection and dissemination, and for ensuring that collected data are maintained and available for use by decision-makers and the public.

The Council is expected to prepare recommendations for the ultimate development of a cost-effective, coordinated, integrated, and comprehensive statewide network for collecting and disseminating water quality information and ongoing assessments of the health of the state's waters and the effectiveness of programs to protect and improve the quality of those waters. The Council will then be involved in an advisory role as the state agencies implement the requirements of SB 1070 over a ten-year period.

The Council and others throughout the state—particularly USEPA Region IX—have taken considerable strides towards developing a better communal understanding of issues. A conference call in January 2009 included participants sharing on projects in the Central Coast, Klamath Basin, San Joaquin River Watershed and the Delta. Four requests of the Council were: (1) recognize all such regional efforts by establishing an RMP subcommittee and including non-agency RMP efforts in the statewide inventory, (2) provide technical transfer opportunities through trainings or workshops, (3) develop regional data centers, and (4) include links to RMP efforts on the Council's web site.

SWAMP Study of Permit-required Monitoring

SWAMP has initiated a pilot study to determine the feasibility of using NPDES permit-required ambient, receiving water monitoring data for regional water quality assessment in the Delta. Steps being taken at this time include: (1) collect all chronic toxicity and receiving water

---

[16] See on-line at http://bdat.ca.gov/.

[17] For information on the bill, see http://www.leginfo.ca.gov/pub/05-06/bill/sen/sb_1051-1100/sb_1070_bill_20060929_chaptered.html. For more information on the Council, see www.waterboards.ca.gov/water_issues/programs/monitoring_council/.

monitoring data back to 2000 for 13 Delta dischargers, (2) assess usefulness, focusing on certain pollutants and uses (fishable, swimmable, aquatic life), (3) assess SWAMP-compatibility of the available data, and (4) evaluate opportunities to improve. Mike Johnson, UC Davis, is managing the project to compile and assess the available data. At this time, metadata are not available for review.

Stormwater Permit Program

On September 2, 2008 the State Board adopted Version 4 of its Strategic Plan. Board Member Gary Wolff requested changes to the language that impacted the Phase II stormwater permit re-issuance. Following is an excerpt of the language that was adopted:

> Action 6.2.1. Pursuant to Section 13383.7 of the Water Code, by July 1, 2009 the State Board will develop guidance for evaluating and measuring the effectiveness of municipal storm water permits, including guidance on how to measure reductions of pollutant loads and improvements in the quality of receiving water in a statistically and scientifically valid manner. Unless infeasible in the timeframe specified by the legislature, the guidance document will also apply to non-municipal storm water permits issued by the state. The Water Boards will rely on this guidance in developing all subsequent stormwater permits, commencing with the reissuance of the statewide storm water permit for Phase II municipal separate storm sewer systems (MS4s), anticipated to occur in mid 2009. That permit will create a baseline for consistency in the municipal storm water permitting program, including items covered in the guidance document and, to the extent feasible, other issues that have been raised regarding the Phase I MS4s, including hydromodification and the use of numeric benchmarks, action limits, or effluent limitations. The State Board anticipates that solutions developed in the guidance document and the reissued Phase II permit will be used by Regional Boards to revise Phase I permits around the State in subsequent years. If that does not occur, the State Board will initiate focused statewide policies to ensure appropriate consistency in stormwater permitting.

This Action, if completed, would likely require receiving water monitoring by all of the Phase II stormwater permittees listed above in section "Stormwater Management Programs".

Recycled Water Policy

Recycled Water Stakeholders Group presented to the State Board a Final Draft Recycled Water Policy on August 28, 2008. The draft policy calls for the State Board to establish a mandate to increase the use of recycled water in California by 200,000 acre-feet per year by 2020 and by an additional 300,000 acre-feet per year by 2030. Among other requirements, salt and nutrient plans would have to be completed within five years; each plan requiring a basin / sub-basin wide monitoring plan that includes an appropriate network of monitoring stations (generally existing wells rather than surface water). The stakeholders would be required to compile monitoring data and report those data to the Regional Water Board at least every three years. The State Water Board will request DWR to provide $20 million for the development of salt and nutrient management plans during the next three years (i.e., before FY 2010/2011).

STATEWIDE WATERSHED PROGRAM

The purpose of the CA Department of Conservation's Statewide Watershed Program, an extension of the previous CALFED Bay-Delta Watershed Program, is to advance sustainable

watershed-based management of California's natural resources through community-based strategies[18]. To date, the program's staff has conducted over 40 meetings attended by over 1500 people who have provided over 2000 comments. A draft program framework will be circulated for comment in 2009.

AQUATIC SCIENCE CENTER

Effective July 1, 2007, the State Water Resources Control Board created a Joint Powers Agreement[19] entered into by and between the State Water Board and the Bay Area Clean Water Agencies for the purpose of creating an agency known as the "Aquatic Science Center" and to use SFEI as its administrator. The Agreement was the culmination of five years of effort. The Center expands SFEI's role to include technical support to a wider audience and its geographic focus to include all areas tributary to the Bay-Delta estuary (thus including all of the Central Valley).

The Agreement was set up to facilitate state and federal grant funding to SFEI as a separate public agency, which was problematic for SFEI as a non-profit organization. The Governing Board of Directors for the Aquatic Science Center at a minimum is composed of the following:

- Deputy Director, Division of Water Quality, State Water Resources Control Board
- Executive Officer, San Francisco Bay Regional Water Quality Control Board
- Executive Officer, Central Valley Regional Water Quality Control Board
- Division Director, Water Division, USEPA Region IX
- Three directors appointed by Bay Area Clean Water Agencies

The Governing Board of Directors may from time to time appoint one or more advisory committees or establish advisory entities. Any advisory committees formed would include, as one of its members, a representative of SFEI and a representative from the Regional Water Board. One potential format for advisory entities is to have four regional watershed-based steering committees (Bay, Delta, San Joaquin River and Sacramento River).

SAN JOAQUIN RIVER BASIN MONITORING PARTNERSHIP PROJECT

While several entities monitor surface water quality in the San Joaquin River Watershed, there is no entity to coordinate those efforts, compile data, assess the information, or disseminate findings. USEPA is funding SFEI is conducting the San Joaquin River Basin Monitoring Partnership Project to propose a San Joaquin Water Quality Regional Monitoring and Assessment Strategy.

The purpose of this project is to encourage a public-private partnership to produce needed information for more effective water quality management. The envisioned approach is that by establishing a framework of shared objectives and activities, and identifying ways to provide for improved coordination, management, and funding, a system can be developed for improved monitoring and assessment of water quality in the San Joaquin River Region. The project is

[18] For more information, see http://www.conservation.ca.gov/dlrp/wp/Pages/Index.aspx.

[19] Resolution No. 2007- 0036.

technically directed and staffed by SFEI, with funding and participation from USEPA, and in consultation with the Central Valley Regional Water Board and other agencies. The Great Valley Center participates in meeting facilitation, stakeholder outreach, and project coordination.

The project was started in September 2006 and is expected to be completed in summer 2009. The final report is expected to summarize findings and give recommendations for how to proceed with a regional monitoring effort. For more information, see the project web site at http://centralvalleymonitoring.org/dev.sanjoaquinmonitoring.org/about.html.

At this time, the directory is being populated with some key, long-term Regional Board monitoring programs (Grassland Bypass, NPDES, and Irrigated Lands), aiming for a stakeholder presentation in spring 2009. Key features of the directory include: allowing multiple users to enter information; automatically keeping the system current to monitoring occurring during a specific fiscal year; providing contact information for people interested in accessing the data (this is not a database); and allowing screening by constituent, watershed, water body, etc. SWAMP is funding expansion of the web-based monitoring directory to the entire Central Valley, in the hopes that this tool will become useful to multiple agencies in tracking current monitoring efforts and facilitate future coordination.

NWQMC BAY-DELTA PILOT STUDY

The National Water Quality Monitoring Council recently funded the San Francisco Estuary Pilot Study[20] under its National Water Quality Monitoring Network. The pilot study included the following objectives:

- Inventory: Inventory current ongoing environmental monitoring programs within the study area (the Delta, Bay, and near-field ocean area) that collect data at a scale similar to that proposed in the Network design. Include information about locations of monitoring sites, frequency of monitoring, parameters measured (or derived), and institutional responsibilities.
- Data Management Issues: Investigate data comparability and data sharing issues in the study area and recommend procedures for their resolution. Compare metadata and data sharing issues among existing programs and how they link to state and/or national data management and data access services.
- Gap Analysis: Identify gaps between existing monitoring and that indicated by the Network design.
- Management Issues: Identify management issues that would be better addressed if the monitoring gaps were filled and data were more comparable and accessible.
- Cost Estimate: Estimate costs of ongoing monitoring and costs to fill identified gaps. Costs totaled in the tens of millions of dollars.

As such, the inventory focused on San Francisco Bay more than on the Delta. The inventory does not address the Sacramento River watershed.

