SWAMP
Surface Water Ambient Monitoring Program

DRAFT

2010 SWAMP Strategy

2010 Update of the Comprehensive Monitoring and Assessment Strategy to Protect and Restore California's Water Quality

Prepared by the Surface Water Ambient Monitoring Program

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California Water Boards

www.waterboards.ca.gov/swamp

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Coordination and collaboration promote consistency and minimize duplication of effort. In that spirit, this document borrows liberally from the work of others. Most of the elements of the Surface Water Ambient Monitoring Program (SWAMP) have been patterned after successful efforts that individual regions, other agencies, and other states are implementing. The result is a stronger, more cost effective program in terms of design and implementation. In particular, Terry Fleming at the U. S. Environmental Protection Agency, Region 9, the members of the SWAMP Roundtable, and the National Water Quality Monitoring Council have influenced the development of this document.

This SWAMP Strategy is built on the original SWAMP Strategy (2005), the SWAMP Scientific Planning and Review Committee (SPARC) report (SPARC, 2006), and reports from the California Water Quality Monitoring Council (CWQMC, 2008 and 2010).

Executive Summary

This document is an update to the Surface Water Ambient Monitoring Program (SWAMP) *Comprehensive Monitoring and Assessment Strategy to Protect and Restore California's Water Quality* (Strategy) developed in 2005. This 2010 Strategy update reports on the progress SWAMP has made in the first five years of a ten-year effort to develop a coordinated and comprehensive monitoring framework for Water Board programs. It also highlights steps that need to be implemented to complete the framework and integrate it into other Water Board programs and improve coordination among other state agencies, local agencies and districts, and non-governmental organizations that monitor surface water throughout the state. The Strategy is organized into the USEPA's 10-elements of a comprehensive monitoring program. The goals remain the same as in the 2005 Strategy with updated objectives (which are not listed in order of priority).

SWAMP's mission is to provide resource managers, decision makers, and the public with timely information to evaluate the condition of surface waters throughout California. SWAMP accomplishes this through carefully designed, externally reviewed monitoring programs, and by assisting other entities statewide in the generation of comparable data that can be brought together in integrated assessments that provide answers to current management questions. The SWAMP program has established the following guiding principles as the foundation upon which to prioritize its activities:

- SWAMP monitoring evaluates the physical, chemical, and biological integrity of California's waters.
- Monitoring and assessment at both statewide and regional levels is necessary to protect and restore water quality.
- Monitoring of both high quality waters and those known or suspected to be degraded is essential to a robust ambient monitoring program.
- Monitoring is designed to support a network of information users that include state, federal, and local agencies, the regulated community, the interested public, and their elected representatives.
- Monitoring efforts are prioritized, and coordinated to maximize utility and minimize costs.
- SWAMP seeks to make the most efficient use of data collected by all Water Board programs, as well as the large amount of data collected by other agencies and the regulated community.

In 2008, the California Water Quality Monitoring Council (CWQMC) was formed to develop a 10-year comprehensive monitoring program strategy for coordinating the water quality and related ecosystem monitoring, assessment, and reporting activities among the various boards, departments, and offices at the California Environmental Protection Agency (CalEPA), the California Natural Resources Agency, the Department of Public Health, and other governmental and non-governmental organizations that monitor California's waters.

The Secretaries of the CalEPA and the California Natural Resources Agency signed a Memorandum of Understanding (MOU) that requires the boards, departments and offices within the two agencies to integrate and coordinate their water quality and related ecosystem monitoring, assessment, and reporting. The SWAMP Strategy has been updated to include coordination with CWQMC efforts and will be appended to the CWQMC's strategy.

The SWAMP Strategy also incorporates the operating principles, monitoring goals, monitoring objectives and strategies of the State Water Board's Strategic Plan. The SWAMP Strategy is a living document that will be updated every five years. The Strategy will serve as the framework for monitoring priorities at both the State and Regional Water Boards.

The SWAMP was created to fulfill the State Legislature's mandate for a unifying program that would strive to coordinate all water quality monitoring conducted by the State and Regional Boards to assess attainment of all core beneficial uses in all water body types. Therefore, continued implementation of the SWAMP monitoring and assessment programs at both the state and regional scales remains a top priority. However, existing resources are not sufficient for the SWAMP to monitor all water bodies for all beneficial uses, so efforts have been focused on a few statewide assessments of key beneficial uses and supporting regional monitoring. Improving coordination with other Water Board programs and external partners also is identified as a priority throughout this Strategy.

As resources decrease, the need for coordination increases. It is important to note that implementation of the SWAMP's monitoring programs and coordination activities are not mutually exclusive. In fact, each has the potential to inform and enhance the other. For example, the monitoring design for a regional watershed assessment may be different than that for an NPDES discharger, but through coordination and appropriate monitoring design these types of programs can often be nested so that the information from the watershed program informs the NPDES assessment and vice versa. In addition, coordination of monitoring activities with other Water Board programs and partners allows opportunities for logistical and cost advantages (e.g., leverage resources, avoid duplication, share data). The SWAMP supports citizen monitoring throughout the state via the Clean Water Team. A Copy of the Comprehensive Monitoring and Assessment Strategy for the Citizen Monitoring Program is in Appendix A). The Clean Water Team is also critical in operating the California Water Quality Monitoring Collaboration Network.

Finally, the SWAMP has been a leader in developing the monitoring infrastructure (e.g., indicators, methods, quality assurance/quality control [QA/QC], and data management) necessary to support a robust monitoring program while also fostering data comparability and collaboration with monitoring partners. The continued development, maintenance, and implementation of the crucial monitoring infrastructure is another priority for the program.

The SWAMP's Core Implementation Priorities

Statewide & Regional Monitoring & Assessment	Coordination	Infrastructure & Tools
▪ Implement statewide and regional monitoring programs ▪ Guide development of assessment tools that transform data into information on beneficial use support in all state waters. ▪ Apply these assessment tools to monitoring data gathered by SWAMP and others to produce timely, high-quality information for resource management. ▪ Improve and strengthen SWAMP (via coordination, partnerships, peer review, training, funding, etc.) so that it fulfills its monitoring and assessment goals at statewide and regional scales.	▪ Engage Water Board regulatory and assessment programs to integrate SWAMP monitoring designs, data, and assessment tools into regional and statewide programs. ▪ Coordinate with the CWQMC to prioritize waterbody types and beneficial uses that SWAMP is responsible for assessing and collaborate with and provide guidance to partner organizations that assess those waterbody types and beneficial uses that are not assessed by SWAMP. Lead the CWQMC work groups on fish consumption safety and stream/lake/river ecosystem health, and develop the web portals to make data and assessments available to decision makers and the public.	▪ Implement Quality Assurance and Data Management Programs to support SWAMP statewide and regional monitoring programs, and to provide tools for partners to produce comparable data. ▪ Implement the SWAMP statewide assessment framework and standards for data comparability, that allow local entities to both contribute data to statewide assessments and view the results of those assessments as context for local monitoring and management.

Introduction

Adequate and accurate monitoring and assessment information is fundamental to preserving, enhancing, and restoring water quality. The information gathered from Water Board monitoring activities is critical to protect the beneficial uses of water, develop water quality standards, conduct federal Clean Water Act assessments, and to determine the effects of pollution and the success of pollution prevention and water quality improvement programs.

The federal Clean Water Act assigns states the primary responsibility for implementing programs to protect and restore water quality. The Clean Water Act (Section 106[e]) requires the U.S. Environmental Protection Agency (USEPA) to determine that a state has established and is operating appropriate methods, systems, and procedures necessary to monitor, and to compile and analyze data on, the quality of navigable waters. In fact, before USEPA will award Section 106 grants, states must report their monitoring and assessment activities and submit that information in their obligatory Section 305(b) reports. However, SWAMP was envisioned to do more than simply fulfill statutory reporting obligations. The program was designed to reach beyond those federal requirements and coordinate a statewide monitoring and assessment framework to improve reporting of the Water Boards efforts and successes in preserving, enhancing, and restoring California's waters.

To meet the Clean Water Act objectives, the Water Boards should be able to answer the following questions:

- What is the overall quality of California's surface water?
- What are the trends in surface water quality over time?
- What are areas needing further protection?
- What are the causes of identified impairments?
- Are the Water Board programs effective?

This Strategy presents SWAMP's vision to fulfill California's Clean Water Act responsibilities and the Water Board's blueprint (outlined in the Strategic Plan 2002, 2008) for improving our monitoring, assessment and reporting activities, to foster a better informed public that translates into behavior changes that ultimately improve water quality.

This 5-year update of SWAMP's 2005 Strategy modifies the long-term implementation plan and its 10-year timeline. This SWAMP Strategy is built on the original SWAMP Strategy (2005), the SWAMP Scientific Planning and Review Committee (SPARC) report (SPARC, 2006), and reports from the California

Elements of a State Water Monitoring and Assessment Program

1. Monitoring Program Strategy
2. Monitoring Objectives
3. Monitoring Design
4. Core Indicators of Water Quality
5. Quality Assurance
6. Data Management
7. Data Analysis/Assessment
8. Reporting
9. Programmatic Evaluation
10. General Support and Infrastructure

Water Quality Monitoring Council (CWQMC, 2008 and 2010).

This document follows the format of USEPA's (2003) *Elements of State Water and Monitoring and Assessment Program*. This Strategy outlines SWAMP's activities in each of the 10 basic monitoring program elements. For each of the elements, we first report the current status of the program and then discuss our activities and plans to implement the Strategy.

1 Strategy

SWAMP's mission is to provide resource managers, decision makers, and the public with timely, high-quality information to evaluate the condition of surface waters throughout California. There were three basic goals outlined in the original Strategy (SWAMP, 2005):

Goal 1.1 Develop SWAMP monitoring strategy for developing and implementing an integrated comprehensive statewide monitoring program in 10 years.

Goal 1.2 Implement the SWAMP monitoring strategy.

Goal 1.3 Promote coordination of monitoring activities and comparability of data.

Current Status

The SWAMP was created in 2000 in response to Assembly Bill 982 (Ducheny, Statutes of 1999) to fulfill the State Legislature's mandate for a unifying program that would coordinate all water quality monitoring conducted by the State and Regional Boards to assess attainment of all core beneficial uses in all water body types. The SWAMP monitoring strategy (SWAMP, 2005) was based on the USEPA's (2003) *Elements of a State Water Monitoring and Assessment Program* and the National Water Quality Monitoring Council framework. It is guided by a Roundtable[1] of experienced State and Regional Water Board monitoring coordinators, has continuing access to university and agency experts in chemistry, toxicology, ecology, and hydrology, and has undergone two formal scientific reviews by external national and international experts. In 2006, there was an overall program evaluation by the Scientific Planning and Review Committee (SPARC). The SPARC comments were incorporated into the SWAMP planning. The recommendations are formally adopted into this update of the SWAMP Strategy.

The first few years of the program were dedicated primarily to supporting Regional Water Board programs and developing the monitoring infrastructure and tools necessary to enhance data comparability and data sharing (SWAMP Quality Assurance Program and Data Management Program). The SPARC Report (2006) commended SWAMP's efforts to develop the monitoring infrastructure and to support Regional Water Board programs, and applauded the Regional Water Boards' entrepreneurial spirit and ability to leverage their efforts. However, it also recommended to SWAMP that it expand its efforts to develop robust statewide assessments and a statewide framework to provide information to multiple users for multiple uses. To meet these goals, the SWAMP needed to design and implement probability-based statewide surveys, prioritize its monitoring efforts to address declining

[1] The SWAMP Roundtable is the coordinating entity for the program. Participants include staff from the State and Regional Water Boards, the Department of Fish and Game, the Marine Pollution Studies Lab, Moss Landing Marine Laboratories, contractors and other interested entities.

budgets, and simultaneously seek to maximize the utility of data collected by the various Water Board programs.

In response to the SPARC (2006) review, SWAMP has shifted its strategy toward greater collaboration with partners. This includes greater integration of SWAMP monitoring and assessment activities with other Water Board programs and external partners. SWAMP initiated efforts on many statewide and regional fronts to align sites and schedules with partners who monitor similar waterbody types and beneficial uses. These partners include stormwater agencies, municipal wastewater dischargers, and irrigated lands regulatory programs. SWAMP is continuing its outreach and coordination with these groups. To further facilitate opportunities for collaboration, SWAMP has invited liaisons from other Water Board programs to attend SWAMP Roundtable meetings, and SWAMP liaisons strive to attend the Roundtables of other Water Board programs [Goal 1.3].

The California Water Quality Monitoring Council (CWQMC) was convened in 2008 as a result of SB1070 (Kehoe, Statutes of 2006), which was passed by the Legislature and signed by the Governor in 2006. The CWQMC is tasked with coordinating water quality and related ecosystem monitoring efforts throughout California, with the goal of addressing as many water quality management needs for as many state waters as possible with available funding, including all waterbody types (such as streams, rivers, lakes, reservoirs, estuaries, coastal areas, and wetlands). In June, 2010, SWAMP and the CWQMC held a joint meeting to align strategies and strategy documents. It was agreed that the SWAMP should focus its limited funds for statewide assessments on two questions: "Is it safe to eat the fish?" and "Is aquatic life protected in freshwater streams?" By working with partners and within the CWQMC framework, this Strategy seeks to address as many water quality management needs for as many state waters as possible with available funding, including all waterbody types (such as streams, rivers, lakes, reservoirs, estuaries, coastal areas, and wetlands), and all core beneficial uses (swimmable, fishable, drinkable, and aquatic life support). This coordination allows SWAMP to focus its statewide monitoring on beneficial uses associated with fish consumption in major water body types and aquatic life use in streams.

Types and Extent of Water Bodies: California is a vast state with 158,700 square miles of surface area and a wide range of water bodies.

WATER BODY CLASSIFICATION	EXTENT
Total Miles of Rivers and Streams	211,513
Perennial River Miles	64,438
Intermittent Stream Miles	124,615
Ditch and Canal Miles	22,059
Number of Lakes/Reservoirs/Ponds	10,141
Acres of Lakes/Reservoirs/Ponds	1,672,684
Miles of Shoreline	3,427
Acres of Wetlands	273,880

The implementation of the monitoring programs and coordination activities are not mutually exclusive. In fact, each has the potential to inform and enhance the other. The SWAMP monitoring infrastructure (e.g., indicators, methods, quality assurance/quality control [QA/QC], and data management) support SWAMP monitoring but also foster data comparability and collaboration with monitoring partners.

Core Implementation Priorities

Statewide & Regional Monitoring & Assessment

- Implement Statewide and Regional monitoring and assessment programs.
- Guide development of assessment tools that transform data into information on beneficial use support in all state waters.
- Apply these assessment tools to monitoring data gathered by SWAMP and others to produce timely, high quality information for resource management.
- Improve and strengthen SWAMP so that it fulfills its monitoring and assessment goals at statewide and regional scales.

Coordination

- Engage Water Board regulatory and assessment programs to encourage active integration of SWAMP monitoring designs, data, and assessment tools into regional and statewide programs.
- Coordinate with the CWQMC to prioritize waterbody types and beneficial uses that SWAMP is responsible for assessing and collaborate with and provide guidance to partner organizations that assess those waterbody types and beneficial uses that are not assessed by SWAMP. Lead the CWQMC work groups on fish consumption safety and stream ecosystem health, and develop the web portals to bring those assessments to decision makers and the public.