[20] The report is available at http://www.sfei.org/rmp/reports/548_RMP_SFEstuaryNWQMN_PilotReport.pdf.

Potential Program Logistics

Based in part on a review of the existing RMP models and region-specific considerations discussed above, this section summarizes critical logistical issues and options associated with implementing an RMP for the Sacramento River watershed. The strategy for developing and implementing an RMP should consider the following elements:

- Encompass a specific geographic area
- Include specific source and beneficial use categories and a critical mass of their stakeholders
- Identify specific monitoring needs (locations, constituents, schedules) and requirements (permits, certifications, California Environmental Quality Act mitigation measures)
- Coordinate with other monitoring efforts to leverage resources
- Secure funding to support the program's objectives
- Use sampling and analytical methods that produce data that are high quality and comparable to other monitoring programs
- Automate data storage and retrieval for a broad audience
- Assess and integrate monitoring data and report the findings to the public in an accessible and transparent process
- Keep the program design flexible enough to react to new information and tailored to local concerns

This section provides an initial attempt to address these strategic elements. While written in a reasonably logical order of progression, clearly many characteristics of an RMP are interdependent. For example, the monitoring plan may have to be scaled down if funding were adequate.

GEOGRAPHIC FOCUS

The geographic focus of the Sacramento River watershed RMP should be the mainstem Sacramento River and its major tributaries. This focus is consistent with historical monitoring, and avoids issues of over-emphasizing some upstream tributaries at the expense of others f*rom the baseline monitoring perspective*. However, that baseline monitoring—as well as other reasons such as impairment listings—will likely lead to more focused monitoring beyond the mainstem.

STAKEHOLDERS AND PARTICIPANTS

Stakeholders depend, of course, on the issues at stake. Watershed challenges for the future are broadly characterized under these topics:

- Water supply
- Water quality
- Flood protection

- Channel stability and habitat

Development and climate change will both affect these characteristics. The initial RMP effort should focus on water quality, subsequently expanding to include biota (macroinvertebrates, biosentinel and sport fish), sediment, and riverine and riparian habitat.

Potential stakeholders fall into three categories:

1. **Participants** would constitute a reasonably cohesive, motivated group of entities who would provide baseline funding and oversight via a Steering Committee.
2. **Collaborators** would participate in coordination meetings and/or a Technical Advisory Committee to leverage resources, minimize redundancies, and share local expertise. Some groups may participate on an *ad hoc* basis for special projects. Other monitoring programs may choose not to participate in or coordinate with an RMP, yet if their monitoring data are publicly available and of adequate quality, an RMP could potentially still use their data to evaluate regional conditions.
3. **Advisors** would have no common activities but could nonetheless provide advice and guidance via a Technical Advisory Committee.

Collaborators and advisors could both review and comment on various planning and reporting documents, and participate in stakeholder meetings. Specific groups to engage fall into several categories are also shown in **Table 6.** The regulatory drivers are described in Table 2 above. The main conclusion drawn from this table is that there are many stakeholders to potentially participate in or at least coordinate with and who could benefit from a Sacramento River watershed RMP. In particular:

- Five POTWs discharge directly to the mainstem Sacramento River and monitor upstream and downstream of their outfalls.
- There are 21 POTWs in the watershed that discharge greater than 1 MGD. Several of these permittees and even those discharging less may become more interested in participating in an RMP as TMDL control programs are developed and implemented throughout the watershed.
- Many municipal stormwater dischargers participate in the California Stormwater Quality Association. Only Phase I stormwater management programs have specific receiving water monitoring requirements, and only the Sacramento Area Co-permittees fall under that program in the Sacramento River watershed. If the 51 Phase II stormwater programs in the Sacramento region are required in the future to include receiving water monitoring, these requirements could be incorporated into an RMP. Finally, some monitoring required under the construction general permit might be covered by an RMP.
- The Central Valley Regional Water Board adopted revised Monitoring and Reporting Program requirements in January 2008. Regional Water Board staff will be developing additional recommendations for a long-term Irrigated Lands Regulatory Program during 2008. A final Environmental Impact Report is expected in 2009. DWR may also monitor some ILRP constituents elsewhere, as noted above in section “Department of Water Resources”.

- Other regulated dischargers, such as fish hatcheries and FERC-licensed hydropower dam operators, may be able to fulfill some or all of their receiving water monitoring requirements by participating in an RMP.
- Water contractors pay the federal or state projects (USBR and DWR) for maintenance and operational costs. In particular, they fund approximately $3 million per year for water monitoring at several Delta pumping plants and elsewhere under DWR's MWQI program and a portion of the Interagency Ecological Program's $3.9 million per year monitoring.

Table 6. Potential RMP stakeholders and their drivers.

Stakeholder Category	Stakeholder Group	Interests	Drivers				
			POD	Drinking Water	Sediment Quality	TMDLs	Discharge Permits
Active, regulated participants	Municipal & industrial wastewater dischargers	Permit compliance monitoring; site-specific objectives	X	X	X	X	X
	Stormwater Managers (Sacramento CMP, Phase II MS4s)	Permit compliance monitoring; site-specific objectives	X	X	X	X	X
	Irrigated Lands Regulatory Program: SVWQC, CA Rice Commission, US Dept. Agriculture, Resource Conservation Districts	BMP effectiveness; permit waiver program compliance	X	X	X	X	X
Drinking Water Purveyors	Water Purveyors: State Water Contractors, CUWA	Drinking water contaminant tracking and source identification	X	X			
	Water managers: DWR Northern District, DWR-MWQI program, USBR	Drinking water contaminant tracking and source identification	X	X			
	CA Dept. Health Services	Drinking water contaminant tracking and source identification	X	X			
Regulated, if interested	Fish Hatcheries: US Fish & Wildlife Service, CA Dep. Fish & Game	Nutrients, pathogens, pesticides	X			X	X
	Reservoir Operators: DWR, USBR, hydropower utilities	Water temperature, hydromodification		X			
	Municipalities undertaking projects subject to CEQA	CEQA compliance and mitigation monitoring			X	X	X
	Construction Projects	Statewide construction general permit compliance			X	X	X
	Dredgers: Port of Sacramento, US Army Corps of Engineers	Contaminant transport and transformations	X	X	X	X	X
Regulators	State: CA Dept Pesticide Regulation, Regional Board, State Board, SWAMP, Delta Vision, BDCP, CA Dept Fish & Game, Ocean Protection Council	303(d) listings; TMDL development	X	X	X	X	X
	Federal: US Army Corps of Engineers, USEPA Region IX, USFWS (under US Dept Interior), NOAA-NMFS	303(d) listings; TMDL development	X			X	X
As needed; project-specific	Integrated Regional Water Management Programs (IRWMPs)	Project effectiveness		X		X	
	Local watershed groups: [1]	Health of watershed; effect of actions		X	X	X	
	Environmental NGOs: BayKeeper, NRDC, CA Sport-fishing Alliance, Sierra Club, Nature Conservancy, Ducks Unlimited	Identifying and tracking ambient water quality issues	X			X	
	Researchers: USGS, Calfed Science Program, various universities	Pollutant transport and transformation	X	X	X	X	X
[1] ~70 within the Sacramento River Watershed Partnerships, see http://www.sacriver.org/watershed/partnerships.php/.							

OPERATIONS AND MANAGEMENT

This section outlines a feasible model—with options—for operating and managing an RMP. A key characteristic of the program, as expressed by most stakeholders, is transparency. The

operations and decision-making process need to be open to broad participation and known by anyone interested.

RMP Operations and Oversight

An RMP would be managed most effectively by a single organization, responsible for contracting and coordinating activities. The SRWP is governed by a 21-person Board of Trustees. Staff include an Executive Director, Watershed Resource Specialist, Watershed Coordinator, and Webmaster. An RMP could continue to be one of SRWP's three program areas (the other two being public education and local watershed support). An RMP would be best served by having an individual RMP Manager to represent the program and to be responsible for implementing necessary activities.

It is expected that three committees would be required to provide primary oversight responsibilities for an RMP:

- Steering Committee – With representatives from the program base funders, the SRWP Board of Trustees, and the Technical Review Committee. Other stakeholders could participate in the meetings but would not have voting rights. Voting would be ruled by majority, not by consensus.
- Technical Advisory Committee – Open to participation by all stakeholders. This committee would be responsible for reviewing key planning documents and assessment reports, and for soliciting external peer review of the program. Key participants would be managers of other monitoring projects in the watershed.
- Coordination Committee – To coordinate monitoring efforts with other partners (e.g., IEP, CALFED, SWAMP) and regions (e.g., Delta, San Joaquin, San Francisco Bay). The program manager would attend these meetings, but other stakeholders could also participate.

Additional *ad hoc* work groups could be formed as needed to investigate and address more specific program management questions. The organizational chart in **Figure 4** demonstrates one possible structure. Outreach and education associated with the monitoring assessment and reporting could be coordinated through SRWP's existing public education activities.