Infrastructure & Tools

- Implement Quality Assurance and Data Management Programs to support SWAMP statewide and regional monitoring programs and provide tools for partners to produce comparable data.
- Implement the statewide assessment framework and standards for data comparability, that allow local entities to both contribute data to statewide assessments and view the results of those assessments as context for local monitoring and management.

Guiding Principles

- SWAMP monitoring evaluates the physical, chemical, and biological integrity of the State's waters.
- Monitoring at both statewide and regional levels is necessary to protect and restore water quality
- Monitoring of both high quality waters and waterbodies known or suspected to be degraded is essential to a robust ambient monitoring program.
- Monitoring is designed to support a network of information users that include state and local agencies, the regulated community, the interested public, and their elected representatives.
- Monitoring efforts are prioritized, and coordinated to maximize utility and minimize costs.
- SWAMP seeks to make the most efficient use of data collected by all Water Board programs, as well as the large amount of data collected by other agencies and the regulated community.

Objectives

Implementing the aforementioned priorities has been the focus of the statewide SWAMP effort for the past three years. Specific actions to continue implementation of these priorities involve multiple strategy elements.

Objective 1.1. Continue to refine and update the SWAMP Strategy [Goal 1.1]

- Integrate the SWAMP Strategy with the CWQMC's strategy to identify gaps in the State's assessment activities, and prioritize SWAMP statewide and regional monitoring to address those gaps and fulfill Clean Water Act requirements.
- Update the SWAMP Assessment Framework (*see Appendix B*) as new assessment tools and strategies become available.
- Update the SWAMP Needs Assessment (*see Appendix C*) in conjunction with future updates to the Strategy.
- Update the SWAMP Strategy document at least every 5 years.

Objective 1.2. Implement the Strategy [Goal 1.2]

- Continue to work through the Roundtable to align the objectives and designs of Regional Board and statewide monitoring to increase opportunities for collaboration and leveraging (elements 2 and 3).
- Continue to support development of new indicators and assessment tools that can be used throughout the state by the various Water Board programs (element 4).
- Continue to build monitoring infrastructure to ensure comparability and enhance sharing of data among State and Regional Board programs (elements 5 and 6).
- Continue to perform monitoring at state and regional scales and prepare assessment reports that inform management, increase the visibility of the program and demonstrate the utility of the program (elements 7 and 8).
- Continue to evaluate the program to ensure that it remains technically sound and to ensure that the information being generated is meeting Water Board needs (element 9).
- Assess needs of the SWAMP program on an annual basis to ensure there is adequate program staff to administer the program at the Water Boards and to maintain and enhance the expertise and capabilities of the SWAMP contract laboratories to allow continued high quality monitoring and assessment (element 10).

Objective 1.3. Institutionalize SWAMP's monitoring and assessment framework into other Water Board programs that require ambient surface water quality monitoring [Goal 1.3]

- Seek support at the State Board level to encourage programs to coordinate ambient monitoring efforts through SWAMP.

Clean Water Team

The Clean Water Team (CWT) works to build and support the State's Watersheds Stewardship through involvement by Citizen Monitoring in order to reduce and prevent water pollution and recover lost beneficial uses.

Citizen Monitoring is any monitoring activity of aquatic resources, aquatic habitat, and or water quality that relies in whole or in part on participation by volunteers, students or non-paid staff. All across California and the nation, citizen monitors are monitoring the condition of streams, rivers, lakes, reservoirs, estuaries, coastal waters, wetlands, and wells. Their efforts are of particular value in providing quality data and building stewardship of local waters.

The CWT has been busy working at local levels to help create steering teams and consortiums. These steering teams and consortiums allow citizen monitoring groups and projects to grow through local networking and using shared resources of monitoring knowledge, skills and training. Self reliance and sustainability of these resources will foster the development of robust monitoring programs and promote the long term growth of citizen monitoring and watershed stewardship. To date there are seven organizations located throughout the state: Citizen Monitors of Orange County, Coastal Watershed Council, San Diego Citizen Watershed Monitoring Consortium, San Francisco Estuary Institute, Sierra Nevada Alliance, Sierra Streams Institute, and Stevens and Permanente Creeks Watershed Council.

The CWT assists these groups through six core functions: outreach and communication, technical assistance/quality assurance, training, loans of equipment, event support, and information management.

- Increase the usefulness and visibility of SWAMP information products to make them more valuable to decision makers and the public, thereby increasing support for the program;
- Meet with programs to understand their assessment needs and seek to optimize designs of statewide programs to maximize utility for Water Board programs
- Increase the number of Water Board programs that utilize SWAMP data, standards and guidance.

Objective 1.4. Coordinate with other Regional and State monitoring programs [Goal 1.3]

- Participate in the CWQMC to identify areas of potential coordination with other agencies within CalEPA and the Resources Agency.
- Coordinate with existing and developing RMPs, including those in the Lake Tahoe basin, Klamath watershed, San Francisco Bay, Sacramento/San Joaquin Delta, San Joaquin watershed, Central Coast, Los Angeles and San Gabriel Rivers watershed, and Southern California Bight.

- Support development of new RMPs to cover additional regions of the state.
- Continue to support citizen's monitoring programs through the Clean Water Team.

2 Monitoring Objectives

Our vision is to clearly articulate monitoring objectives as attainable targets for producing the information needed to answer assessment questions at the statewide and Regional levels.

Goal 2.1 Define statewide monitoring objectives

Goal 2.2 Define regional monitoring objectives

Goal 2.3 Develop consensus on shared objectives

Current Status

In November 2000, SWAMP submitted a comprehensive set of objectives to the State Legislature <hyperlink to document>. In February 2005 the SWAMP Roundtable held a workshop to articulate monitoring objectives that could be applied at both State and Regional Water Board scales. There was consensus that the objectives of all Water Board programs could be framed around the protection of core beneficial uses: aquatic life, "swimmable", "fishable", and "drinkable". There are over 25 beneficial uses that vary by waterbody within each Region. However, the concept of core beneficial uses is useful as an organizing framework for monitoring around core uses shared by most waterbodies (Table 1). Protecting these "core beneficial uses" is likely to protect most other beneficial uses.

There also was consensus at the workshop that regardless of beneficial use or waterbody type the monitoring objectives of most Water Board programs could be framed around the following five key questions.

1. **What is the overall quality of waters in the Regions and the State?** CWA *Section 305(b)* requires that states determine the extent to which their waters meet the objectives of the CWA, attain applicable water quality standards, and provide for the protection and propagation of balanced populations of fish, shellfish and wildlife (*40 CFR 130.8*).
2. **To what extent is water quality changing over time?** The California Water Boards must assess and report on the extent to which control programs have improved water quality or will improve water quality for the purposes of "the protection and propagation of a balanced population of shellfish, fish, and wildlife and . . . recreational activities in and on the water" (*40 CFR 130.8[b][2] and 130.8[b][1]*). Under *Section 319(h)(11)* of the CWA, the California Water Boards must report on reductions in non-point source loadings and related improvements in water quality. Under *Section 314(a)(1)(F)*, a state must report on the status and trends of water quality in lakes. The California Water Boards should also be able to identify emerging environmental issues related to new pollutants or changes in activities within watersheds.
3. **What are the problem areas and areas needing protection?** Under *Section 303(d)*, the California Water Boards must identify impaired waters. The California Water Boards should also identify waters that are currently of high quality and should be protected from degradation per the State Water Board's Antidegradation Policy. In order to protect and

restore waters, monitoring and assessment programs should identify the causes and sources of impairment.

4. **What level of protection is needed?** The USEPA and the California Water Boards establish the level of protection that monitoring data should be evaluated against. For example, the California Water Boards use data from monitoring programs to conduct triennial reviews of state water quality standards and Basin Plans, develop and adopt revised designated uses and water quality criteria, establish water quality-based effluent limits in NPDES permits, establish TMDLs and assess which levels of management measures (MMs) are most appropriate for nonpoint sources.
5. **How effective are clean water projects and programs?** The California Water Boards should monitor to evaluate the effectiveness of specific projects and overall programs, including but not limited to *Section 319* (nonpoint source control), *Section 314* (Clean Lakes), *Section 303(d)* total maximum daily loads (TMDLs), *Section 402* NPDES permits, *Section 401* water quality certifications, water quality standards modifications, compliance programs (Discharge Monitoring Report information) and generally to determine the success of management measures, especially those implemented with state funds.

SWAMP monitoring is built around these core uses and the five management questions. These are the five basic questions that should be asked by all the Water Board programs whether they be at the State or Regional Board level. The objectives of all SWAMP monitoring at the regional and statewide scales are framed around answering one or more of these five questions for a particular beneficial use and waterbody(s) combination.

The Monitoring objectives for the Regional Water Board have been developed for each of the nine Regions and are updated annually (see Regional Fact Sheets, Appendix D). Regional Water Boards are often required to conduct *ad hoc* monitoring on short notice to address immediate threats to water quality. The SWAMP framework provides the flexibility to Regional Boards to address these issues.

The SPARC recommended that SWAMP focus its *statewide* assessment efforts on fewer waterbody/beneficial use combinations and coordinate with other monitoring programs to address other waterbody/beneficial use combinations. SWAMP responded by limiting its statewide efforts to two critical assessment needs: fish consumption safety in all fishable waters and aquatic life in freshwater rivers and streams (Table 1).

The goal of the SWAMP Bioaccumulation Monitoring Program is to address the “Fishable” use through surveys of contaminant concentrations in fish tissue throughout waters of the state (lakes, coastal waters, rivers). The monitoring program has the following objectives: 1) determine the proportion of lakes, streams, and coastal sites in which edible fish tissues exceed thresholds for specified contaminants; 2) conduct screening of California waters to identify problem areas where additional monitoring should be conducted to determine whether a fish consumption advisory should be developed; and 3) determine, over the longer term, whether these proportions and contaminant concentrations are increasing or decreasing to evaluate the effectiveness of management actions in reducing contamination.

Table 1. SWAMP statewide monitoring programs organized according to beneficial use and waterbody combination

Water Body Type	Core Beneficial Use			
	Aquatic Life	"Swimmable"	"Fishable"	"Drinkable"
Wadeable Streams	SWAMP – Statewide (Bioassessment & SPoT)		SWAMP – Statewide (Bioaccumulation)	
Large Rivers	SWAMP – Statewide (SPoT)			
Lakes				
Estuaries				
Ocean, Coastal, Bays				
Wetlands				

The goal of the Bioassessment Monitoring Program's Perennial Streams Assessment is to assess the "Aquatic Life" use in wadeable streams throughout the state. The objectives of the monitoring program are to 1) determine the percentage of California's perennial wadeable streams that are in good, fair, and poor ecological condition and identify high quality watersheds; 2) provide baseline data for assessing trends over time at both impaired and high quality waters; 3) determine the proportion of stream length associated with various stressors to ecological condition; and 4) determine the relative risks to ecological condition associated with these stressors.

The goal of the Stream Pollution Trends (SPoT) monitoring program is to assess trends in stressors that may be affecting aquatic life in rivers and streams. The objectives of the monitoring program are to 1) determine long-term trends in stream contaminant concentrations and their biological impacts statewide; 2) relate water quality indicators to land-use characteristics and to the effectiveness of agency management efforts; and 3) establish a network of sites throughout the state to serve as a backbone for collaboration with local, regional, & federal monitoring programs.

The waterbody by beneficial use framework along with the five core management questions has been adopted by the CWQMC as an organizing principle in their efforts to coordinate and integrate monitoring and assessment activities within CalEPA and the Resource Agencies.

Objectives

SWAMP will use the beneficial use framework and the five management questions as an organizing framework to integrate SWAMP efforts with other Water Board programs and leverage monitoring and assessment efforts. The integration of SWAMP monitoring infrastructure within Water Board programs will result in better performance measure outcomes for all programs that address the question as to whether the programs are effective.

Objective 2.1: SWAMP will work with programs at the State and Regional Boards to determine how objectives of the three statewide programs can be refined to better support Water Board programs [Goal 2.1]

- BOG will continue to work with Regional Boards to make information accessible and useful to Water Board programs (methyl mercury, listings).
- The Bioassessment workgroup will work with Water Board programs determine how results from the perennial stream survey can be used to support the objectives of Water Board Programs (e.g., Assessment, Nonpoint Source, NPDES and Stormwater) and policies under development (e.g., Riparian Policy, Hydromodification Policy).
- SPoT will continue to work with Regional Boards to evaluate effectiveness of programs to reduce pollutant concentrations and loads at the watershed scale.

Objective 2.2: Continuing evaluation and review of the specific monitoring objectives for Regional Water Board programs [Goal 2.2]

- Regional Water Board SWAMP coordinators will continue to prepare peer-reviewed monitoring plans that identify specific monitoring objectives for monitoring projects.
- Regional Water Board SWAMP coordinators will continue to make information available to staff working on 305(b) and 303(d) assessments.
- Regional Water Board SWAMP coordinators will continue to use objectives to coordinate/integrate/leverage resources within their Region.
- Regional Water Board SWAMP coordinators will work with programs to prioritize and refine objectives to meet Regional needs

Objective 2.3: Guidance for developing monitoring objectives for partner programs [Goal 2.3]

- SWAMP will continue to work with partner programs at the Water Boards to align monitoring objectives with the Clean Water Act objectives
- SWAMP will continue to work with its CWQMC workgroup partners to develop the Safe to Eat Fish Portal and the Healthy Streams Portal.
- SWAMP will continue to work through the CWQMC to identify agency efforts that can be used to address other waterbody/beneficial use combinations.

3 Monitoring Design

Our vision is to develop scientifically sound monitoring designs to guide efficient collection of data to meet SWAMP's monitoring objectives with available resources, and to coordinate monitoring designs among SWAMP programs, other Water Board programs, and other agencies and partners through the CWQMC. The goals expressed in the 2005 Strategy for monitoring design were:

Goal 3.1 Refine management questions for assessing core beneficial uses for all waterbody types

Goal 3.2 Inventory management questions of existing programs and monitoring entities

Goal 3.3 Develop strategy to answer assessment questions for each waterbody type

Goal 3.4 Design cost-effective monitoring program(s)

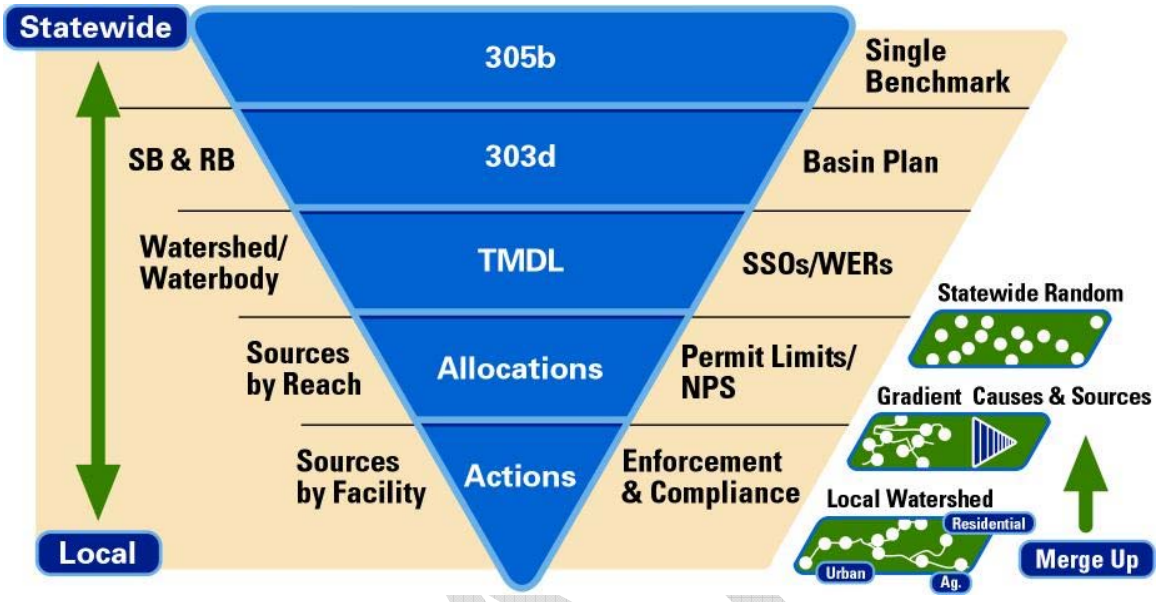
Goal 3.5 Develop and implement a suite of predictive tools to maximize our ability to effectively manage water quality.