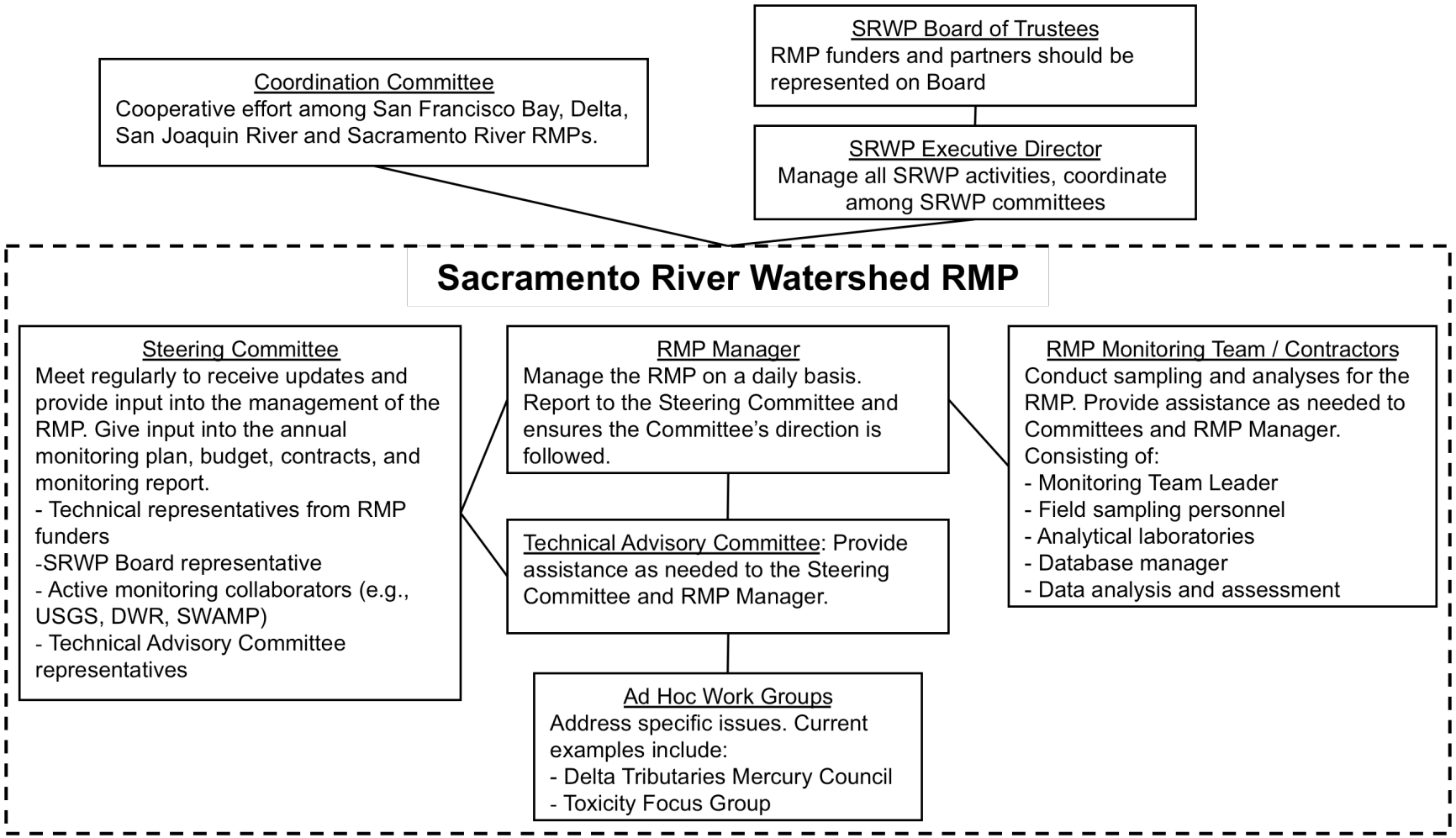


Figure 4. Schematic representation of potential organization of an RMP for the Sacramento River Watershed.

Data Compilation, Assessment, and Reporting

A key suggestion by the statewide Water Quality Monitoring Council[21] is that web-driven, user-oriented data access portals be developed and implemented by a series of issue-specific workgroups operating under the Council's overall guidance and approval. An RMP's data should be compiled and managed in a SWAMP-compatible format to allow linkage with the SWAMP database (see section "SWAMP Study of Permit-required Monitoring" above), which would fulfill a fundamental need for statewide consistency. Such efforts should be coordinated with the Council's efforts (SB1070).

Data summaries and assessments addressing an RMP's goals and objectives (see section "Introduction") should generally occur annually. The assessments depend on the questions addressed by the monitoring plan (see next section). The data and associated assessments should be reported in several formats, including:

- Addition of new data to a SWAMP-compatible database with a user-friendly, map-based interface identifying monitoring stations, and providing links to reports and coordinating monitoring efforts
- Submission of data to the SWAMP database
- Publication of an annual monitoring report suitable for a technical audience, including use in the state's 305(b) report
- Technical papers on key subjects, such as modeling results and special studies
- Publication of an annual monitoring summary suitable for a general audience
- Presentations at the State of the Sacramento River Watershed Conference and a Bay-Delta summit[22]
- Press releases and announcements in the monthly SRWP eNewsletter

Coordination with Other In-region Monitoring Programs

Recalling the three levels of participation in an RMP (participant, collaborator, advisor) how and when to interact with collaborators can be important. Most monitoring programs are designed for multiple years but budgeted annually. Therefore, the Coordination Committee should meet approximately quarterly, with the broad goals of designing consistent, coordinated monitoring programs and sharing initial findings before they are published.

---

[21] The Council published a report of its recommendations titled "Maximizing the efficiency and effectiveness of water quality data collection and dissemination" on December 1, 2008. The report is available at http://www.waterboards.ca.gov/water_issues/programs/monitoring_council/docs/sb_1070_full_report_final.pdf.

[22] The State of the Sacramento River Watershed conference is scheduled periodically by the SRWP. An annual Bay-Delta summit was recommended by the Little Hoover Commission in its critique of the Calfed program. The purpose of such a summit would be for policymakers to meet in public to explain their activities and share the latest scientific findings regarding the Bay-Delta.

Bay-Delta Coordination

Due to the size and the diverse range of regional conditions in the San Francisco Bay Estuary and its watershed, it is unlikely that monitoring could be effectively administered over the entire area by one entity. Rather, four distinct RMPs appear likely to be developed (**Figure 5**): Sacramento River watershed, San Joaquin River watershed, Delta Region, and San Francisco Bay. Nonetheless, coordination at that Bay-Delta watershed scale would be helpful. The focus of coordination should be on the following:

- Share downstream environmental concerns while respecting local concerns[23].
- Develop and implement a consistent quality assurance program plan
- Compile data in a SWAMP-compatible format

The level of coordination at the scale of the entire Bay-Delta and its watersheds would depend on how much each RMP depends on the other. In general, downstream stakeholders (San Francisco Bay and Delta) would be more interested in monitoring by upstream stakeholders (San Joaquin and Sacramento Rivers Watersheds) than vice-versa. Overall coordination, encompassing all four RMP regions and beyond, could be facilitated through any of several entities:

- SWAMP – See sections "Regional Monitoring Activities" and "Supporting Efforts". SWAMP program managers already coordinate statewide and regional monitoring programs.
- Coordination Committee – A new entity could be created under the Delta RMP. The Delta RMP implementing entity is best suited to provide regional coordination because the Delta overlaps all three other RMP areas.
- Statewide Watershed Initiatives – The Statewide Watershed Program and the California Water Quality Monitoring Coalition both may provide organizational structures for larger-scale coordination.
- Aquatic Science Center – See section "Supporting Efforts". SFEI, which is the implementing agency of the Aquatic Science Center, manages the San Francisco Bay RMP and is being funded to support several efforts in the Delta.
- Delta Protection Commission – A governor-appointed commission whose mission is to adaptively protect, maintain, and where possible, enhance and restore the overall quality of the Delta environment consistent with the Delta Protection Act, and the Land Use and Resource Management Plan for the Primary Zone.
- A new entity created by the Interim Delta Policy Group, as proposed by the Delta Vision Task Force[24]

---

[23] Examples of this coordination are already evident in recent SRWP monitoring, such as monitoring flame retardants (polybrominated diphenyl ethers) in fish collected in the watershed by the CALFED Fish Mercury Project to address a concern initially identified for the San Francisco Bay region.

[24] See Delta Vision Committee Implementation Report, 12/31/08, available at www.resources.ca.gov/docs/Delta_Vision_Committee_Implementation_Report.pdf.

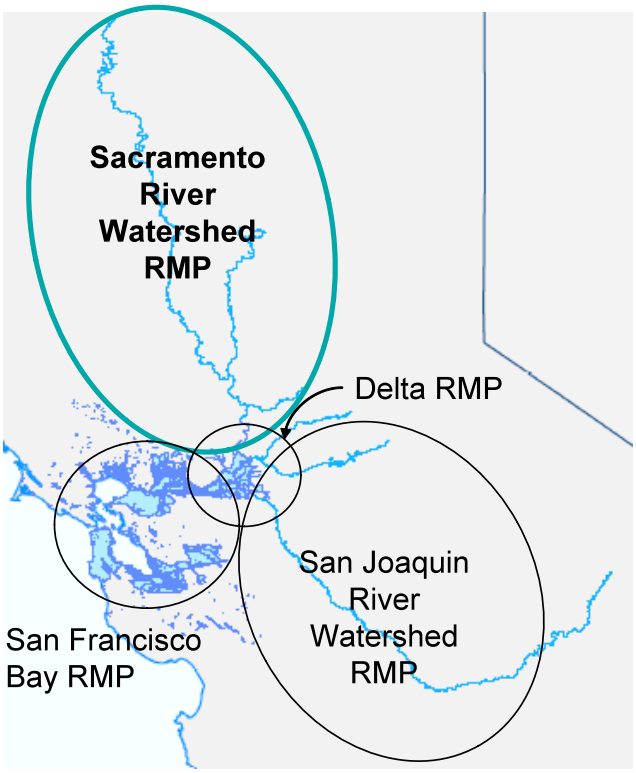


Figure 5. Likely delineation of regional monitoring programs in the Bay-Delta watersheds.

Each oval in this figure—representing large areas with unique stakeholders, interests and environmental concerns—should be considered to represent an independent decision-making body. That independence notwithstanding:

- The Central Valley's largest and third largest metropolitan areas, Sacramento (population: >1 million) and Stockton (population: 270,000), respectively, lie within two overlapping RMP areas.
- The Delta today is the most contentious region. Receiving water from all three other regions, an RMP for the Delta would need to coordinate greatly with three overlapping RMPs.

The Sacramento River and San Joaquin River Watersheds RMPs could morph into programs parallel in character to each other, but still different from the Bay and Delta RMPs. Differences between the two riverine RMPs compared to the downstream regions' RMPs are likely to be a natural result of:

- Essentially linear downstream flow hydrology of the Sacramento and San Joaquin watersheds versus a more mixed (i.e., less linear) system in the Bay and Delta
- Larger geographic scale of the tributary watersheds compared to the Delta or Bay proper
- Dominant land uses of forest, rangeland, irrigated agriculture in the tributary watersheds versus urban land use in the Bay
- Number, extent and types (pollutants and their sources) of impaired reaches

MONITORING PLAN

A monitoring plan describes the details of the monitoring program—what will be measured, when, where, and how. Much of such a plan's details is beyond the scope of this report and presumptive at this stage. Instead, development of an RMP monitoring plan is left as an early task for the SRWP's existing Monitoring Committee or the proposed RMP Manager with support from the Steering and Technical Advisory Committees. At this point, it is reasonable to assume that an RMP monitoring program might be similar to the monitoring program implemented in 2006-2007, described above in section "Sacramento River Watershed Program Monitoring".

This section starts the process of re-evaluating that program by addressing several key program characteristics. In broad terms, each decision of what to include can be categorized as "foundational" (a necessary, baseline element of the program) or "supplemental" (useful, but not critical). Also, the monitoring data should be collected with a goal of providing inputs to watershed models such as WARMF.

Locations

A fundamental decision will be how to distribute monitoring stations throughout the watershed. Many approaches are possible, including:

- Statistical random design as used for EMAP
- Rotating basin design as used for USGS' NAWQA program
- Targeted design (select key locations based on known inputs, activities, or interests)
- Extrapolation design (study a few representative locations intensively and extrapolate results to everything else)
- Some combination of these.

Past SRWP watershed monitoring generally followed a targeted design, monitoring stations at key junctures along the mainstem Sacramento River and at the mouths of major tributaries. Focused study areas were identified based on those results.

Specific monitoring stations may include three types of sites, characterized as:

- Long-term sites used for baseline/trends analyses of ambient water quality conditions (i.e., upstream stations to represent "background" or "undisturbed" conditions, tributary mouth stations that integrate effects of the entire watershed)
- Periodic, intensive sites used to increase spatial (e.g., toxic hot spots or exceptional pollutant sources) and temporal resolution (e.g., flood or drought conditions)
- Pollutant- and issue-specific sites

At this point, the consensus of the stakeholders actively involved in RMP development is that the monitoring stations in the mainstem Sacramento River and its major tributaries should be continued. While a few sampling stations may be used by more than one entity or program, broad redundancy in current monitoring is not evident. Fundamental questions remaining to address include:

- How to coordinate with monitoring conducted by others in upstream tributaries?

- How to account for localized or tributary watershed-scale effects if only monitoring at a regional scale?
- How to use mainstem monitoring data to calibrate water quality simulation models?

Monitoring Timing

Three types of monitoring should be considered by the RMP:

- **Regular, baseline monitoring:** Done periodically according to calendar dates. The frequency would depend on the variability (daily, seasonally, inter-annually) of interest for each set of constituents. The recent monitoring frequency of monthly sampling events, with some constituents and media only monitored monthly, seasonally, or annually, was generally found to be adequate for meeting the SRWP's goals. Cyclical (once every five years), stratified-randomized fish tissue sampling could be included. Also, annual citizen-based events such as the California Coastwide Snapshot Day and World Water Monitoring Day could be included.
- **Event-based monitoring:** Target specific events, such as droughts, forest fires, pesticide applications, chemical spills, or fish kills. "First-flush" or other weather-induced events could also be considered, but should be addressed at the watershed scale.
- **Special studies:** Conduct special studies to address specific questions. Research studies and TMDL source identification monitoring would be included.

Monitoring Media and Constituents

Several media and constituents could be monitored in an RMP, including (approximately in order of highest priority first):

- **Water column:** Physical, chemical, microbiological, and toxicity testing could be conducted in a similar manner as past monitoring efforts, focusing on the same mainstem sites monitored historically (see section "Sacramento River Watershed Program" above). Constituents on the 303(d) list (see section "Water Body Impairments" above) should be a priority. Priority toxic pollutants with numeric water quality criteria given in the California Toxics Rule should be monitored periodically.
- **Sediment:** An RMP could apply the approach of the State's proposed sediment quality objectives (once adopted), which rely on three separate indicators of toxicity or impairment. This new means of quantification may provide a reliable tool for quantitatively evaluating and addressing regional contamination issues.
- **Bioassessment and tissue monitoring:** Biota found at various locations can be evaluated for species densities, diversity, and a variety of other community metrics. These communities serve as biological integrators of variable environmental conditions and exposures and may be the most direct empirical indicators of overall ecosystem health and responses. Fish and other biota also integrate variable environmental conditions and exposures, and concentrations of pollutants in their tissues act as indicators of potential risks to human health and wildlife from bioaccumulated pollutants.
- **Watershed health indicators:** Apply the environmental index tool being developed by the SRWP (see section "Sacramento River Watershed Program Monitoring" above).

The most useful—although also most expensive—monitoring program would be framed by a combined approach that monitors pollutants in water, sediment, and tissue, biotic community assemblages and toxicity, and physical habitat conditions. The most recent monitoring program followed this approach to a degree.

The state of knowledge regarding endocrine disrupters, personal care products and pharmaceuticals is incomplete. Additional research and development of analytical methods and surrogates are still needed to determine potential environmental and public health impacts before such compounds are monitored effectively.

Quality Assurance Program Plan

A Quality Assurance Program Plan (QAPP) documents the planning, implementation, and assessment procedures for a particular project, as well as any specific quality assurance and quality control activities. It integrates all the technical and quality aspects of the project in order to provide a "blueprint" for obtaining the type and quality of environmental data and information needed for a specific decision or use. The SRWP's QAPP used for the most recent monitoring cycle would serve as a foundation, but would require updates and revisions to address new program goals, approaches, and monitoring requirements. Generally, the program's QAPP should continue to be consistent with SWAMP requirements[25].

Similarly, an RMP database would have to be compatible with the California Environmental Data Exchange Network (CEDEN). Although other databases are available, CEDEN is used by many organizations, and the creation of a new database is not prudent. In addition, historical SRWP data are currently in the CEDEN database, and continuity is critical.

Likewise, insofar as an RMP would coordinate with other local monitoring activities, the program would have to ensure that the managers of those activities know what data quality requirements would be needed ultimately to be considered useful in the broader context. The general trend in the watershed, even without an organizing structure such as an RMP, is to be consistent with SWAMP requirements.

BUDGET EXPECTATIONS AND FUNDING

Based on the general program logistics outlined up to this point in this section, budget expectations are provided here. Funding sources to meet those budgets are then discussed.

Reasonable Budget Expectations

The reasonable budget for an RMP can be estimated in two ways. One way is to assume the same level of monitoring as conducted historically is continued in the future. The most recent water quality monitoring effort by the SRWP was funded at approximately $600,000 per year. An RMP with consistent and stable funding may be able to realize

The most recent water quality monitoring effort by the SRWP was funded at about $600,000/year. If each of the 2.5 million citizens in the Sacramento River watershed were to contribute the same rate as San Francisco Bay citizens, a Sacramento RMP would receive $1.1 million/year.