Current Status

SWAMP developed a set of objectives and management questions that are consistent with those of other Water Board programs (Section 2). However, even programs with similar monitoring objectives may need to approach the questions at different scales and may require different monitoring designs. For instance, the NPDES program may focus on differences upstream and downstream of a discharger, the Non-point source program may be concerned with restoration at the watershed scale. No single design can meet the needs of all Water Board programs. However, SWAMP has developed the monitoring infrastructure (indicators, methods, QA/QC, and data management) to allow data collected at different scales by various Water Board programs to be integrated (Figure 1). SWAMP is working each of the major Water Board programs to identify and refine their monitoring questions so that different monitoring designs can be nested within a consistent statewide framework.

A continuing goal of SWAMP is to integrate its monitoring designs so that data collected at certain sites and times can be used for more than one program. Beyond the logistical and cost advantages, there are informational advantages because statewide programs provide perspective for regional monitoring and regional programs provide finer detail for the statewide programs (Figure 1). This enhances the value of each assessment for resource management decision making. At a minimum such evaluation of monitoring design should be conducted to avoid duplication of Water Board efforts. The ultimate objective is to better refine the management questions and align monitoring efforts of SWAMP with those of other Water Board programs.

Figure 1. Statewide assessment framework that allows assessment of different monitoring questions at different special scales.



The monitoring performed by Regional Water Board programs is predominantly targeted monitoring. This design is good for evaluating trends at a particular location, for comparing conditions upstream-downstream of a particular source for compliance purposes, and for performing general gradient analyses. However, the results from targeted analyses cannot be generally extrapolated in space (upstream or to the watershed as a whole). Furthermore because monitoring funds tend to be limited, this type of monitoring tends to be located in known problem areas. As a result the information from targeted monitoring programs tends to give a biased (i.e., more polluted) picture of the state as a whole (Rehn and Ode, 2009).

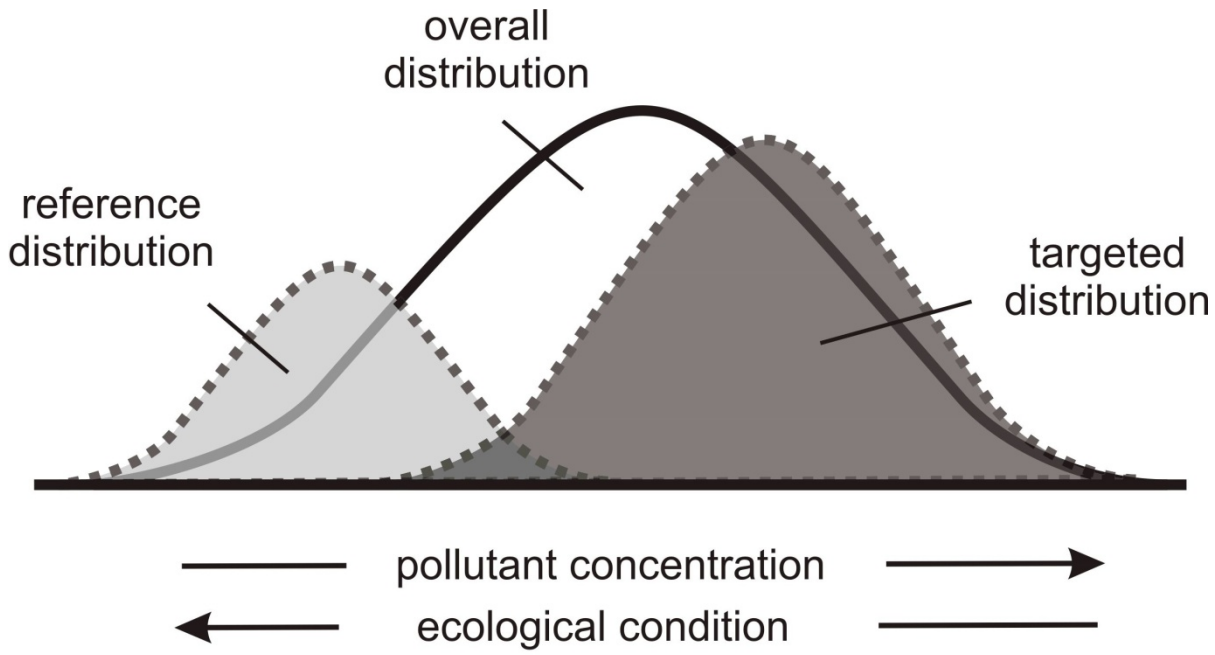
Probability-based monitoring designs are used to provide unbiased estimates of statewide or regional condition. They are better suited to answer questions about the status of a particular resource, such as "what percent of river miles are in poor condition" or "what percent of lakes have fish with tissue contamination levels above an OEHHA threshold". They provide information on "background conditions" (i.e. the true distribution) of the resource) across a state or region but are not designed to provide information about any particular waterbody.

While probability-based designs provide an unbiased estimate of the existing background condition, they are not optimal for defining the reference conditions. The concept of reference is critical to all Water Board programs because it provides context for evaluating narrative objectives. In a state as complex as California, both targeted and probability-based designs are likely to be necessary to define reference (Ode and Schiff 2009).

In reality both targeted and probabilistic monitoring designs are required to generate the data necessary for the Water Boards to conduct an accurate assessment of the quality of waters (Figure 2). Targeted monitoring is used to assess conditions at areas at known or suspected contamination. The statewide probability-based programs provide a large scale context

within which Regional Water Board monitoring programs operate. Reference monitoring provides information on desired condition.

Figure 2. Theoretical distributions of monitoring variables across all sites (probabilistic and targeted surveys) and reference sites.



The SWAMP Perennial Steams Assessment (PSA) currently in the 11th year of implementation uses a probabilistic-design to monitor biological condition in streams throughout the state. The PSA design is integrated with USEPA's National Rivers and Streams Survey. In 2005, SWAMP worked with the Water Boards Nonpoint Source (NPS) program (2005-2009) to adjust the monitoring design to address a number of programmatic questions that the NPS program had such as the relationship between land use and biological condition. SWAMP has also worked with Regional Boards 4, 8 and 9 to encourage the Stormwater Monitoring Coalition in Southern California to nest their biological monitoring within the larger statewide PSA. The Lahontan Region has expanded the PSA monitoring in the Sierra.

SWAMP initiated a Reference Condition Management Program (RCMP) to evaluate reference conditions in perennial streams throughout the state. The RCMP also employs random sampling, but the sampling frame is carefully limited through geographic information system (GIS) analysis and reconnaissance to only those stream reaches that are minimally disturbed. In many areas of the state there are no natural areas, so that the best reference sites available are simply those that are the "least disturbed". Regional Boards 1, 2 and 6 are using a portion of their SWAMP allocations to leverage this effort.

The SWAMP Bioaccumulation Monitoring Program monitors fish contamination throughout the state by employing a design that integrates features of probabilistic and targeted designs. This program randomly samples waterbodies in distinct size class strata statewide, but also targets the most heavily fished locations. The design of the Lakes Bioaccumulation study was adjusted to provide information that would be useful to Regional Boards preparing the 303(d) list. The Los Angeles Region used its Regional SWAMP resources to expand and enhance the statewide Lakes Bioaccumulation fish contamination surveys to include additional lakes in the Region.

The SWAMP Stream Pollution Trends (SPoT) Monitoring Program uses an entirely targeted design to select sites near the base (discharge point) of large watersheds throughout the state. A targeted design is used but to detect trends over time at a station and to develop an understanding of the relationships between land use, management activity, and stream pollution in large California watersheds. All of the Regions participated in site selection for the SPoT program to set up a network of long-term sites linked to Regional and stakeholder monitoring programs. The Central Valley Region used its Regional SWAMP resources, in collaboration with the Department of Water Resources, to increase sampling frequency and number of parameters monitored at SPoT sites within the Region.

Much of the targeted monitoring data generated through Regional Board regulatory programs (e.g. NPDES, Irrigated Lands or TMDL program) can be used to help assess the status of waterbodies at the local scale (as required under 303[d]). SWAMP does not intend to replace or supplant monitoring and assessment activities of other Water Board programs but to work with these programs to make more efficient use of the monitoring resources. Each of the statewide programs is designed to provide Water Board programs with background and context necessary to evaluate the data generated by local or regional programs. The San Gabriel Watershed Program (See box) provides an example of nesting of monitoring designs can lead to more efficient use of monitoring and resources [Goal 3.4]. SWAMP will continue to encourage similar efforts to develop watershed monitoring programs such as those being

San Gabriel River Regional Monitoring Program

The SGRRMP is a watershed-scale counterpart to existing larger-scale regional monitoring efforts in the southern California region that seek to address questions and concerns about regional conditions and trends (State Water Resources Control Board Surface Water Ambient Monitoring Program, U.S. EPA's Western Environmental Monitoring and Assessment Program, and the Stormwater Monitoring Coalition). Incorporation of local and site-specific issues within a broader watershed-scale perspective was and remains one of the unique features of the SGRRMP. By considering ways to improve overall cost effectiveness of monitoring efforts in the watershed, the plan includes reductions of redundancies within and between existing monitoring programs. Efforts within the program include targeted monitoring of contaminants of concern and adjustment of monitoring locations and sampling frequencies to better respond to management priorities. The multi-level monitoring framework combines probabilistic and targeted sampling for water quality, toxicity, and bio-assessment.

formed for the Klamath, San Joaquin, Ventura, Los Angeles River, and San Luis Rey Watersheds.

SWAMP has also worked with other statewide programs. SWAMP uses the information generated by the state's Beach program to address the "swimmable" beneficial use at coastal beaches throughout the state. The GAMA program can help address issues related to the quality of drinking water. Both of these programs are using targeted designs to effectively monitor the entire population of high priority beaches or priority groundwater basins. Both the BEACH and GAMA program are actively working with the CWQMC on the data portals. SWAMP will continue to refine and integrate its monitoring designs and leverage support from partners to provide as much high quality information as possible with available funding [Goal 3.4].

SWAMP has explored detailed approaches to further integrate monitoring designs by using probabilistic monitoring with ecological indicators to test assumptions of non-impairment in upper reaches of watersheds where limited or no monitoring has occurred. Effective management of water quality will require a commitment not only to monitoring but also to the development of predictive tools or models. Models are needed to extrapolate measured water quality conditions to unmonitored, comparable areas. This ability to extrapolate or make predictions can be very useful for cost-effective assessment. [Goal 3.5].

Objectives

Objective 3.1: Implement SWAMP monitoring at State and Regional Board scales to address beneficial uses at waterbodies throughout the state [Goal 3.4]

- Align, to the extent possible, the monitoring designs of the statewide and regional SWAMP programs to achieve the most efficient use of data collected (Figure 1).
- Work to integrate statewide monitoring of ecological indicators with local monitoring of known problem areas to best describe the extent of known impairments, identify previously unknown problems, and protect high quality waters.

Objective 3.2: Use SWAMP assessment framework based on beneficial uses and management questions to facilitate efficient coordination of SWAMP monitoring with other Water Board programs [Goal 3.1, Goal 3.3 & Goal 3.4]

- Make guidance available to other Water Board programs to best design monitoring to address objectives.
- Continue to coordinate with Water Board programs at the statewide level (NPS, TMDL, Assessment Unit).
- Work to align the design of SWAMP monitoring efforts with those of other Water Board programs.

Objective 3.3: Use SWAMP assessment framework based on beneficial uses and management questions to engage with the CWQMC and partner programs to optimize monitoring designs and achieve efficiencies through coordination of indicators, surveys, and analyses [Goal 3.1, Goal 3.2, Goal 3.3 & Goal 3.4]

- Build on the web-based Central Valley Monitoring Directory developed by the Aquatic Science Center, with funding from the Central Valley Water Board and USEPA.
- Determine whether partner program monitoring designs align with and/or compliment SWAMP designs.
- Continue working with and initiating new stakeholder-based regional monitoring programs and to align their designs with SWAMP to achieve efficiencies.
- Lead CWQMC workgroups for aquatic life in streams and fish consumption safety so as to promote data comparability and integrated assessments.

Objective 3.4. Develop and implement a suite of predictive tools to maximize our ability to effectively manage water quality [Goal 3.5]

- SWAMP will investigate the use of models to extrapolate results from probability based surveys for use in 303(d) listings decisions for identifying both impaired and unimpaired waters.

4 Indicators

Our vision is to develop, select, and implement indicators and assessment thresholds that appropriately represent the condition of the environmental attributes and beneficial uses to be assessed, diagnose the causes and sources of impairment, and evaluate the effectiveness of management actions to improve water quality in California. The 2005 Strategy had the following four goals for indicator development.

Goal 4.1 Define core indicators for statewide monitoring and assessment for each designated use and for overall watershed health.

Goal 4.2 Recommend set of core and supplemental indicators for use at local watershed scale.

Goal 4.3 Develop indices for assessment of biological communities for different waterbody types.

Goal 4.4 Develop a set of locally appropriate indices of biological integrity (IBI) for wadeable streams.

Current Status

SWAMP uses and endorses the concept of core and supplemental indicators (Table 2) in Water Board programs at both Statewide and Regional scales. Core indicators are designed to evaluate the status or condition of waterbodies relative to beneficial uses of concern. Core indicators are appropriate statewide, but may not always be cost effective or necessary to include all in statewide monitoring programs.

Supplemental indicators are intended to be more diagnostic and are necessary when waters are known or suspected to be impaired, and effective management action requires an understanding of the causes and sources of the stressors responsible for the impairment. These indicators are often less directly tied to the beneficial uses and more closely related to the chemical/physical/biological mechanisms that either cause impairment or drive the fate and transport of stressors. Examples include toxicity identification evaluations (TIEs), endocrine disruption assays, flow measurement, hydrologic modeling, and GIS analyses. SWAMP and other Water Board programs have been involved with the continuing development of diagnostic indicators, most recently with advanced TIE methods and improved analysis of chemicals of emerging concern (such as pyrethroid pesticides and algal toxins).

Given the diversity in hydrology, land use, and Basin Plans among Regions, Regional Water Boards need the flexibility to pick and choose indicators that are applicable to their management question and appropriate for their Region. Use of SWAMP indicators and performance-based quality control provides data comparability so that Regional data can be combined with statewide data in integrated assessments.

Aquatic Life Use Indicators

Streams: SWAMP has invested substantial resources over the past five years in the development of ecological indicators (macroinvertebrate and algal bioassessment) and ecological metrics such as IBIs to produce biological objectives based on these indicators [Goal 4.3]. The statewide Bioassessment Monitoring Program interacted with the USEPA, the external scientific review committee, and expert groups (e.g., the Southwest Association of Freshwater Invertebrate Taxonomists [SAFIT]) to develop and refine bioassessment methods, metrics for combining taxonomic observations into indices for assessment, and biological objectives as part of standards development. SWAMP fostered the development of IBIs for North and South Coast, the Central Valley, and Eastern Sierras and has developed observed/expected (O/E) models for the State [Goal 4.4].

SWAMP continues to implement and test the California Rapid Assessment Method (CRAM) in for use in their statewide stream surveys. The SWAMP developed and implemented a statewide reference condition management plan. This work will help define thresholds for ecological indicators being developed through SWAMP.

Bays and Estuaries: SWAMP also contributes data and coordinates with the State Board Ocean Standards Unit in the development of sediment quality objectives (SQOs) for bays and estuaries. The sediment quality objectives are based on synoptic measurement of a suite of sediment indicators including chemistry, toxicity, and benthic ecology, and define thresholds and narrative criteria for their interpretation and use in impairment designations. SWAMP endorses the use of the SQO triad for assessing sediment conditions.

Stream Pollution Trends Program: The SPoT program has adopted indicators from the USGS NAWQA program, and has worked with its external scientific review committee to establish the specific list of indicators most useful for documenting trends in watershed activity and stream pollution over time. SPoT measures pesticides, metals, industrial compounds and toxicity in sediment collected from multiple points in depositional stream reaches low in the target watersheds.

Fish Consumption Use Indicators

The California Toxics Rule provides water quality criteria that can be used to protect fish consumption. However increasingly there is interest in assessing concentration of contaminants in fish tissue. With the exception of methyl mercury there are no water quality standards for fish tissue concentration. The Office of Environmental Health Hazard Assessment has developed fish contamination goals (FCGs) and a set of assessment threshold levels (ATLs) for some of the key bioaccumulative pollutants (mercury, DDT, PCBs, chlordane).The statewide Bioaccumulation Monitoring Program has implemented an analyte list comprised of persistent organic pollutants and trace metals of concern, including PCBs and mercury; and has established target fish and shellfish species which will serve as a foundation for future monitoring and trend analysis.

Swimming Use (REC 1)

There are well-defined water quality standards/thresholds for the evaluation of indicator bacteria for the protection of uses associated with water contact recreation (e.g. REC1). SWAMP encourages the monitoring total coliform, fecal coliform and enterococcus at coastal beaches and monitoring of *E. coli* in freshwater to be consistent with the State Board plans to adopt *E. coli* as a statewide freshwater standard.

Drinking Water Use (MUN)

For uses related to drinking water (MUN), Maximum Contaminant Levels (MCL) developed by the CA Department of Public Health are the primary standards for evaluation. These MCLs are incorporated into all Regional Board Basin Plans.

Objectives

The SWAMP's objectives related to indicators are to coordinate with other State and Regional Water Board programs to continue the alignment of indicators, quality assurance and data management under the framework of the CWQMC; assist in the development of biological objectives based on ecological indicators; and assist in the development and implementation of sediment quality objectives. The SWAMP is committed to the CWQMC workgroup as a way to share guidance and information on indicators and their appropriate use.

Objective 4.1: Maintain and implement a set of appropriate monitoring indicators representative of the status of beneficial use support and diagnostic tools for Water Board programs [Goal 4.1, Goal 4.2, Goal 4.3, Goal 4.4]

- Maintain a list of currently identified status indicators for the SWAMP and partner programs that are representative of ecological and human health attributes of concern.
- Continue assisting with the development of bioassessment methods, metrics, and thresholds for wadeable streams.
- Continue assisting with the development of diagnostic indicators, such as TIEs and analysis of chemicals of emerging concern.
- Keep track of indicator development efforts within the state (including SQOs in Delta, statewide nutrients, new criteria and rapid indicators for pathogens, contaminants of emerging concern) to identify areas of coordination and partnership with the SWAMP.
- Utilize the State Water Board's Water Quality Goals database for standardizing numeric assessment thresholds.

Objective 4.2: Work within the CWQMC framework to assist in developing, standardizing and implementing indicators to be used by partner programs to assess all waterbody types in California [Goal 4.1 & Goal 4.2]

- Coordinate with CWQMC workgroups to identify and share indicators and assessment thresholds and identify opportunities to align assessment and indicator development with other programs within CalEPA and Natural Resource agency.

Table 2. The SWAMP Recommended Water Quality Indicators for General Designated Uses Categories (modified from US EPA 2007)

Beneficial Uses	Indicators	
	Core	Supplemental/Diagnostic
Aquatic Life & Wildlife	**Conventionals** Temp, Conductivity, pH, DO, nutrients **Toxics** Metals, Bioaccumulative **Toxicity** Water and/or Sediment **Biological Conditions** Invertebrates (streams) Chlorophyll (lakes, streams, estuaries) Algae Wetlands **Physical Habitat** PHab (streams) CRAM (wetlands)	Other chemicals of concern in water column or sediment TIEs Water and/or Sediment Health of organisms Landscape/Land use Flow
Fish/Shellfish Consumption	**Chemical Indicators** Mercury, Chlordane, DDTs, PCBs **Fecal Indicators (for shellfish)** Total and Fecal coliform	Other chemicals of concern in water column or sediment Landscape/Land use
Recreation	**Fecal indicators** Enterococci, total and fecal coliform (seawater) *E. coli*, enterococci (freshwater) **Other** Secchi depth (lakes) Nuisance plant Growth Chlorophyll *a* Microcystis/Microcystin	Landscape/Land use Other chemicals of concern in water column or sediment Flow Nutrients
Drinking Water	Trace metals Pathogens (DW Rule, BP language) Algae (microcystis) Nitrates Salinity Sediments/TDS	Other chemicals of concern in water column or sediment Nutrients Flow Landscape/Land use

5 Quality Assurance

Our vision is to develop, implement, and maintain the quality assurance tools and capabilities needed by SWAMP, and shared with partner programs, to allow comparable data from many sources to be used in comprehensive water quality assessments. The role of SWAMP's quality assurance program is to foster the production of data to inform decision-making (i.e., identifying water quality impairments, fish consumption advisories, TMDL targets, etc.). The goals for this element are as follows:

Goal 5.1 Implement Quality Assurance Team to provide technical oversight and direction to SWAMP QA activities

Goal 5.2 Develop and document SWAMP Measurement Quality Objectives (MQOs) for each of the core indicators

Goal 5.3 Evaluate the existing QA/QC program, including new methods and program changes, against SWAMP Objectives

Goal 5.4 Implement QA activities to produce data of high consistency/comparability among projects of different scales

Goal 5.5 Implement QC procedures to produce defensible, credible data that meets SWAMP Quality Assurance Program Plan (QAPrP)

Goal 5.6 Integrate SWAMP QA/QC procedures in other State Water Board programs

Current Status

In January 2005, SWAMP formed its QA Team, consisting of a QA Officer, QA Coordinator and several QA Specialists [Goal 5.1]. The QA Officer leads the team and reports to the SWAMP Program Coordinator and the Water Board QA Program Manager. The QA Team designates a liaison for each major project, Regional Water Board, and testing parameter. The QA Team holds monthly meetings with the QA workgroup, which consists of the SWAMP Coordinator, the Water Board QA Program Manager, and a representative from US EPA Region 9. The QA Team reports its progress to the SWAMP Roundtable several times each year. The QA Officer produces semi-annual reports to the SWAMP Program Coordinator and the Water Board QA Program Manager as well as other interested parties and organizations.

The initial SWAMP Quality Assurance Management Plan (QAMP) was finalized in 2002 [Goal 5.2]. In 2008, the QA Team, in conjunction with the Roundtable and stakeholders, released the Quality Assurance Program Plan (QAPrP) to replace the 2002 QAMP. The QA Team formed focus groups in May 2005 to address each program testing parameter. There are six focus groups consisting of toxicity testing, organic analytes, inorganic analytes, conventional analytes, bioassessment studies, and field measurements. Each group is used as a resource for sample collection, analysis, reporting, and data assessment [Goal 5.2].

The QA Team also reviews new and existing quality assurance project plans (QAPPs) for Regional Water Boards, bond fund grantees, and partner programs. Since January 2005, the QA Team has reviewed over 170 QAPPs. The QAPPs are compared with the SWAMP Measurement Quality Objectives (MQOs) and the USEPA 24-element QAPP requirements [Goal 5.3]. The QA Team also guided the development of an expert software system to help SWAMP and partner programs develop their QAPPs [Goal 5.6].

In addition, as part of a system-based approach, the QA Team has developed SWAMP-specific standard operating procedures for contract laboratory assessments (audits), data verification, data classification, corrective actions, communication of quality assurance program updates, and quality assurance policy and decision-making [Goal 5.4 & Goal 5.5]. All standard operating procedures are ground-tested prior to finalization and are re-assessed annually.

The QA Team creates and facilitates a framework within which all SWAMP programs and participating partner programs can generate data of known and documented quality, appropriate to project information needs, and comparable for integrated assessments [Goal 5.4 & Goal 5.5]. The QA Team accomplishes this by:

- developing and reviewing planning documents (such as Quality Assurance Project Plans);
- creating templates, checklists and other tools to guide partner programs in developing their QA planning documents;
- establishing MQOs for SWAMP measurement parameters;
- assisting in the development of expert system software;
- participates in kick-off meetings to ensure all parties are familiar with project QA requirements before the project begins;
- conducting laboratory and field audits and recommending corrective actions to improve performance;
- creating standard procedures for and assisting with data classification and verification;
- providing QA reports to management; and
- supporting State Water Board efforts to integrate SWAMP with other Water Board programs.

Within SWAMP, the QAPrP serves as an umbrella document for use by each of SWAMP's contributing projects. It describes the program's quality system in terms of organizational structure; the functional responsibilities of management and staff; the lines of authority; and the interfaces for those planning, implementing, and assessing all activities conducted.

While the focus is on data generated by the SWAMP program, the principles and procedures are applicable to the generation of ambient monitoring data by other State and Regional Water Board programs. To date SWAMP has worked with the Stormwater Program to develop monitoring plans and QAPPs for their bioassessment monitoring; assisted the Central Valley Regional Water Board to develop QA/QC and data management procedures

to meet their program needs; and initiated the effort to add marine matrices MQOs to the QAPrP in collaboration with the Ocean Standards Program [Goal 5.6].

Objectives

The SWAMP QA program conducts a range of continuing activities to provide guidance and facilitate the production of data of known and documented quality that is comparable within the SWAMP program at the Water Boards and with SWAMP's partners in other Water Board units and in the larger California monitoring community. The list of program priorities for the next three to five years includes the following:

Objective 5.1 Maintain the QA Team [Goal 5.1]

- Maintain a QA Team with regularly evaluated roles and responsibilities.
- The QA Team will continue to serve as technical experts to provide the program with oversight and direction and advice on needed standard operating procedures for QA, field and laboratory methods.

Objective 5.2 Develop and document SWAMP MQOs [Goal 5.2]

- The QA Team will maintain updated quality assurance documentation including the QAPrP, project QAPPs, and standard operating procedures. This will include developing, revising and documenting MQOs for all SWAMP field and laboratory parameters; developing field, laboratory and data QA methods for bioassessment; and defining reporting limits for chemistry laboratories.

Objective 5.3 Evaluate existing QA/QC program against SWAMP objectives [Goal 5.3]

- The QA Team will ensure that the data classification and verification system is up-to-date and documented in a standard operating procedure.
- The QA Team will ensure that the system is implemented as designed by developing tools and guidance for QAPP development and data classification.

Objective 5.4 Implement QA activities to produce comparable data among projects of different scales [Goal 5.4]

- Provide tools and guidance on develop project QAPPs that are consistent with the SWAMP QAPrP.
- Conduct training workshops, review and approve project and laboratory standard operating procedures, and participate in project kick-off meetings. This will ensure that all project participants understand the QA/QC procedures and activities for which they are responsible and increase the likelihood that the problems are identified during the project so that corrective action can be implemented.

Objective 5.5 Implement QC procedures to produce defensible, credible data that meets SWAMP QAPrP [Goal 5.5]

- The QA Team will implement QC procedures to ensure the program is being implemented at all phases, from sample collection to analysis to data processing and management. QC activities will include laboratory and field audits, interlaboratory comparisons/calibration and performance evaluation tests, and data classification and verification.

Objective 5.6: Guidance and tools for partner programs to facilitate data comparability and allow water quality assessments based on combined data sets [Goal 5.6]

- A major focus of the SWAMP program and specifically the QA Team over the next five years will be to work with other Water Board programs to ensure that their ambient monitoring data are collected and stored in a way that they can be combined with other data sets for broader-scale assessments such as 303(d) listing decisions. The State Water Board maintains a Quality Management Plan (QMP), which is the planning document that applies to all of the Water Board's quality systems and requires all Water Board programs to develop QA Program Plans to meet program needs. The State Water Board formed the QA Roundtable to coordinate the development of these plans and assess each programs' needs in terms of data quality objectives. Generally, each program must have data of sufficient quality to assess compliance with water quality standards designed to protect beneficial uses. SWAMP will work with the QA Roundtable to develop recommended reporting limits (RLs) that relate to beneficial use attainment. In addition, the QA Team will provide technical expertise to Water Board programs to develop comparable QA systems to fit their needs.

6 Data Management

Our vision is to manage the flow of data from initial measurement, through acquisition and storage in data management systems, to data output and assessment, so that accurate information is available in a timely manner to decision makers and the public. The original Strategy included the following goals.

Goal 6.1 SWAMP ambient monitoring data will be stored and checked for comparability in the SWAMP database.

Goal 6.2 Provide training and tools to facilitate the use of SWAMP data and information by the State Water Board (intra-agency) and non-State Water Board (Inter-agency) programs.

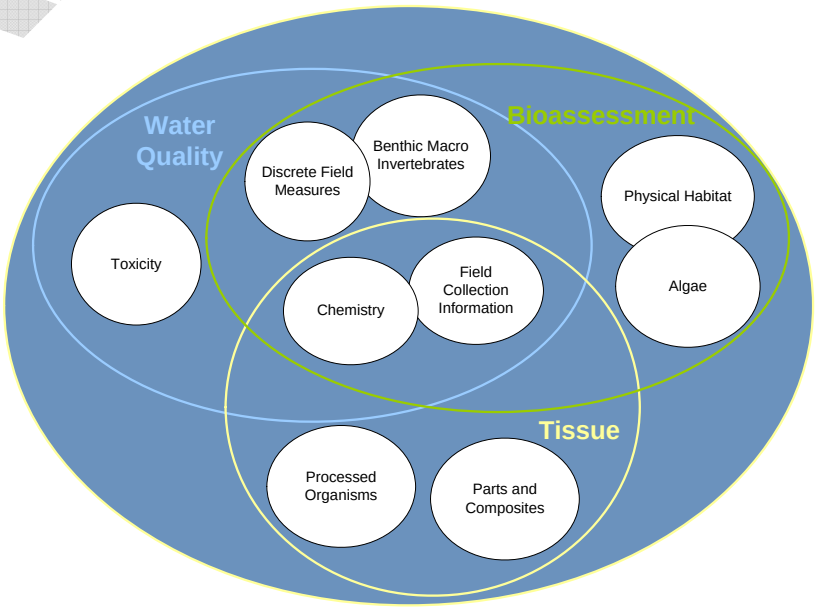
Goal 6.3 Integrate SWAMP data with information collected by the California Water Boards and non-Water Board Programs.