[25] See http://www.waterboards.ca.gov/water_issues/programs/swamp/qapp.shtml.

greater cost-efficiencies than the sporadically-funded SRWP monitoring.

Another way is to assume that similar levels of per capita funding generated elsewhere for RMPs could be generated in the Sacramento River watershed. The San Francisco Bay RMP costs approximately $3 million/year for a population of nearly 7 million, or $0.43 per person per year. If each of the 2.5 million citizens in the Sacramento River watershed were to contribute (via their special district directly or via NPDES permit fees) the same amount as San Francisco Bay citizens, a Sacramento RMP would receive $1.1 million per year. Thus, the overall cost per person applied in San Francisco Bay would suffice to fund approximately double the most recent monitoring effort in the mainstem Sacramento River.

At the other end of the per capita spectrum, on the order of $7 million per year is spent on Delta water quality monitoring.

Funding Sources and Mechanisms

The goal for funding is a stable source with minimal administrative requirements. Funding for an RMP could eventually come from several groups and individual entities within those groups. Various funding levels and mechanisms for assuring those funds could be considered. That is, the percent contribution for the overall program from various sources can be set by an RMP's steering committee, while the relative contributions among each group's members can be negotiated among themselves separately. The various entities are characterized as described above in section "Stakeholders and Participants".

Base Funding – Program Participants

Given that a stable source of funding is needed to administer an RMP, participants would need to provide reasonable assurance of regular, baseline funding for the program. Support by these groups may also include in-kind contributions. Contributors, as defined above, could also be considered base funding, as long as their own efforts are relatively stable and done in coordination with an RMP.

SWAMP currently supports several monitoring projects throughout the state. The watershed's portion of statewide monitoring projects (e.g., fish tissue monitoring, bioassessments, endocrine disrupting chemicals monitoring) could be incorporated into an RMP.

Support Funding – Downstream Stakeholders

Another component of funding is downstream stakeholders. The Delta is currently the focus of significant water quality interest by, among others: the state legislature, the State Board and Central Valley and San Francisco Bay Regional Boards, water purveyors, agencies participating in the Interagency Ecological Program and CALFED. These entities would have to be convinced to provide funds to an RMP, with the ability then to participate in the monitoring design.

RMP costs could be divided between watershed and downstream interests as shown in **Table 7**. The "state fund" could be a collective fund from the four RMPs, with contributions proportioned on a per capita, relative watershed area, or other basis.

Table 7. Potential distribution of funding between the watershed's RMP and downstream water purveyors.

Constituent Group	Funding Proportion
Watershed Issue – Primarily a concern/interest within the watershed	100% by watershed RMP
Downstream Issue – Not a concern/interest within the watershed, monitored only to satisfy downstream interests	100% by state fund
Broad-reaching Regional Issue – A basic water quality measurement or issue relevant throughout the watershed and Delta	50% by watershed / 50% by state fund

Special Funding – Grants

Funding for an RMP could be funded in part by grants. Grants are a key funding source for some RMPs, including Chesapeake Bay's. The objective would be to obtain grant funds for special projects or otherwise additional effort beyond the baseline monitoring funded by participating entities. Grants require a relatively high level of administration to propose for funding, and to account for and report on funds received and spent. Monitoring goals may have to be adjusted based on grant requirements and limitations. As experienced by the SRWP in the past, grant funding is not stable and can not be a reliable source of long-term funding.

Special Funding – Mandatory Minimum Penalties

NPDES permittees can be subject to mandatory minimum penalties if they violate conditions in their permits. In some instances, the money from these penalties can be diverted to support supplemental environmental projects. An RMP could be characterized as such a project and receive those funds. Because of the uncertain and random nature of permit violations and subsequent penalties, such funds would best serve to support special studies rather than baseline monitoring.

The proposed policies on Supplemental Environmental Projects and Use of the State Water Pollution Cleanup and Abatement Account for Regional Water Quality Improvement Projects are independent of one another but both were considered at the February 3, 2009 Board Hearing. In the past, these issues have been addressed as part of the Water Quality Enforcement Policy. They are being considered separately at this time but it is expected that they may become part of a larger Water Quality Enforcement Policy in the future.

The Supplemental Environmental Projects policy[26] was adopted with a soft ceiling maximum of 50% of a penalty be used on such projects and allows for public education. The Use of the State Water Pollution Cleanup and Abatement Account for Regional Water Quality Improvement Projects policy would have set aside 50% of a penalty to be used by Regional Boards for regional projects. In the end, the State Board decided not to adopt the policy, but will provide some clarity to Regional Board and State Board staff on use of such funds (i.e., that it should be fairly distributed between regions, assistance in implementing projects, develop a list of fundable projects).

[26] The final policy is available at http://www.waterboards.ca.gov/water_issues/programs/enforcement/index.shtml.

Conclusions and Next Steps

This report summarizes the findings of an investigation of the feasibility of developing and implementing a sustainable RMP for the mainstem Sacramento River watershed. Such an RMP would coordinate with and compliment other monitoring programs and water quality management projects both within the Sacramento River watershed and as part of the larger Bay-Delta watershed.

In spite of the many regulatory and financial incentives to participate in an RMP, there still remain several significant challenges. The previous section "Potential Program Logistics" begins to describe a potentially feasible RMP, aiming to maximize incentives while minimizing challenges. Addressing the remaining challenges should be the focus of subsequent work.

Several actions are proposed as next steps in the ongoing investigation. The actions are listed in approximate chronological order, although there will be considerable overlap. For context, dates for various related activities are listed here:

Activity or Product	Due Date
Phase 2 municipal stormwater program statewide general permit	2009
Delta RMP Phase 1 Action Plan due to Central Valley Regional Board	June 2009
San Joaquin River basin monitoring partnership program assessment report and monitoring inventory / tool	June 2009

MEET WITH POTENTIAL RMP PARTICIPANTS

Participants in the development of this study report included a broad range of stakeholders. The next step is to meet with potential RMP participants—paying members of the program—to obtain commit. That core group—and their staff—will then have to address many of the questions raised in the preceding section. A "phased approach" is likely to be most successful, starting with a smaller group addressing the highest priority objectives and building off early successes. The goal should be to organize a viable, committed group of program participants in 2009-2010, leading to initiating monitoring by water year 2011-2012.

CONTINUE TO PARTICIPATE IN DELTA RMP DEVELOPMENT PROCESS

The short-term (2008-2009) goal for the Delta Strategic Workplan's action to develop a Delta RMP is to establish a framework for regularly gathering, compiling, assessing, and reporting readily available data currently being collected under Water Board programs and external programs, such as the IEP. The longer-term (by 2014) goal is to develop a RMP for the Bay-Delta. Inherent in both the short- and long-term efforts is the need to develop a framework for coordinating monitoring and assessment efforts in and around the Delta.

This activity is using a collaborative stakeholder process, in coordination with similar efforts in the Bay-Delta and upstream tributaries, to develop goals and objectives for the short-term assessment and reporting framework and the long-term RMP and to establish the management framework, data management, assessment, review, and reporting processes, and funding

strategies for each. The short-term assessment will identify parties with monitoring efforts and data currently being collected, which will form the foundation for an RMP[27].

SRWP should participate in these discussions so that parallel efforts are coordinated and consistent to the extent practicable. During fiscal year 2008-2009, SRWP should also facilitate a joint CVCWA-BACWA meeting to share concerns, experiences and advice on regional monitoring.

INTEGRATE RMP OPTIONS INTO CURRENT REGULATIONS

A key element to sustainable, reliable funding is a legal basis for requiring participation from regulated entities. The San Francisco Bay Regional Board implemented the Bay Area RMP in Resolution No. 92-043. Subsequently, NPDES permits included language requiring participation. Draft language similar to that used in the San Francisco Bay region is provided here as one possible example:

> Regional Monitoring Program
>
> On [date] the Regional Water Board adopted Resolution No. [number] directing the Executive Officer to implement a Regional Monitoring Program for the [region]. Subsequent to a public hearing and various meetings, the Regional Water Board requested major permit holders in this region, under authority of Section 13267 of the California Water Code, to report on the water quality of the [receiving water body]. These permit holders responded to that request by participating in a collaborative effort, through the [RMP implementing organization]. This effort is known as the [region] Regional Monitoring Program (the [region] RMP), which includes collection of data on pollutants and toxicity in water, sediment, and biota of the [receiving water body]. This Order requires the Discharger to participate in and contribute to an RMP. This direct and financial participation in an RMP will serve to offset or wholly satisfy the ambient monitoring requirements of the permittee(s).

SRWP should work with NPDES-permitted wastewater dischargers to revise Monitoring & Reporting Requirements in existing NPDES permits (approvable by the Executive Officer) and to use language such as the above in new permits.