Current Status

Data generated by statewide and Regional SWAMP programs are submitted to the SWAMP database, managed by the Data Management Team (SWAMP DMT) [Goal 6.1]. Staff began development of the SWAMP data management system in 2001, based on a Microsoft Access®. A key component is identical temporary and permanent data tables designed to separate draft data from data of known and documented quality. The SWAMP data management system has continued to build off this initial MS Access-based model, however the permanent side of the database now resides in a MS SQL Server® database. The current v2.5 SWAMP database design has been in place since 2007.

Figure 3 shows the data types that the SWAMP database is able to store: water quality, tissue, and bioassessment. Tables for discrete field measurements, water column and sediment chemistry including bacteria indicators, and water column and sediment toxicity are fully functional. Tables for bioaccumulation including fish, bivalves, birds, and mammal tissue residue have been in place since 2008. Tables for bioassessment data including benthic macro invertebrates, algal, and habitat assessment are in production and will be fully functional in 2011.

Figure 3. SWAMP database v2.5 data elements



The SWAMP DMT provides technical support, tools and training for submitting data to the database [Goal 6.2]. The DMT

maintains the existing data and data systems and develops tools for retrieving data from the database. Data is entered into the SWAMP database either through data entry forms or loaded through specialized data loaders. Maintaining existing data in the SWAMP database makes up another large portion of the SWAMP DMT resources. The SWAMP DMT staff serves as project management liaisons for all SWAMP projects. This includes working with the appropriate regional board staff person to make sure the data sets are complete, classifying all results for data quality, and migrating project data to the permanent side of the database.

Table 3. Results counts from SWAMP database as of October 2010

	Samples	Field Results	Toxicity Tests	Lab Results	Tissue Results	Benthic Results
Initial Monitoring Effort (Temp[1])	16,339	1,225,834	101,157	976	27,891	268,426
Data of Known & Documented Quality[2]	45,062	108,712	669,201	6,675	74,840	462
TOTAL	**61,401**	**1,334,546**	**770,358**	**7,651**	**102,731**	**268,888**

[1] Data stored on the temporary side of the SWAMP database

[2] Data have been verified against the SWAMP measurement quality objectives.

SWAMP participants can query the SWAMP database to access data for Water Board assessments [Goal 6.2]. Basic data access queries have been built to allow SWAMP users immediate access to both the temporary and permanent side of the database. SWAMP is actively engaged in the development and implementation of a number of assessment tools, such as the automated query tools for generating lines of evidence for the integrated CWA section 305(b) and 303(d) assessments. The DMT also provides information for the Water Board's annual performance report.

Data comparability within SWAMP, with other Water Board programs and with other agencies is another important goal for SWAMP [Goal 6.3]. The DMT has provided training sessions in data entry for field data collectors and in data formatting to laboratories. The DMT has created and periodically updates manuals for training on database use and analytical query tools to assist the State Water Board (intra-agency) and non-State Water Board (inter-agency) programs in accessing data and using the SWAMP database. The DMT also maintains a data management comparability helpdesk.

SWAMP also established four Regional Data Centers tasked with working with local data providers to submit data into the California Environmental Data Exchange Network (CEDEN), which was launched to the public in August 2010. Data stored in the SWAMP database are exported to CEDEN on a regular basis and made available to the public through online query tools. Data generated by partner programs are submitted to one of the four Regional Data

Centers (RDCs), operated by Moss Landing Marine Labortories (MLML), the Southern California Coastal Water Research Project (SCCWRP), the San Francisco Estuary Institute (SFEI), and the University of California at Davis (UCD). Each of the RDCs receives data in SWAMP comparable formats and transfers data to the California Environmental Data Exchange Network (CEDEN), funded by SWAMP, to act as a clearing house for water quality data used in comprehensive assessments. CEDEN also will be a primary source of data for the California Water Quality Monitoring Council's My Water Quality web portals that present answers to key assessment questions asked by decision makers and the public. SWAMP is committed to the CWQMC workgroup and web portal approach as a way to share guidance and information on indicators and their appropriate use, leading to increased data sharing and comprehensive assessments based on data from multiple programs.

Objectives

The SWAMP DMT will continue to maintain and improve the SWAMP database system and products for all SWAMP data elements and will maintain and update the database as new technologies are developed. The DMT will continue to load SWAMP ambient monitoring data to the temporary side, verify and classify it, and then transfer it to the permanent side. The DMT also will continue to develop tools and training modules as well as coordinate the State Water Board and non-Water Board programs to facilitate the use of the SWAMP database and data to increase data comparability throughout California.

SWAMP will continue to work with the RDCs to improve and expand on current data tools as well as provide new tools and new data to help turn data into information. The RDCs will continue to work with programs to upload their data into the CEDEN system and to expand the types of data currently available through the CEDEN. CEDEN will provide automated services for grant recipients and smaller data generators to assist them in uploading their data to the system. CEDEN will continue to work with the SWAMP DMT and the State Water Board staff to provide data formats which are required for the integrated assessment report application and increase the use of this tool beyond SWAMP. CEDEN will provide exports of CEDEN data to the USEPA WQX system for use in currently available applications, and to help programs meet their Federal data submittal requirements. CEDEN also has plans to automate many of the Bioassessment analysis functions being developed by the SWAMP Bioassessment workgroup and the SWAMP DMT to expand the use of bioassessment data in regulatory purposes.

Objective 6.1: Develop and implement a data management system that maintains and documents the integrity of SWAMP data and metadata from initial measurement to final assessment, and efficiently retrieves data to answer SWAMP assessment questions [Goal 6.1]

- Maintain the SWAMP database capable of storing ambient monitoring data elements.
- Verify and classify all SWAMP data to clearly document quality.
- Develop effective methods for querying and extracting data from the SWAMP database and CEDEN in formats useful for answering assessment questions.

- Develop and update the Data Management Plan and business rules to manage data flow.

Objective 6.2: Facilitate data comparability within SWAMP, with other Water Board programs, with CWQMC partners, and with participating stakeholder monitoring programs [Goal 6.2]

- Work with the Water Board's Assessment Unit, the SWAMP participants, and the Regional Data Centers to define the minimum data elements needed to submit data to CEDEN.
- Conduct training on input to SWAMP database.
- Staff the data management help desk.
- Maintain automated data checker applications for all entities submitting to the database.
- Initiate user group meetings to share data management information.
- Continue to work within the Regional Data Centers to incorporate new data types and to incorporate the best data management practices.

Objective 6.3: Facilitate data exchange within SWAMP, with other Water Board programs, with CWQMC partners, and with participating stakeholder monitoring programs [Goal 6.3]

- Maintain updated replicated databases at each Regional Data Center as well as the CEDEN master replicate.
- Efficiently export data between the SWAMP database and CEDEN.
- Expand CEDEN by using existing resources at the RDCs and leveraging professional contacts within a regional area and work with other programs to develop formats and crosswalks to allow for the exchange of data with CEDEN.
- Develop applications that allow users to query data on the web and allow for downloading of data in standard formats.
- Develop systems to extract data from CEDEN to populate the Water Board 305b/303d on line Integrated Assessment of water quality conditions and impaired waters in California.
- Develop systems to extract data from CEDEN to populate the CWQMC on line web portals where information can be easily accessed by decision makers and the public.
- Make the CEDEN network self-sustaining.

7 Data Analysis and Assessment

Our vision is to provide a consistent science-based assessment framework that integrates data from SWAMP and partner programs to effectively answer assessment questions and inform water quality management decisions at the State and Regional levels. The original goals of the strategy are as follows:

Goal 7.1 Develop a method for assessing standards attainment for listing purposes (303(d)).

Goal 7.2 Develop guidance to assist in 303(d) and 305(b) assessments, consistent with the 303(d) listing policy.

Goal 7.3 Contribute to statewide and regional assessments to achieve comprehensive assessment of all water bodies for all beneficial uses.

Current Status

Assessment is the translation of monitoring data into information relevant to identified management issues. The overall focus of the SWAMP Strategy is that all Water Board activities contribute to identifying high priority assessment questions and providing answers to those questions to aid resource managers and the public in making informed policy decisions.

SWAMP contributes to the determination of beneficial use support for all California waters under CWA §305(b), and the identification of waters not supporting beneficial uses (i.e., impaired waters) as required by CWA §303(d) (see box). Both of these assessments are described in the biannual Integrated Report. SWAMP provides data, tools and expertise to the State and Regional Water Board assessment units to develop lines of evidence for beneficial use support ratings and impairment designations consistent with the State Water Board's Policy for Developing California's Clean Water Act §303(d) List [Goal 7.1 & Goal 7.2] SWAMP funded the

Beneficial Use Support Categories	
1	A water that supports a minimum of one California Beneficial Use for each Core Beneficial Use that is applicable to the water; and 2) has no other uses impaired.
2	A water that supports some, but not all, of its California beneficial uses; and 2) has other uses that are not assessed or lack sufficient information to be assessed.
3	A water with water quality information that could not be used for an assessment, for reasons such as: monitoring data have poor quality assurance, not enough samples in a dataset, no existing numerical objective or evaluation guideline, the information alone cannot support an assessment, etc.
4A	A water segment where ALL its 303(d) listings are being addressed; and 2) at least one of those listings is being addressed by a USEPA approved TMDL.
4B	A water segment where ALL its 303(d) listings are being addressed by action(s) other than TMDL.
5	A water segment where standards are not met and a TMDL is required, but not yet completed, for at least one of the pollutants being listed for this segment.

development of the California Water Quality Assessment Database (CalWQA) which is the primary tool use by 303(d) staff at the State and Regional Water Boards to develop the Integrated Report.

SWAMP conducts three priority statewide assessments [Goal 6.3]:

- The Bioaccumulation Program has completed its first assessment of California lakes and is beginning its assessment of coastal waters.
- Bioassessment Program: The PSA currently is in the middle of its 11th sampling year. They have produced the following reports: SWAMP recently completed a draft technical report that will provide source material for a series of management reports that will showcase the many potential applications of PSA data in Water Board management programs. The RCMP's programmatic plan has been peer-reviewed, finalized, and posted at the State Water Board's website. The RCMP will be further refined to define regionally appropriate stressor thresholds for screening and selecting reference sites and to establish alternate strategies for identifying appropriate reference sites in areas that lack a sufficient number or distribution of minimally disturbed candidate sites.
- Stream Pollution Trends (SPoT) Program has completed its first two years of monitoring, with one of those years substantially limited due to funding shortfalls. Those data currently are being assessed to establish baselines for long-term trends and to investigate relationships between land use and stream pollutant concentrations and toxicity. A report on the first two years is due in 2011.

Regional SWAMP programs conduct a variety of assessments to determine compliance with Basin Plan objectives, categorize impaired waters, identify causes of impairment, locate and manage pollution sources, regulate discharges, and manage nonpoint sources such as urban stormwater and agricultural runoff [Goal 7.3]. These SWAMP assessments can be found on Regional Water Board web sites (e.g., http://www.ccamp.org/). The regional assessments utilize SWAMP monitoring design, quality assurance, and data management tools to ensure data are collected consistent with the statewide programs and can be combined for broader scale assessments.

SWAMP is aligning many of its programs with the California Water Quality Monitoring Council's (CWQMC) approach to assessment. The Council has formed Work Groups that are tasked with developing assessment questions around themes: Is it safe to eat fish and shellfish?; Is it safe to swim at my beach?; Is our water safe to drink?; and Are our ecosystems healthy? The Work Groups then identify and obtain data sets to answer the questions and develop web portals to convey the assessments to the public. SWAMP has taken the lead on two Work Groups to develop CWQMC web portals that provide easily accessible assessments of the health of aquatic life in streams and the level of contaminants of sport fish and shellfish in all California waters. These Work Groups operate under the CWQMC guidelines to develop the two web portals, participate in the development of

thresholds for beneficial use support assessment, and establish report card formats for communicating water quality conditions.

The CEDEN data exchange network initially supported through SWAMP funding provides data for web portals addressing a range of beneficial uses and waterbody types (See section Data Management).

Objectives

Objective 7.1: Apply SWAMP tools and expertise to high priority assessments [Goal 7.1 & Goal 7.2]

- Provide guidance and tools to assist in CWA 305(b)/303(d) assessments including the translation/interpretation of narrative standards.
- Ensure that SWAMP data generated from statewide and Regional Board monitoring efforts is available for use in integrated report.
- Support the development and sharing of tools (such as automation software) to facilitate assessment of compliance with Basin Plan objectives.
- Support the development and sharing of tools (such as CCAMP automation software) to assess impaired waterbodies and overall resource conditions (303d/305b).

Objective 7.2: Implement the three SWAMP statewide assessments [Goal 7.3]

- The Bioaccumulation program will continue its assessment of coastal waters and plan for subsequent assessment of large rivers.
- Assess the ecological condition of perennial streams and reference sites. PSA is currently (2008-2011) focused on increasing representation across CA's major ecoregions. Highest priority for the RCMP will be given to sampling reference sites as needed to support the development of biological objectives.
- Assess trends in stream pollution and relationships with land use and management action. In 2010 the SPoT program will complete its first assessment of stream contamination and toxicity in large California watersheds. SPoT will begin its trend analysis with the second assessment in 2011.

Objective 7.3: Use CWQMC Portals as a framework for assessment [Goal 7.3]

- Coordinate SWAMP assessment strategy with the CWQMC to identify waterbody types, beneficial uses, and management questions that SWAMP will address.
- Integrate, where appropriate, data from different indicators and designs to generate efficient statewide assessments.
- Create a general and adaptable set of thresholds against which to compare all SWAMP measurements for report cards and policy action at the statewide and Regional levels.

Objective 7.4: Implement and assist with special assessments for identified resource management issues [Goal 7.3]

- Provide data for and assist with the development of Sediment Quality Objectives (SQOs).
- Provide monitoring expertise and guidance for assessment of Areas of Special Biological Significance (ASBS).
- Partner with other Water Board programs, the USEPA and other agencies on shared assessments such as the National Surveys for Lakes, Streams, Coastal Waters, and Wetlands.

8 Reporting

Our vision is to make all SWAMP data available to the public, to translate SWAMP data into information useful for making resource management decisions, and to provide timely reports in formats most accessible to target audiences. To accomplish this, SWAMP identifies target audiences, selects the most effective media to reach them, and provides a range of products from newsletters and fact sheets to interpretive reports and statutory documents, such as the Integrated Report (Clean Water Act (CWA) Section 303(d) list / 305(b) Report), and the CWQMC *My Water Quality* web portals.

Goal 8.1 Produce timely and complete water quality reports and lists as required by the Clean Water Act and consistent with current USEPA guidance.

Goal 8.2 Report to the public on water quality taking into account the needs of interested audiences. Use various formats and media such as brochures, fact sheets, report cards, oral presentations, and the Internet.

Goal 8.3 Produce technical reports and peer reviewed journal articles resulting from monitoring program activities.

Current Status

The SWAMP provides data and participates in assessments to compile reports and lists required under the Clean Water Act including [Goal 8.1]:

- The CWA Section *305(b)* water quality assessment report, which characterizes the condition and quality trends of monitored waters within the state and is due on April 1 of even-numbered years. This is the primary state surface water quality assessment report to USEPA and draws upon information from SWAMP, the Non-Point Source program, TMDLs, and other national, state and local assessments.
- The CWA Section *303(d)* list identifies all impaired waters based on existing and readily available information. The list is also due on April 1 of even-numbered years.
- Development and submission of *305(b)* water quality assessment reports and *Section 303(d)* lists of impaired waters can be integrated. The Integrated Report will satisfy CWA reporting requirements for both *Section 305(b)* water quality reports and *Section 303(d)* lists. SWAMP data were used in the generation of x% of the new listings.
- The annual data update requirement may be satisfied by uploading monitoring data to the national Water Quality Exchange (WQX) warehouse or updating the *305(b)* assessment information in the California Water Quality Assessment (CalWQA) database which is compatible with the USEPA National Assessment Database. SWAMP funds were used to support the development of CalWQA.
- *Section 406* of the Clean Water Act, as amended by the Beaches Environmental Assessment and Coastal Health Act of 2000, requires states with *Section 406* grants to submit information on monitoring and notification programs for coastal recreation

waters. Details on the California program are included in the Annual Clean Beach Initiative Report to the Legislature.

In addition the SWAMP provides data for a number of reports that satisfy California State requirements [Goal 8.2]:

- In 2009, the Water Boards released the first annual Performance Report. The second annual report was released in September 2010. The first two reports focus primarily on the Water Boards activities to protect water quality (e.g., number of permits issued, inspections conducted, enforcement actions issued). However the long-term vision is that the Performance Report also will measure the Water Boards performance in terms of environmental outcomes such as water quality improvement. Results from SWAMP's statewide assessments were used to report on ecosystem health in the Water Board's Annual Performance Report [Goal 8.2]. Those report cards were an initial step toward the long-term goal of reporting environmental outcomes.
- The California Water Quality Monitoring Council provides recommendations for improving monitoring and assessment through coordination among local, regional, state and federal agencies and other entities that collect water quality data in California. Their efforts focus on developing theme-based web portals for reporting water quality and associated ecosystem health information to answer questions important to resource managers and the public as a means for developing collaborative relations among monitoring entities and thereby improving the efficiency and effectiveness of monitoring, assessment, and reporting.

SWAMP provides and supports a variety of reports. Most of the reports are available to the public in paper and electronic form and include fact sheets, data reports, quality assurance reports, interpretative reports and the Integrated Report. These reports provide an analysis and interpretation of the data collected. Technical reports are summarized in fact sheets that capture key findings in a more accessible format [Goal 8.3].

Technical reports from the statewide SWAMP programs are available on the SWAMP website. The Bioaccumulation Program has published a review of historical data on bioaccumulation in coastal fish and shellfish, as well as an assessment of edible fish contamination in California lakes. The Bioassessment Program has continued a series of reports on the ecological health of California streams (SWAMP, 2006, 2008) and will be producing a scientific report on the first 8 years of the PSA along with a series of management reports. They have also contributed to a series of reports on the development of bioassessment indicators and metrics. The SPoT program's first report is due in 2010. All of these programs have contributed data used in the Integrated Report. SWAMP has also produced a number of reports on special studies [Goal 8.2 & Goal 8.3]. SWAMP reports can be found at: http://www.swrcb.ca.gov/water_issues/programs/swamp/reports.shtml.

SWAMP Regional programs have produced numerous reports to address Basin Plan priorities and local issues. These can be found at: http://www.swrcb.ca.gov/water_issues/programs/swamp/regionalreports.shtml.

SWAMP funds have also been used to develop reports to support specific programs. In 2008, SWAMP worked with the Ocean Planning Unit to assess aquatic life use in Bays and Estuaries using the newly developed sediment quality objectives. This report was provided to the Board to inform their decision to adopt the SQOs. SWAMP also supported monitoring of Areas of Special Biological Significance (ASBS). A report on the status of water quality in ASBSs is expected in late 2010. Also in 2008 SWAMP supported the assessment of the quality of estuarine wetlands throughout the state using the California Rapid Assessment Methods. This report supported the State's Wetland Condition Report (2010). CRAM methods are currently being deployed as part of the SWAMP's Bioassessment Monitoring Program. It is hoped that this work will ultimately support CRAM development and Water Board efforts to formulate its riparian policy

Objectives

Objective 8.1: Produce timely and complete water quality reports and lists as required by the Clean Water Act and consistent with current USEPA guidance [Goal 8.1]

- Contribute the necessary quantity and quality of SWAMP data for use in the Integrated Report including healthy streams.
- Assist in developing guidance for defining whether a water body has been adequately assessed and when there is sufficient information to assign a water body to Category 1 (fully supporting all beneficial uses).
- Participate in the data analysis and preparation of the Integrated Report.

Objective 8.2: A web-based reporting system that effectively transfers information to decision makers and the public [Goal 8.2]

- A SWAMP website that posts SWAMP assessment products and draws target audiences.
- A CWQMC fish and shellfish consumption safety web portal maintained by the SWAMP Bioaccumulation Oversight Group (BOG).
- A CWQMC stream ecosystem health web portal maintained by the SWAMP Healthy Streams Partnership.
- A CEDEN system capable of exporting data through efficient query tools and able to support information delivery to the public through CWQMC web portals.
- An Integrated Report website that includes an interactive map that delivers detailed water quality assessment information to the public.
- Provide information for the Water Board's Annual Performance Report including recommendations for reporting environmental outcomes.

Objective 8.3: A SWAMP water quality reporting strategy that uses various formats to most effectively reach target audiences [Goal 8.2]

- Up-to-date SWAMP website providing access to all communication products.

- Regular manager's reports, fact sheets, brochures, and report cards summarizing state and regional assessments.
- Regular publication of the Monitor newsletter.
- Presentations to colleagues at the National Water Quality Monitoring Conference and other professional meetings and workshops.
- Email subscriptions and press releases to alert target audiences of product releases.
- A series of webinars to present assessment tools, program descriptions, monitoring results and assessments to a wide audience.

Objective 8.4: Effective communication with agency management [Goal 8.2]

- Presentations and briefings to management at the Water Boards and partner agencies.
- Presentations to the CWQMC.
- Liaison to Roundtable meetings for other Water Board units such as TMDL and NPS.
- Timely water quality reports to agency managers and decision makers.

Objective 8.5: Technical reports and peer reviewed journal articles resulting from SWAMP activities [Goal 8.3]

- Technical reports for all statewide and regional assessments available within two years of data collection.
- Support for publication in scientific journals as a form of external peer-review.

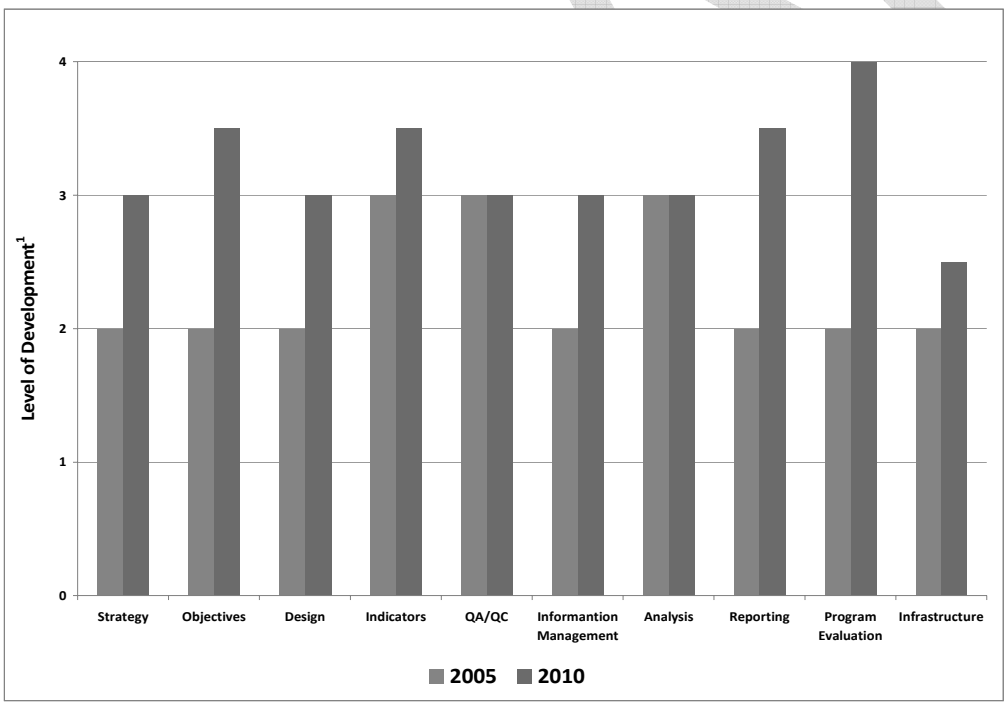
9 Programmatic Evaluation

Our vision is to conduct periodic reviews of each aspect of the program to determine its scientific validity, whether it is being implemented as designed and how well it serves the water quality decision needs of the state.

This will require the California Water Boards, in consultation with USEPA Region 9, to conduct periodic reviews of the SWAMP program to determine how well the program is being implemented and how well it serves the water quality decision needs for all state waters, including all waterbody types. This review must include an evaluation of the monitoring program strategy to determine how well each of the 10 elements is addressed and how to incorporate needed changes and additions into future monitoring cycles. This evaluation will take into consideration the effects of funding shortfalls on implementation of the monitoring program strategy.

In 2005, SWAMP was evaluated against the 10 elements program. In 2010, an evaluation by USEPA showed that the program made significant progress in each of the 10 elements (Figure 4 and Table 4).

Figure 4. Evaluation of California's monitoring strategy (2005-2010)



[1] Level of Development: Levels 1 and 2 are not consistent with the *Elements* (USEPA 2003) guidance, Level 3 programs are consistent with the Elements Guidance, and Level 4 represents and enhanced program.

Table 4. Summary of the SWAMP's progress toward meeting the ten monitoring program elements

Element	Evaluation of SWAMP 2010
Strategy	The SWAMP Strategy is being revised to acknowledge formation of the California Water Quality Monitoring Council (CWQMC), which is a multi-agency workgroup. State Board does not have the resources to monitor all water resources within the State. The SWAMP Strategy is being integrated with the CWQMC to provide framework for increased coordination of monitoring and assessment.
Objectives	The original Strategy called for SWAMP to address four core beneficial uses (swimmable, fishable, aquatic life use, drinking water) in multiple waterbody types across the State. The SWAMP is focusing on aquatic life use in streams and fish tissue contamination in lakes, coastal zone and rivers. The CWQMC is being used as a forum to coordinate with other State and federal agencies to generate data to assess beneficial uses in other waterbodies.
Design	The SWAMP implemented probabilistic monitoring statewide for aquatic life use in perennial streams and fish contaminants in lakes and coastal waters. Challenges remain in working with designs of other agencies to meet overall objectives.
Indicators & thresholds	Refining biological indicators for streams including invertebrates, periphyton and riparian wetlands. Working with Department of Public Health on thresholds for bioaccumulation. Need to work with resource agencies to explore and develop other indicators for aquatic life use.
QA/QC	Developed statewide QA/QC program for the SWAMP activities performed by Regional Boards and Statewide surveys. Now integrating the SWAMP QA/QC procedures into other State Board programs or the programs of other State agencies. Emphasis is on defining appropriate levels of comparability.
Information Management	Developed data management structure for multiple data types (water quality, toxicity, sediment and tissue contaminants, physical habitat, macroinvertebrates). The SWAMP is not able to support all state ambient data needs. SWAMP is supporting development of the California Environmental Data Exchange Network as a tool for agencies to share data. SWAMP is also working with CWMQC to develop theme-based portals built around four core beneficial uses as a means to communicate information to the general public. There are challenges associated with getting agreements to standardized formats for data exchange.
Analysis & Assessment	Significant effort has been invested on development of tools for use in 305b and 303d assessments. Challenges remain in institutionalizing use of biological endpoints in 303d listing in all nine Regional Boards across the State.
Reporting	Produced several statewide condition surveys (aquatic life use in perennial streams, fish contamination in lakes, sediment quality in coastal waters). The SWAMP also produced a diverse array of other products including regional reports, special studies, fact sheets, newsletters, press releases, and presentations at professional meetings. Link to the SWAMP statewide reports webpage.
Programmatic Evaluation	A programmatic peer review of the SWAMP was completed in 2005. Since then, peer reviews have been focused on particular aspects of the program (i.e., Bioaccumulation Survey, Database Management, Reference Approach). These come at a cost, but are well worth it.
Infrastructure Planning	Funding for basic infrastructure is a challenge. Program needs evaluated during 106 negotiations and workplan development. The SWAMP is looking to use permit fees as a potential source of funding.

SWAMP should be evaluated as part of a continuous improvement feedback loop. This may include, for example, undertaking audits focused on implementation of the monitoring program objectives, quality assurance protocols, and laboratory and data assessment procedures.

Goal 9.1 Ensure that the program is being implemented as designed.

Goal 9.2 Ensure that the SWAMP program is meeting the needs of other Board programs (for example, the TMDL or NPS programs).

Goal 9.3 Ensure that the program is technically sound.

Current Status

Currently, the SWAMP program receives input, review and guidance from a number of entities that assist the program:

SWAMP Roundtable: Coordination of SWAMP is achieved through monthly meetings of the SWAMP Roundtable. The Roundtable is composed of State and Regional Water Board staff and representatives from other agencies and organizations, including the Department of Fish and Game, the Marine Pollution Studies Laboratory and the University of California. Interested parties, including members of other agencies, consultants or other stakeholders are welcome to participate. Roundtable members provide programmatic, technical and logistical support and guidance on the implementation of the program. Generally, decisions are made by consensus. The strength of the current program resides in the Roundtable. Together, the skills, knowledge, abilities and perspectives of the individual members combine to form a coordination entity stronger than its individual participants [Goal 9.1].

California Water Quality Monitoring Council: The CWQMC is co-chaired by the California Environmental Protection Agency and the Natural Resources Agency and is comprised of stakeholders from the regulated community, non-governmental organizations, and academia. The CWQMC serves as a review body for the SWAMP and recently reviewed a draft of the SWAMP strategy revision, which will be appended to the Council's comprehensive monitoring strategy [Goal 9.2].

Watershed Technical Advisory Committees: Some regions have elected to receive reviews and coordinate their watershed assessments by relying on locally appointed technical advisory committees (TACs). The TAC functions vary and may include planning and/or review. Although effective for individual regions, TACs' inconsistent implementation among regions limits their overall program value [Goal 9.3].

Scientific Planning and Review Committee: An external scientific panel, the Scientific Planning and Review Committee (SPARC) was organized by SWAMP to review monitoring objectives, design, approaches, indicators and other relevant topics. Committee members are representatives from federal and state agencies and academics with expertise in fields such as monitoring program management, monitoring design, ecology, chemistry, quality

assurance, pathogens, toxicology and statistics. The SPARC met in 2005 and produced a set of written recommendations, finalized in 2006. Since then, each of the three SWAMP statewide programs has convened its own external scientific review committees to guide these programs [Goal 9.1, Goal 9.2 & Goal 9.3].

External Scientific Review for the three SWAMP statewide programs: The Bioaccumulation, Bioassessment, and Stream Pollution Trends monitoring programs each have convened external scientific review committees that meet as needed to review program objectives, designs, indicators and assessments. These committees are comprised of nationwide experts in the programmatic and technical aspects of relevant disciplines, and include managers of related federal programs such as USEPA EMAP and USGS NAWQA [Goal 9.3].

Objectives

Objective 9.1: Evaluate workplans, perform audits, and develop performance measures to ensure the program is implemented as designed [Goal 9.1]

- Review annual and/or multi-year workplans, including the Regional SWAMP work plans and monitoring plans, to ensure that all program elements are addressed in workplans.
- Use information from regional audits to document extent of compliance with elements.
- Develop program performance measures and report on them annually.