Similarly, if indeed receiving water monitoring is required of Phase II stormwater permittees, language similar to the above should be incorporated in the general permit.

[27] These statements are taken from the June 2008 draft Delta Strategic Workplan.

CONDUCT GAP ANALYSIS

A more comprehensive gap analysis would be a useful exercise for the Sacramento River Watershed. The process basically involves identifying monitoring data needs, existing data and associated monitoring programs, and gaps in full coverage. Monitoring needs could be as broad as this list, adapted from SFEI's Pilot Study (see section "NWQMC Bay-Delta Pilot Study" above):

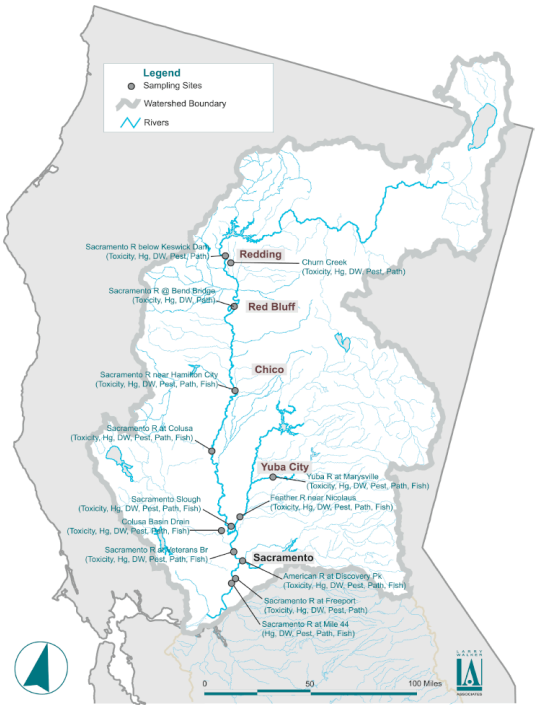
Resource Components	• Delta • Rivers • Groundwater • Wetlands • Swimming areas
Study Types	• Atmospheric deposition (air mass and wet) • Bioaccumulation (in fish, birds, and bivalves) • Community studies (fish, birds, benthos, zooplankton, phytoplankton, and intertidal) • Habitat mapping (mapping historic and current ecological condition and land use) • Pathogen monitoring for beach condition • Water and sediment quality monitoring for nutrients, physical condition (employing both continuous monitoring and discrete sampling methods) • Water, sediment, and tissue monitoring for regulated and emerging contaminants

IDENTIFY POTENTIAL GRANT PROGRAMS

Several federal, state, and private grants may be available to support baseline monitoring or special studies. A list of potential sources should be developed to summarize opportunities and constraints associated with each grant source.

Appendix 1. Draft RMP Fact Sheet

A Regional Monitoring Program for the Sacramento River Watershed



SRWP Monitoring Program Sampling Sites, 2005-2007

Monitoring in the Sacramento River Watershed

The Sacramento River Watershed Program (SRWP) has been monitoring the Sacramento River and its major tributaries since 1998. The SRWP's monitoring program was started because there was a need to better understand water quality in the Sacramento River Watershed.

Thus far, over $5 million has been spent on the SRWP Monitoring Program through grant funding from the USEPA and more recently a Proposition 50 Watershed Program grant. In implementing its monitoring program, the SRWP has collaborated with monitoring efforts of other agencies including the Central Valley Regional Water Quality Control Board, U.S. Geological Survey, California Department of Water Resources and Department of Fish and Game.

The goals of the monitoring program were to develop a cost-efficient, coordinated monitoring program that assessed baseline conditions in the Sacramento River's main stem and its tributaries; one that identified causes, effects and extent of problems; and one which could be used to measure improvements in management.

Launching an Effort

Encouraged by its monitoring success, SRWP is launching an effort to develop a long-term, sustainable regional monitoring program for the Sacramento River Watershed. A major portion of the funding for the program must come from the program's stakeholders. The major drivers for monitoring and potential stakeholders are listed here:

Drivers

- Pelagic Organism Decline (POD) in the Delta
- Central Valley Drinking Water Quality Policy
- Sediment quality objectives
- 303(d) list, TMDLs, and 305(b) report
- NPDES permits with receiving water monitoring requirements
- Irrigated Lands Regulatory Program
- Delta islands drainage

Potential Stakeholders

- Wastewater Dischargers
- Stormwater Dischargers
- State Water Resources Control Board
- Regional Water Quality Control Boards
- California Urban Water Agencies
- State Water Contractors
- California Department of Water Resources
- California Department of Public Health
- Irrigated Lands Regulatory Program
- CALFED agencies and Interagency Ecological Program members
- Non-Government Organizations

Purpose

An RMP could serve many purposes, including:

- Determine background pollutant concentrations for permitting and assessing compliance with water quality standards
- Understand pollutant fate and transport, linking water quality to beneficial uses and sources to impairment
- Establish baseline conditions for water quality, sediment quality, biodiversity and ecological health
- Evaluate emerging contaminants
- Evaluate status and trends in conditions over time

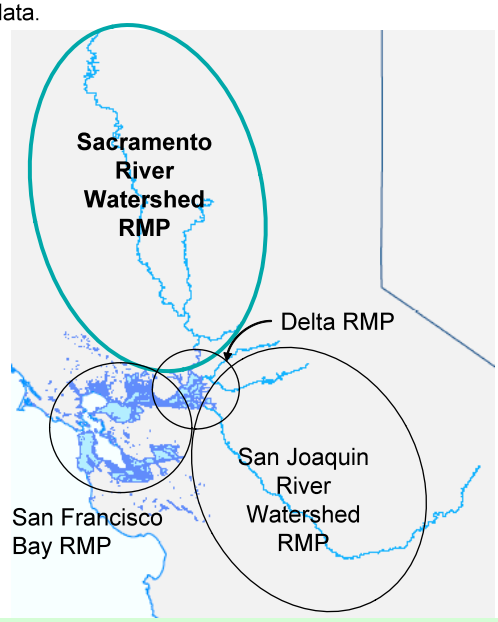
Obj ectives

The multi-faceted objectives of the RMP could include:

- Monitor ambient water quality within the watershed in a science-based, watershed approach
- Communicate and coordinate with separate monitoring efforts to prioritize and focus public sector efforts
- Contribute to a comprehensive water quality and sediment monitoring database
- Provide regular, integrative assessment reporting and program evaluation
- Respond to new information and changing priorities to inform decision-makers

Linking to the Bay-Delta Estuary

Due to the vast range of regional conditions and interests in the San Francisco Bay Estuary and its watershed, monitoring may not be administered over the entire area by one entity. Each RMP would coordinate its monitoring to ensure consistency, comparability, and utility of monitoring data.



Incentives

The overall benefit of an RMP would come from collectively understanding water quality problems. Specific incentives that an RMP would provide include:

- Coordination with regulators to prioritize and adaptively manage pollution issues with a watershed-scale perspective
- Satisfy NPDES permit compliance monitoring requirements
- Provide actual (rather than conservatively assumed) background concentration data
- Establish standards for sampling and analysis to generate comparable, high-quality data
- Leverage other monitoring efforts to minimize redundancy and overlap

Challenges

The main challenges to address in developing an RMP with sufficient, equitable, reliable funding include the following:

- Participants lose some independence while they commit for the long-term
- Coordination among various stakeholders with potentially divergent interests may be contentious
- Different pollutants of concern may apply in different areas of the watershed
- Concerns identified at a distant site may incorrectly implicate a discharger
- Monitoring at distant sites would not identify localized hot spots
- May forego monitoring many water bodies that are currently monitored by NPDES dischargers

The Sacramento River Watershed Program was founded in 1996. The SRWP was certified in 2002 as a California not-for-profit corporation. The mission of the SRWP is to ensure that current and potential uses of the watershed's resources are sustained, restored, and where possible, enhanced, while promoting the long-term social and economic vitality of the region. For more information, visit www.sacriver.org/.

SACRAMENTO RIVER watershed PROGRAM

RMP Investigation Contact
Stephen McCord
Larry Walker Associates
(530) 753-6400
sam@lwa.com

SRWP Contact
Mary Lee Knecht, Executive Director
(916) 549-4017
marylee@sacriver.org

[Date Revised: 22 May 2008]

Appendix 2. Program Models

Several existing RMP models are described in this appendix. This information provides some context on the potential focus and scale of an RMP for the Sacramento River watershed. The following questions were asked generally of each program discussed:

- When did the program begin?
- What were the obstacles overcome?
- What is the legal / organizational structure for managing the program?
- Who participates (and at what level) in designing and implementing the monitoring program?
- What are the monitoring program's goals and objectives?
- What is the scope of the program (geographic area covered, frequency, constituents)?
- What is the program's budget and how much funding is received annually by each sources? How are funders persuaded to participate?
- How has the program benefited participants?
- What advice do you have for starting a new program?