Objective 9.2: Evaluate the program to ensure it is meeting the needs of other Water Board programs [Goal 9.2]

- Annual evaluation by SWAMP.
- Annual evaluation by USEPA.
- Periodic evaluation by program offices.

Objective 9.3: Employ peer review to ensure that the program is technically sound and scientifically defensible [Goal 9.3]

- Continue technical review of all Monitoring Plans and technical reports.
- Develop and implement process to respond to Scientific Planning and Review Committee recommendations.
- Conduct focused review of program elements to ensure they are implemented as designed and cost-efficiently.
- Participate in triennial review of the CWQMC comprehensive monitoring strategy as required by the enabling legislation (SB 1070, Kehoe, Statutes of 2006).

10 General Support and Infrastructure

Our vision is to provide the support needed to implement a coordinated and comprehensive monitoring and assessment program, and to maintain the infrastructure and program capabilities necessary to accomplish program goals.

Goal 10.1 Provide ongoing program coordination, administration and oversight

Goal 10.2 Update the SWAMP needs assessment

Current Status

SWAMP is currently funded at approximately 7 percent of the original estimate in the 2000 Needs Assessment. The lack of adequate resources has seriously limited what SWAMP is able to accomplish. It is highly unlikely that the program will ever have the resources described in 2000. This Strategy update reflects our current efforts to increase support for SWAMP by increasing the value and access to SWAMP information products, and to coordinate with partners who can assist with coverage of other Clean Water Act monitoring requirements.

SWAMP has since greatly reduced its monitoring scope and has targeted its statewide programs on two critical areas: contamination of edible fish and shellfish in all waterbody types, and aquatic life beneficial uses in streams. To meet the Clean Water Act requirements of assessing all waters for all beneficial uses, SWAMP needs to both seek additional funding and increase its coordination with partner programs that monitor areas where SWAMP cannot.

SWAMP has had partial success in both areas. The USEPA and the State Water Board have allocated CWA §106 funds to support the SWAMP statewide programs at their current levels. SWAMP Regional and infrastructure allocations have declined, and additional funding sources need to be identified. Our coordination efforts were greatly enhanced with the creation of the California Water Quality Monitoring Council. The CWQMC has recommended and begun implementation of a system of theme-based work groups to address the range of waterbody type/beneficial use combinations in need of assessment. SWAMP is taking responsibility for the Safe to Eat Fish and Shellfish work group and the Aquatic Ecosystem Health in Streams, Rivers, and Lakes work group. A web portal for the Safe to Eat Fish and Shellfish theme was released in 2010 and currently is being enhanced with new data and assessments. The Healthy Streams Partnership is developing a web portal for release in 2011.

The SWAMP also is actively recruiting partners in other Water Board programs, other CalEPA and Natural Resources agencies, the regulated community, and citizen monitoring organizations. By providing tools for data comparability and exchange, SWAMP is encouraging these entities to generate and contribute data that can be integrated into comprehensive assessments that would otherwise exceed SWAMP's scope. SWAMP's statewide programs share sites and indicators with partners to provide statewide perspective

for local programs and greater spatial detail for statewide assessments. SWAMP's Regional programs actively partner with local entities to leverage SWAMP funds and increase the information value of resulting assessments. SWAMP also is working with the State Water Board's Quality Assurance Program and the recently assembled QA Roundtable to develop Quality Assurance Program Plans for all Water Board programs that collect ambient surface water monitoring data.

One area in need of infrastructure improvement, as identified by both the Roundtable and the CWQMC, is the contracting process by which SWAMP accesses the capabilities of the University of California and California State University to conduct monitoring, data management, and assessment. The State Legislature has begun to address this issue with the passage and signing of Assembly Bill 20 (Solorio, Statutes of 2009) that requires the Department of General Services, to establish a model contract with standard contract provisions for UC and CSU agreements. This may be one step toward streamlining a contract process that currently requires multiple reviews and results in lengthy delays.

Objectives

Objective 10.1: Increased visibility and usefulness of SWAMP information through targeted reporting and dissemination via the CWQMC web portals [Goal 10.1]

- By engaging partners and making monitoring information more accessible on the CWQMC web portals and other outlets, SWAMP intends to increase its outreach and make its programs more valuable to the public and decision makers (Element 8).

Objective 10.2: Provide ongoing program coordination, administration and oversight [Goal 10.1]

- Support Water Board staffing levels adequate to manage SWAMP contracting and administrative needs.
- Identify and implement the most effective method of contracting for the program.
- Maintain laboratory and field capability adequate to handle current and anticipated monitoring workload.
- Maintain the expertise and capabilities of the SWAMP contract laboratories to allow continued high quality monitoring and assessment.
- Document the history of key SWAMP communications, decisions, budgets, and products to support SWAMP institutional memory.

Objective 10.3: Provide regional coordination [Goal 10.1]

- SWAMP Regional Coordinators will strive to coordinate monitoring among Water Board programs and other agencies and entities at a regional scale; however, resource constraints may limit their ability to do this in a comprehensive manner.
- Provide administrative oversight.

- Support travel required to attend the National Water Quality Monitoring Conference and other key opportunities to get review and insights for program improvement.
- Identify other state-funded monitoring that could be more professionally, efficiently, and cost-effectively conducted by SWAMP.
- Work with the CWQMC to develop proposals to improve monitoring to determine effectiveness of state financed water quality improvement projects.

Objective 10.4: Update the SWAMP needs assessment [Goal 10.2]

As SWAMP pursues this dual approach to program support, staff will need to identify current and future resource needs to fully implement the SWAMP Strategy. As part of an ongoing triennial review and planning process, the following needs should be assessed, considering current conditions and planned improvements:

- Identify the required number of staff needed for the SWAMP program implementation;
- Identify the laboratory support needed to conduct high quality analyses and manage data according to SWAMP procedures;
- Identify training needs for program implementation by field, laboratory, data management and data assessment staff;
- Identify annual monitoring needs of Regional Water Boards;
- Identify annual monitoring needs of The State Water Board;
- Prepare budget for upcoming year; and
- Forecast budget needs for three years.

Appendices

Appendix A

Comprehensive Monitoring and Assessment Strategy for the Citizen Monitoring Program

Comprehensive Monitoring and Assessment Strategy for Citizen Monitoring Programs

November 2009

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Funded through State Water Resources Control Board Grant Contract No. 06-308-250-0.

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This document is based on the ten elements as found in "Elements of a State Water Monitoring and Assessment Program" (USEPA, 2003). Our document describes how citizen monitoring data can be incorporated into a statewide water quality database and the data used to assess attainment of beneficial uses of California's surface waters.

We recognize and are grateful for the development of online upload tools developed by Shelly Moore, SCCRWP, and Dave Paradies, CCAMP. Without these tools, citizen monitoring efforts would be severely underutilized throughout all of California.

The Technical Advisory Committee for this project has provided valuable insight and support of this project both in the development of the guidance documents as well as providing valuable data as to the condition of surface waters around the state.

The staff with the SWRCB, Clean Water Team and the California Water Monitoring Council have shown commitment and willingness to incorporate citizen monitoring data into the statewide process as well as ensure that communications with agency staff and support for citizen monitoring programs continue beyond the timeframe of this project.

For all, we are grateful.

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PREFACE

Water is California's most precious resource, and with a population of over 38 million people, the demand for clean water is growing exponentially. At the same time, the health and availability of water to its users is compromised due to urban and agriculture runoff, illegal dumping of pollutants, reduced permeability and habitat destruction.

The State Water Resources Control Board (SWRCB) and its nine Regional Water Quality Control Boards (RWQCB's) are tasked with the protection of California's water resources, but monitoring, assessing and reporting on the state of California's water quality is a monumental task. With 53 watersheds in the state, only one-half of the fresh water bodies are assessed by the SWRCB. This includes 15% of California's rivers, streams and creeks and about 50% of the lakes, pond and reservoirs. In addition, only 53% of California's wetlands and 42% of bays and estuaries are assessed (SWRCB, 2002)

To assist the state in meeting its water quality objectives, the Surface Water Ambient Monitoring Program (SWAMP) was formed in 1999 to "preserve, protect, enhance and restore the quality of California's water resources through monitoring programs, as well as to ensure proper allocation and efficient use of these waters."
(http://www.waterboards.ca.gov/water_issues/programs/swamp/**)**

During this same time period the SWRCB began to initiate a citizen monitoring program. The Clean Water Team (CWT) was developed to further the SWRCB's Non-Point Source efforts at a community level through citizen monitoring. As the SWRCB began to award grants for projects which incorporated citizen monitoring, the Clean Water Team (CWT) became very active in providing direct support to those organizations receiving grant funds. Later, the CWT's focus was directed to support citizen monitoring groups which were participating and contributing towards the state's Clean Water Act 303(d) list and Total Maximum Daily Load (TMDL) programs (Burres 2003). Due to organizational changes in the early 2000's the CWT was incorporated into SWAMP. Over this entire time period the number of citizen water quality monitoring groups across the state grew from just a few to well over 200. (Burres 2007 and 2008)

Data generated by the citizen monitoring (CM) groups, in part, has been used by the state to help fulfill some of the state's water quality objectives and the following goals of the Comprehensive Monitoring and Assessment Strategy to Protect and Restore California's Water Quality 2005 (SWRCB, 2005).

- Surface waters are safe for drinking, fishing, swimming, and support healthy ecosystems and other beneficial uses.
- Individuals and other stakeholders support our efforts and understand their role in contributing to water quality.
- Water quality is comprehensively measured to evaluate protective and restoration efforts.

Unfortunately, citizen data is not universally accepted, and the time that citizen groups put into planning, training, and collecting valuable data is underutilized. During this time of economic crisis and increased degradation of California's water quality, it is more important than ever for

the state to take advantage of the existing data and resources that citizen monitoring groups can provide. One way to facilitate this process is to integrate the data citizen groups generate into a statewide data sharing system.

To support the integration of citizen monitoring data to the statewide data sharing system, the California Citizen Water Quality Monitoring Program (CCWQMP) was created under SWRCB grant contract number 06-308-250-0 and will be reported on within this document funded under this same contract. The goals of the project are to:

a) Develop a process for volunteer data to be uploaded into a statewide database.
b) Help the Non-Point Source (NPS) program and other state and regional programs use citizen monitoring data more effectively.
c) Fill in data gaps with citizen data and create a more robust set of water quality information for California.
d) Use citizen data to when setting state policy(ies), evaluating program success(es), and when assessing both water quality status and trends.
e) Promote and support volunteer water quality monitoring programs throughout the state.

At the same time, citizen monitoring groups and the RWQCBs need to examine how citizen monitoring efforts will fit into the water quality goals and objectives of SWAMP and the California Water Quality Monitoring Council. This "Comprehensive Monitoring Strategy for Citizen Monitoring Programs" will provide a framework for the integration of citizen monitoring data.

BACKGROUND

The Federal Clean Water Act gives states and territories the primary responsibility for implementing programs to protect and restore water quality. In Section 106(e)(1), the Clean Water Act requires the US EPA to determine that a state is monitoring the quality of navigable waters and compiling and analyzing data on water quality. Before the US EPA will award Clean Water Act Section 106 grant funds, states must report their monitoring and assessment activities and submit that information into their obligatory Clean Water Act Section 305(b) report.

To meet these Clean Water Act requirements and provide comprehensive information on the status of beneficial uses of California's surface waters, state programs such as SWAMP are tasked with answering the following questions:

- What is the overall quality of California's surface waters?
- To what extent is surface water quality changing over time?
- What are the problem areas and areas needing protection?
- What level of protection is needed?
- How effective are clean water projects and programs?

The SWAMP program is also designed to go beyond the federal requirements and coordinate a statewide framework of high quality, consistent, and scientifically defensible methods and strategies to improve the monitoring, assessment and reporting of California's water quality. To

help states fulfill their federal requirements, the US EPA produced a document that identified ten elements in a State Water Monitoring and Assessment Program (US EPA, 2003).

The state's Citizen Monitoring groups already help provide data which contributes toward the State's Clean Water Act 305(b) Report, TMDLs, best management practices, storm water permits, and other local and state projects. This document will therefore examine *how* the efforts of over 200 citizen monitoring groups in California fit into the ten elements as presented in the Comprehensive Monitoring and Assessment Strategy to Protect and Restore California's Water Quality (SWRCB, 2005). In the future, this information may be integrated into the California Water Quality Monitoring Council's comprehensive strategy.

Figure 1.

Elements of a State Water Monitoring and Assessment Program
1. Monitoring Program Strategy
2. Monitoring Objectives
3. Monitoring Design
4. Core Indicators of Water Quality
5. Quality Assurance
6. Data Management
7. Data Analysis/Assessment
8. Reporting
9. Programmatic Evaluation
10. General Support and Infrastructure

The SWRCB currently monitors little over one-half of the state's water bodies. The agency simply does not have the monitoring resources to effectively evaluate all of the surface waters in the state. It is up to the SWRCB, SWAMP and other state agencies, therefore, to work with partners to identify and implement additional monitoring resources to satisfy the water quality goals of the Clean Water Act.

Citizen water quality monitoring groups are an additional, albeit underutilized, resource. There are currently over 200 citizen monitoring groups throughout the state, who collectively donate tens of thousands of hours of their time to monitor water quality every year. The cost of volunteer time is substantial. The assigned value of volunteer time in CA in 2007 was $21.97/hr (Independent Sector, 2009). In light of the current economic climate, it would benefit the state to examine its relationship with citizen monitoring groups. For example, a subset of thirty-five monitoring programs surveyed collect 7,726 data points per year. If we assume each result requires 2 hours of volunteer time that equates to a minimum of $339,480 per year worth of volunteer service.

To determine the quality and quantity of citizen monitoring data, 35 CM groups statewide responded to a survey developed by the California Citizen Water Quality Monitoring Program. Results showed that; the commitment of citizen groups was high; most groups monitored year-round, and the longevity of groups was an average of 11 years (Statement of Needs, 2008). The "workforce" of these groups was made up of approximately 66 citizen monitors per group. The number of sites monitored was also substantive; 54 sites/yr/group and an average of 257 data

points/yr/group. Three-fourths of the groups had documentation for quality assurance, and most groups were trained by regional or state experts. Furthermore, the objectives on which citizen groups focused were synonymous with state water quality monitoring objectives: pollution detection, land-use impacts, establishing base-line data, assessing best management practices, salmonid protection, and flood prevention. In addition to contributing data for the state's 303(d) listing and the 305(b) report, several groups were involved in Phase I and II Stormwater permit monitoring. Almost all groups surveyed were also involved in public outreach and education activities. This strongly supports a principle written into the Comprehensive Monitoring and Assessment Strategy to Protect and Restore California's Water Quality which states "The Water Boards will provide education and outreach opportunities so that Californians understand their responsibilities and abilities to protect water quality."

Citizen monitoring data can, and does, fill spatial and temporal gaps which address the state's water quality objectives. Compatibility of citizen data to that of state data is assured through state or regionally -approved QAPPs, in addition to the SWAMP protocol taught to citizen monitoring groups by state-approved trainers. Furthermore, most citizen groups who have approved QAPPs have been partially or totally dependent on state grants (i.e. Proposition 13, 40, 50, 84, 319h), and are required to submit their data to their RWQCB or SWRCB grant manager.