Additional insight into monitoring consortiums can be found in a report by USEPA (1997). "Monitoring consortiums: A cost-effective means to enhancing watershed data collection and analysis." EPA841-R-97-006. Office of Water (4503F), Washington, DC. 37 pp.

REGIONAL MONITORING PROGRAM FOR WATER QUALITY IN THE SAN FRANCISCO ESTUARY

Contact: Jay Davis, RMP Lead Scientist, SFEI, www.sfei.org/rmp

In 1993, the San Francisco Bay Water Board entered into a memorandum of understanding with the San Francisco Estuary Institute (SFEI) to administer and manage a new collaborative effort, the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP), established to monitor receiving waters and provide integrated, comprehensive, systematic information on water quality in San Francisco Bay. The RMP is supported by funds contributed by all entities that hold waste discharge requirements issued by the San Francisco Bay Water Board to discharge waste into the Estuary. Participating entities include dredgers, power plant cooling water dischargers, industrial dischargers, stormwater dischargers, and municipal wastewater dischargers. Funding for the RMP is provided by these groups, who themselves raise revenues from their members. Each group, along with the Regional Board, is represented on the Steering Committee and the Technical Review Committee. Committee meetings are open to interested parties and everyone's input is certainly considered even though some attendees do not have voting authority.

SFEI is a non-profit corporation governed by a Board of Directors composed of scientists, environmentalists, regulators, and representatives of local governments and industry. Every year SFEI produces an annual summary of water quality in the Bay, *Pulse of the Estuary*, which provides objective information about water quality in San Francisco Bay.

The Regional Board and permitted dischargers are intricately involved in the RMP, participating on the committees and workgroups that oversee the monitoring efforts and special studies. Their direct participation in the monitoring results in data which all sides trust.

Since its inception in 1993, the RMP budget has increased from $1.5 to $3 million/year. In general, the geographic scope of the RMP is only the Bay and does not focus on urban streams where most stormwater monitoring occurs. The only exception is that the RMP does conduct pollutant loading studies in small urban tributaries that discharge directly to the Bay. These studies assist RMP participants in calculating pollutant loads from local watersheds to the Bay.

A portion of the RMP is currently funded by stormwater programs, and there is stormwater representation on the Steering and Technical Review committees. In addition, stormwater managers are currently evaluating whether a stormwater monitoring coalition is needed to better coordinate monitoring among stormwater programs in the Bay area. This coalition would be focused on urban streams and be supplemented by SWAMP statewide monitoring efforts and the RMP.

SOUTHERN CALIFORNIA REGIONAL MONITORING PROGRAMS

Contact: Ken Schiff, Deputy Director, SCCWRP, www.sccwrp.org

The Southern California Coastal Water Research Project (SCCWRP) Authority is a joint powers agency focusing on environmental research. The common mission is to gather the necessary scientific information so that member agencies can effectively, and cost-efficiently, protect the Southern California marine environment.

SCCWRP is comprised of 14 member agencies that include representatives of city, county, state, and federal government agencies responsible for monitoring and protecting the marine environment: the cities of Los Angeles and San Diego; the County Sanitation Districts of Los Angeles and Orange Counties; the Los Angeles, San Diego, and Santa Ana Regional Water Quality Control Boards; the State Water Resources Control Board; the US Environmental Protection Agency, Ventura County Watershed Protection District, Los Angeles County Department of Public Works, the Ocean Protection Council, Orange County, and San Diego County. These entities pay a voluntary "membership fee" totaling $2.7 million per year. The remainder of needed funds come from grants.

SCCWRP was formed in 1969 to address limited knowledge about the effects of wastewater and other discharges to the Southern California coastal marine environment. Today, SCCWRP's goals are as follows:

- To develop, participate in, and coordinate programs to understand ecological systems in the coastal waters and to document relationships between these systems and human activities;
- To answer relevant questions regarding the Southern California coastal waters:
    - Is it safe to swim?
    - Is it safe to eat the fish?
    - Is the ecosystem healthy?
    - Are the natural resources being protected?

- To effectively communicate research findings and recommendations, through a variety of media, to decision makers and other stakeholders;
- To continuously examine the composition and structure of SCCWRP to enhance the ability of the organization in achieving its mission;
- To serve as a catalyst in forming partnerships and alliances which further these goals; and
- To provide an information management system to archive, retrieve, analyze, and display SCCWRP data in order to achieve the above goals and enhance understanding of the Southern California Bight.

The SCCWRP Commission's Technical Advisory Group (CTAG) is a panel including representatives of each of the SCCWRP member agencies. The purpose of CTAG is to act as the primary link between the SCCWRP Commission and member agencies and SCCWRP staff. It fulfills this purpose by performing the following functions:

- Technical and Scientific Review: CTAG provides advice and guidance on the SCCWRP research plan, assisting in its development and helping to assure that it meets the science and managerial needs of the member agencies. CTAG also provides advice and guidance on ongoing SCCWRP projects and activities and reviews and comments on SCCWRP technical reports.
- Liaison: CTAG members keep their respective agencies informed of SCCWRP activities. This includes communication both to Commissioners and to member agency staff. CTAG members also serve as points of contact between SCCWRP and their respective agencies and facilitate collaboration of their respective agencies with SCCWRP.
- Technology Transfer: CTAG provides an avenue for SCCWRP to transfer scientific and technical information to the member agencies on a wide range of topics pertinent to the broad responsibilities of these agencies.
- Interagency Interaction: CTAG provides a unique forum for exchange both between agencies in different roles (i.e., regulatory and regulated agencies) as well as among different agencies in similar roles.
- Special Projects: As the need arises, CTAG collaborates closely with SCCWRP staff on special projects that require a high level of integration of managerial, technical, and scientific issues. In this role CTAG provides the insights of the regulatory and regulated agencies.

The best-known regional effort is the collaborative Southern California Bight Marine Regional Monitoring Program. The last Bight monitoring program was estimated at over $7.5 M, but less than $750K actually came through SCCWRP. Virtually all of the field effort was conducted in-kind. Even most of the funding received was used for contractor support in field sampling and analysis. The trade-off is that while multiple entities each conducting fieldwork is less cost-effective, the levels of local experience and understanding of monitoring results are higher.

SCCWRP also organizes the Stormwater Monitoring Coalition of Southern California, which includes all of the stormwater agencies and Regional Boards from Ventura to San Diego counties.

One of SCCWRP's keys to success is the multi-disciplinary composition of its staff, which numbers about 50 employees. SCCWRP is comprised of internationally recognized analytical chemistry, benthic ecology, fish biology, watershed conditions, toxicology, and emerging research units, providing ready access to the range of skills needed to address complex environmental issues. SCCWRP has published nearly 200 technical reports and contributed to more than 300 articles in scientific journals.

Advice from the program' Deputy Director included the following:

- Be ready to invest lots of time into meetings if you want to do the program as a co-operative rather than a one-shop deal. Group-based, consensus-driven programs can be a struggle, but definitely worth the effort once everyone is vested into the program.
- Keep your monitoring design based around answering specific questions, not just collecting data for the sake of it. However, it's OK to change the question once you get a satisfactory answer. Managers should be making day-to-day decisions based on the information if the program is to remain viable for the long-term.

SAN GABRIEL RIVER REGIONAL MONITORING PROGRAM

Contact: Edward Belden, Water Programs Manager, 213-229-9947, edward@lasgrwc.org, www.lasgrwc.org/SGRRMP.html

A group of multiple stakeholders representing major permittees, regulatory and management agencies, and conservation groups developed the San Gabriel River Regional Monitoring Program (SGRRMP) in 2004. The development of the program was motivated by a permit condition for the Los Angeles County Sanitation District. The objectives of the program are to increase awareness of the importance of issues at the watershed scale and to improve the coordination and integration of monitoring efforts for both compliance and ambient conditions.

The SGRRMP is a watershed-scale counterpart to existing larger-scale regional monitoring efforts in the southern California region, for example SWAMP, USEPA's Western Environmental Monitoring and Assessment Program, the Southern California Bight Project, and the Stormwater Monitoring Coalition of Southern California (see previous section). The reduces redundancies within and between existing monitoring programs, targets monitoring efforts on contaminants of concern, and adjusts monitoring locations and sampling frequencies to better respond to management priorities in the San Gabriel River watershed.

The workgroup convened to prepare the SGRRMP identified five core questions that provide the structure for the regional program:

- What is the environmental health of streams in the overall watershed?
- Are the conditions at areas of unique importance getting better or worse?
- Are receiving waters near discharges meeting water quality objectives?
- Are local fish safe to eat?
- Is body contact recreation safe?

The resulting multi-level monitoring framework combines probabilistic and targeted sampling for water quality, toxicity, and bio-assessment and habitat condition.

CENTRAL COAST LONG-TERM ENVIRONMENTAL ASSESSMENT NETWORK (CCLEAN)

Contact: Dane Hardin, Program Director, Applied Marine Sciences, www.cclean.org

In 1998, the Central Coast Regional Water Board began encouraging the wastewater dischargers in the Monterey Bay area to fund the design of a regional monitoring program that would extend the Board's regional stream monitoring efforts into marine waters. Program participants include the City of Santa Cruz, City of Watsonville, Duke Power Plant, Monterey Regional Water Pollution Control Agency, and Carmel Area Wastewater District, who operate under a Memorandum of Agreement. The City of Watsonville is the Lead Agency for all financial and contractual matters.

The program is directed by a Steering Committee, which consists of a representative from each participant and the Central Coast Regional Board. A consultant (Applied Marine Sciences, Inc.) provides the Program Director, who oversees all technical aspects of the program, including supervision of contractors, data analysis and reporting. Participants fund the program through two funding elements. First, each participant pays $5,000 as an annual base fee. Second, the sum of the base fees is subtracted from the total program cost, including the Lead Agency's contract and invoice management costs, and the remaining cost is allocated to each participant on a prorated basis, according to their total volume of wastewater discharged to the ocean. Nonpoint dischargers are being integrated into the program and a separate funding formula for that component is being developed.

The goal of CCLEAN is to assist stakeholders in maintaining, restoring, and enhancing near-shore water and sediment quality and associated beneficial uses in the Central Coast region. This goal is being achieved by collecting, assessing, and disseminating scientifically rigorous information to facilitate sound resource management decisions regarding land-use practices, permitting issues, and wastewater treatment methods. Near-shore waters are defined as those estuarine or marine waters that are close enough to shore to be potentially affected by human activities within the Region. The specific objectives of the program are as follows:

- Obtain high-quality data describing the status and long-term trends in the quality of near-shore waters, sediments, and associated beneficial uses.
- Determine whether near-shore waters and sediments are in compliance with the Ocean Plan.
- Determine sources of contaminants to near-shore waters.
- Provide legally defensible data on the effects of wastewater discharges in near-shore waters.
- Develop a long-term database on trends in the quality of near-shore waters, sediments and associated beneficial uses.
- Ensure that the near-shore component database is compatible with other regional monitoring efforts and regulatory requirements.
- Ensure that near-shore component data are presented in ways that are understandable and relevant to the needs of stakeholders.

The CCLEAN monitoring program was implemented in 2001 and has evolved as data have answered some questions and revealed new ones. Initially, the program consisted of twice-per-year sampling (wet season and dry season) for concentrations of persistent organic pollutants (POPs) in wastewater effluent and POPs and bacteria in mussels at around Monterey Bay and monthly sampling of nutrients in rivers, streams and wastewater and bacteria along the 30-foot contour adjacent to wastewater discharges. Annual sampling of sediment for POPs and sediment characteristics, as well as benthic organisms, was implemented along the 80-meter contour, also in the first year. In the second year of the program, twice-per-year sampling of POPs in four major rivers was added to the program. In the third year of the program, twice-per-year sampling of POPs, nutrients and bacteria in ocean waters approximately 5.5 miles offshore in Monterey Bay was begun. Additional data synthesis is performed by NOAA.

Annual costs of the base program have averaged approximately $400,000. Since 2004, CCLEAN has been awarded nearly $2M through grants from the State Water Board to study the effects of POPs on sea otters and the geographical and biological sources of fecal pathogens and the relationship between their concentrations in the environment and the concentrations of indicator bacteria. Over the next five years, CCLEAN will incorporate storm runoff monitoring, begin sampling emerging contaminants of concern and screening wastewater for endocrine disrupting activity.

CCLEAN participants indicate that the most important activity in designing a regional monitoring program is developing consensus among stakeholders regarding program goals and objectives. With CCLEAN, when it was agreed that protection of beneficial uses was a high priority, evidence of impairments was sought from stakeholders and the published scientific literature, which then guided decisions about what to measure. The program has been effective in determining the largest sources of contaminants to marine waters in the Monterey Bay area and the effects of those contaminants. This information has identified several impairments to beneficial uses that were not previously known and has informed management decisions about how to reduce those impairments.

CHESAPEAKE BAY PROGRAM

Contact: Peter Tango, Chesapeake Watershed Monitoring Coordinator, USGS/CBPO, 410-267-9875, http://www.chesapeakebay.net/monitoring.aspx?menuitem=19916

The Chesapeake Bay Program is coordinated through the Chesapeake Bay Program Office, housed in Annapolis, Maryland. Since the early 1980s, EPA has provided funding to this office to support the restoration partnership. Through an annual appropriation from Congress, the EPA office provides the scientific, analytical and coordinating functions to make the partnership work. Since 1995, EPA funding of the Bay Program Office has remained steady at about $20 million annually. Approximately 15% ($3 million) is used for monitoring programs.

The Chesapeake Bay Monitoring Program began in 1984. The long-term monitoring program coupled measures of nutrient and sediment loading with a largely fixed-site monitoring program measuring physical, chemical and biological parameters. Analysis of results has provided status and trend tracking information for assessing Bay conditions. Monitoring also fed calibration and verification data to the Chesapeake Bay Modeling Program, aiding the understanding of Bay status and potential paths to restoration progress through examination of management scenarios.

Nutrient and sediment loading targets for watersheds have recently been developed based on desired goals of habitat condition attainment for the support of Bay life.

The monitoring program has evolved in its utility and effectiveness at addressing diverse management needs of the community. Beyond status and trends, long-term data have been used to define water quality criteria protective of living resources. Technological advances in monitoring (e.g. DATAFLOW, CONMON) now provide data for environmental assessment and interpretation at scales that were not available in the 1980s. Statistical analysis of results has grown with new approaches to load trend estimations (ESTIMATOR: USGS), the addition of criteria assessment methodologies (e.g. Cumulative Frequency Distributions), indices of biotic integrity (e.g. BIBI, PIBI) and similar indices (BHHI – UMCES Report Card) to the package of status and trends measures that sustain Bay health reporting.

The monitoring network goals and objectives are described as follows.

- The primary objective of the Tidal Monitoring Network was to provide water quality information necessary for assessing the new water quality criteria for dissolved oxygen, water clarity and chlorophyll, with the goal of removing the Bay and its tidal rivers from the list of impaired waters.
- Secondary objectives would provide information for defining the nutrient and sediment conditions necessary for protecting living resources (e.g. water quality to support crabs, oysters and fish) and vital habitats (water quality to support submerged aquatic vegetation).
- Water quality information would also be available to support the refinement, calibration and validation of the Chesapeake Bay Water Quality Model.
- Nontidal water quality monitoring has had a principle purpose of supporting the development of load estimates from the free-flowing tributaries to the Chesapeake Bay (STAC 2005).
- The regional interest in multi-species fisheries management, as well as indicators of the Bay's health, has rekindled interest in routine zooplankton monitoring for the tidal waters of Chesapeake Bay and its tributaries (Olson et al. 2005).

Further utility of the Chesapeake Bay Program monitoring results include annual federal reporting requirements:

- Mandatory reporting to Congress: Reports to Congress are required every five years that include measures of health and restoration. For health, it states the specific years to compare with the current year are 1985, 1995 and 2005. For the jurisdictions, there are the mandatory 303d/305b regulatory criteria reporting needs.
- GAO and Omnibus Appropriations – Set annual targets, actual actions for 2008, 2009 and 2010, funding levels and agencies responsible and have a way to measure progress.
- US EPA Strategic Plan – further requires monitoring information in reporting.
- OMB PART – requires the setting of targets and measuring action over those targets. Annual targets tend to be restoration goals (load reductions of P, N and sediment, forest buffers, etc.). SAV and dissolved oxygen are longer term outcomes measured annually against a 5 year target.

Products serving the reporting role include:

- Annual Bay Health Assessment Reports – 2005, 2006 and 2007.
- Annual Bay Restoration Reports – 2005-2007
- Chesapeake Bay Report Card – UMCES 2005-2007
- Ecological Forecasting and Tracking newsletters – EcoCheck, 2005-2007.

The River Input Monitoring Program network is used to estimate annual loads from large watersheds, support data integrated with the Chesapeake Bay watershed modeling effort that captures land- and air-based activities, and couple BMP implementation and provides nutrient and sediment loadings outputs to the Chesapeake Bay Water Quality Model. A MOU was signed to expand the network by as many as 100 sites.

The Shallow Water Monitoring program provides intensive spatial mapping, at biweekly intervals, combined with the application of cumulative frequency distribution assessments of specific criteria attainment. Sentinel sites have been established. Integration with modeling needs and utility remains a challenge. Continuous monitoring data are: (1) abundant but less well integrated into criteria attainment, model refinement and assessments, (2) have not been defined as per what a site represents, and (3) have no habitat characteristics measured to associate with site data behavior at this time. Event-related assessments (fish kills, algal blooms, standing waves) have been captured but are not criteria-specific applications of the program elements.

The Chesapeake Bay monitoring database is one of the most comprehensive compilations of its kind nationally and internationally. The incorporation of new technologies into achieving monitoring needs for management continues to advance the program.