The state stands to benefit significantly by working with citizen monitoring programs and incorporating their data into one central database. An increase in statewide coordination between regional boards and these citizen water quality monitoring groups will greatly enhance the quantity and quality of monitoring data available to resource managers. This document is intended to incorporate citizen monitoring activities into the SWAMP Comprehensive Monitoring and Assessment Strategy and into and strategy produced by the California Water Quality Monitoring Council.

1. Monitoring Program Strategy

A monitoring strategy for citizen groups which addresses the state assessment framework outlined in this report is comprehensive in scope and covers monitoring objectives, monitoring design, core indicators of water quality, quality assurance, data management, data analysis/assessment, reporting, programmatic evaluation and general support and infrastructure.

Goals of a comprehensive strategy for citizen groups

- Individuals and other stakeholders support citizen monitoring efforts and understand their role in assessing water quality.
- Water quality is comprehensively measured to evaluate baseline conditions and restoration efforts.
- Citizen monitoring data is to be better utilized to support state water quality objectives (*see section 2.)*

Implementation Timeframe

- By December, 2009, the California Data Upload and Checker System (Cal DUCS) (produced under SWRCB Contract No. 06-308-250-0) will be available to all citizen groups for upload of their data into a SWAMP-compatible statewide database.

- A Communication and Outreach Committee made up of citizen water quality monitoring coordinators, RWQCBs, SWAMP and California Water Quality Monitoring Council will ensure;
    - Continued dialogue between the state and citizen monitoring groups
    - Development or enhancement of communication tools such as websites, webinars, newsletters and workshops

Evaluation

- Continued evaluation of the working relationship between citizen monitoring groups and state will be necessary. This may occur via annual (regional and/or state) citizen monitoring workshops, direct Regional Board feedback, presentations to the SWAMP Roundtable, and assessment and enhancement of monitoring programs.

2. Monitoring Objectives

The vision of SWAMP is "to define a complete set of monitoring objectives, based on beneficial use attainment and reflecting the full range of regulatory responsibilities and water quality programs for all water bodies" (SWAMP webpage "SWAMP History and Organization", 2009). In November 2000, SWAMP identified monitoring objectives critical to the design of a monitoring program that are efficient and effective in generating data that serve management decision needs.

Most monitoring objectives for citizen groups include:

- Helping to establish water quality status and trends,
- identifying impaired waters (303(d) listing) which is based on assessment of beneficial uses,
- evaluation of Best Management Practices (BMPs) and ecological restoration implementation.

The table below addresses how the work of CM groups relates to SWAMP regional goals and objectives.

Table 1. Regional Water Quality Control Board and CM Group objectives

SWAMP Goals and Objectives	Citizen Data Goals and Objectives[1]
• Employing a sampling design that allows the measurement and evaluation of **spatial and temporal trends** in watershed water quality,	Trend data to determine watershed health and to establish a baseline of water quality conditions.
• Using **standard sampling protocols**, SWAMP QAMP procedures and the SWAMP database to **provide statewide consistency and availability of data,**	Ensure use of the SWAMP Advisor and Upload tool (Cal DUCS)
• To monitor and assess the water quality of the regions watersheds with the primary	Collect necessary information to assess objectives for the beneficial use "COLD"

[1] Based on information from a statewide survey in which 35 citizen monitoring groups responded.

objective of **determining if the beneficial uses** are being protected.	(water quality monitoring in cold water waterbodies such as salmonid waterways) and "REC 1" (direct water contact recreation such as swimming beaches)
• Measure **environmental stressors, (i.e. pollutants), biological effects (toxicity tests), and ecological indicators (benthic community analysis)** to evaluate whether beneficial uses are being protected.	Toxicity tests at outfalls, lakes, streams, and bays; bioassessment combined with chemistry to determine if fresh water fish and swimmable waters are being protected
• Determine **if impacts are associated with specific land uses or water management**.	Develop a monitoring design to determine impacts from specific land uses.
• Generate data and associated information for the development of indices to evaluate ecological indicators (**Index of Biological Integrity for macro invertebrates**)	Benthic macro invertebrate (BMI) data was used in over ½ of groups along with physical habitat (P-HAB), chemistry and ambient measurements to determine watershed health. This data can be incorporated into indices and condition assessments.
• To develop **indices of biological integrity** for streams and rivers based on in stream benthic macro invertebrate and algae assemblages, to be used as a tool for evaluating biological integrity	Citizens monitor BMIs, algae, periphyton, P-HAB to determine biological integrity of streams and rivers
• Provide a **screening level assessment of water quality, based on a variety of chemical, physical and biological indicators**. Data is used to evaluate beneficial use support in the surface waters of the region.	Citizens collect chemical, physical, biological data to screen waterbodies.
• Assess whether **water quality conditions are getting better or worse over time.**	Long term data sets evaluate trend data taken for chemistry, bacteria, BMI, bank erosion, etc to measure positive or negative changes over time.
• Monitor surface water throughout the region to determine **ambient water quality** and whether beneficial uses are being impacted.	Ambient data is collected on a monthly to weekly basis to measure water quality conditions.
• **Coordinate all SWAMP activities** to maximize monitoring frameworks already in place and leverage existing resources,	There is high coordination within regional groups or "hubs" but not sufficient statewide coordination.
• **Target water bodies for monitoring where water quality information is scant**.	Through Cal DUCs there will be a system in place to determine where there are data gaps that can be filled.
• **To use ambient water quality data to determine the overall conditions of water bodies in the region for inclusion in the 305(b) Report and the 303(d) list of**	CM groups monitor same places throughout the year and submit data to RWQCB to be included in 303(d) list and 305 (b) Report

impaired water bodies.	
• To provide reliable, high quality information necessary **to produce 305(b) and 303(d) list *that are more comprehensive and more defensible*** than those of past years.	Some, but not all, citizen data is included in the evaluation of impaired water bodies. State agency data sets can be enhanced by CM data.
• Employing a sampling design that allows the measurement and evaluation of **spatial and temporal trends** in watershed water quality,	State agency data sets can be enhanced by CM data, especially with Google Earth which facilitates mapping monitoring sites.

The monitoring objectives used by citizen groups fall within the State's 28 beneficial use categories as found within the water quality control plans, aka basin plans. A large number of citizen monitoring groups monitor primarily for Primary Water Contact Recreation (REC-1) and/or Cold Freshwater Habitat (COLD). This bodes well with the inclusion of citizen data to populate the web portals being developed by SB 1070 California Water Quality Monitoring Council. The web portals currently include:

- Swimming Safety at Beaches (Safe to Swim)
- Human health risk associated with sport fish consumption (Safe to Eat Fish and Shellfish)
- Drinking water safety (Safe to Drink)
- Wetlands status (Wetlands)

The theme-based workgroups developed by the Statewide Monitoring Council are tasked with developing criteria for the inclusion of data collected by multiple sources including citizen monitoring programs. Until then, below is an example from the Central Coast Regional Water Quality Control Board of monitoring criteria for REC-1.

Is there evidence that it is unsafe to swim?
Are swimming conditions improving or getting worse?
Beneficial Use: Water Contact Recreation (REC-1)
Monitoring Objective(s): At sites throughout water bodies that are used for swimming, or that drain to areas used for swimming, screen for indications of bacterial contamination by determining percent of samples exceeding adopted water quality objectives and EPA mandated objectives. Central California Ambient Monitoring Program (CCAMP) data as well as data collected by local agencies and organizations will be used to assess shoreline and creek conditions.
Monitoring Approach: Monthly monitoring for indicator organisms (e.g. *E. coli*, fecal coliform…); compilation of other data sources
Assessment Limitations: CCAMP sampling approach does not meet the frequencies identified in the Central Coast Basin Plan of 5 times in a 30-day period.
Criteria:

- Fecal coliform exceeding 400 MPN/100 ml
- *E. coli* exceeding 235 MPN/100 ml
- Application of the binomial test to sample exceedence rate according to the SWRCB Listing Policy (2004), where

    - Null Hypothesis: Actual exceedance proportion is <=10%
    - Alternate Hypothesis: Actual exceedance proportion >25%
- Geometric mean of fecal coliform samples greater than 200 MPN/100mL

Interpretation: A minimum of five exceedances is required to determine impairment. If the site has exceedances, but there are fewer than five, site is considered partially impaired. The geomean criterion is compared to the geomean of data from the entire sampling year. If a site geomean exceeds the geomean criterion, the site is considered impaired. Trend data will be evaluated using non-parametric approaches, including Seasonal Mann-Kendall and Kruskall-Wallace tests, and by evaluating change in exceedance rate over time.

Based on the above criteria, if a CM group wants to tailor their monitoring objectives to have their data included in assessment of beneficial uses; then they need to design their monitoring plan to include some or all of the parameters listed under Monitoring Approach.

3. Monitoring Design

Like SWAMP, citizen monitoring groups utilize monitoring designs which maximize the ability to meet monitoring objectives with existing resources. Many citizen monitoring groups work with their Regional Board representatives to contribute data towards 303(d) listings and to a lesser extent, TMDLs. Remediation plans of impaired water bodies may include addressing a series of issues from pollutants to increased temperature and low flow rates.

Goals of the citizen monitoring integration program:

- To assist the state in filling in spatial and temporal gaps with citizen data.
- To help with long-term monitoring for temporal and spatial trends.
- To target water bodies for monitoring where water quality information is scant.
- To coordinate with other data collection efforts.
- To use ambient water quality data to determine the overall conditions of water bodies in the region for inclusion in the 305(b) Report and the 303(d) list.
- To see if water quality conditions are getting better or worse over time.

To help assist the state in filling in spatial and temporal data gaps, there needs to be a mechanism by which the individual designs of citizen groups can be nested into the statewide program, especially in the waterbodies with beneficial uses that include of swimming, drinking, and fishing. To do this, the following questions need to be addressed;

- *Spatial*
    - *Where do citizen groups monitor? Are the sites represented on a GIS layer?*
    - *Are sites on a 303(d) listed water body that might provide source tracking information?*
    - *Are there areas that are not monitored that should be?*
    - *Are there areas where multiple programs are monitoring that might be able to share resources?*
- *Temporal*
    - *Are sites monitored at appropriate times and frequencies to provide necessary information?*
    - *How often should sites be monitored to answer specific questions?*

- *Citizen monitoring programs should be aware of each Region's sampling design and monitor at Regional Board sites when they are not monitoring.*

- *Design coordination*
  - *Do citizen monitoring programs fill necessary data gaps in the SWAMP monitoring program?*
  - *Do neighboring monitoring programs coordinate with upstream programs?*
  - *Are methods and protocols comparable?*
  - *Is all necessary information being collected, ie. hardness with metals analysis, temperature and pH with ammonia measurements?*

Most citizen groups use a site-specific monitoring design which incorporates fixed stations and targeted monitoring. See the examples below;

Table 2. State Monitoring Designs used by Citizen Monitoring Groups

Monitoring design	Design definition	Examples from citizen group monitoring
Fixed station	Repeated long-term sampling or measurement of parameters at representative points for the purpose of determining environmental quality characteristics and trends.	Snapshot Day, outfall monitoring, World Water Day, and ambient data to determine need for the 303(d) listing
Targeted monitoring	Sampling at location-specific sites which are usually selected for monitoring based on a list of considerations and information needs.	Project effectiveness, ambient conditions for the 303(d) listing and 305(b) report.
Stratified random	A sampling method in which the population is separated into groups (strata) usually based on some internal similarities, then selecting a random sample within each stratum.	BMI by ½ of surveyed groups
Probability-based sampling	A sampling method in which randomness is built into the design so that properties of the sampled population can be assessed in terms of their likelihood of occurrence or existence.	No citizen programs identified.

4. Core Indicators of Water Quality

To evaluate the effectiveness of management actions to improve water quality in the state, SWAMP currently uses core indicators that denote the health of different waterbody types and their associated beneficial uses. Core indicators for each type of waterbody include physical/habitat, chemical/toxicological, and biological/ecological endpoints as appropriate. SWAMP also uses supplemental indicators when they have reasonable expectations that a specific pollutant is present in the watershed, when core indicators suggest impairment, or to support a special study, such as screening for potential pollutants of concern.

In fiscal year 2006-2007, SWAMP refined their core indicators to indentify and develop those that accurately indicate water quality at the federal, state, watershed and project scales. SWAMP intended for these refined indicators to better inform them of the relationship between water quality and the land use activity of the surrounding land and/or effects of landscape changes (ie. timber clear-cutting practices causing increased sediment deposits in salmonid breeding grounds). The indicators tested by SWAMP are also monitored by citizen groups. Table 3 cites the portion of surveyed groups who monitored the water quality indicator(s) specified by the state.

Table 3. 2007 Survey of 35 Citizen Monitoring Groups Statewide

Current SWAMP Indicators	**Indicator Description and Purpose**	**Portion of Surveyed CM Groups Monitoring this Indicator**
Conventional chemistry (DO, pH, etc.)	To assess general health.	80%
Nutrients	To determine attainment of beneficial uses	66%
Fecal Indicator Bacteria	Total coliform, fecal coliform, *E. coli* and enterococcus for MUN, REC-1, and REC-2	57%
Benthic macro-invertebrate community metrics	Fresh water macro-invertebrate communities (via IBI) is used to indicate watershed health, especially in waters that support fish.	51%
Lab analysis	Includes trace metal and organic analytes, including OP, OC, pyrethroid pesticides, PCBs, PAHs, etc. All measured in water, sediment, or tissue for watershed health.	Metals 37%
Sedimentation	Turbidity, TSS (SSC), pebble counts and other streambed metrics are used to determine sedimentation as it affects living organisms in the watershed, especially fish habitat.	11%
Toxicity testing	Toxicity done via bio-assays with fresh and salt water organisms to determine toxicity.	1%

Core Indicator Objectives

It is SWAMP's vision to develop and implement a set of monitoring indicators with assessment thresholds, which can be used to track the status and trends of water quality and to evaluate the effectiveness of management actions to improve water quality in the state. This type of information will also be used by the California Water Quality Monitoring Council to populate the online web portals.

This requires that a core set of indicators be defined for each water resource type. This includes water quality parameters with physical/habitat endpoints as appropriate, that reflect designated uses, and that can be used routinely to assess attainment with applicable water quality standards throughout the state. SWAMP's core set of indicators must also contribute to statewide tracking

of water quality indicators being implemented under the Environmental Protection Indicators for California project (EPIC). The EPIC project is responsible for maintaining an environmental indicator system to assist environmental programs in evaluating the outcomes of their efforts, and in identifying areas that require more attention.

Citizen groups already collect data for the first of EPIC's main quality indicators, "the assessment of aquatic life and swimming uses." They have also traditionally provided data for the state's TMDL program and for 303(d) listings. Common beneficial use categories addressed by citizen groups have been water contact recreation (REC-1; indicator; bacteria) and cold water fish (COLD; chemical, physical, biological indicators).

Citizen groups, with the help of their Regional Board representatives, can enhance their monitoring efforts by:

- Adopting the state's recommended core and supplemental indicators for use at a local watershed scale.
- Adopting indices for assessment of all beneficial uses as determined by SWAMP and the California Water Quality Monitoring Council.

5. Quality Assurance

One of the main challenges for the acceptance of citizen data is the lack of understanding of the level of quality of citizen monitoring data. Another challenge is the lack of standardization of the vocabulary monitoring groups use when collecting and entering data. Quality Assurance Project Plans (QAPPs) address both issues since QAPPs document project management, data generation and acquisition, assessment and oversight, and data validation and usability in a standard format. The collaborative process required between the data generators (citizen group), the grantor, and the official who must approve of the QAPP ensures a solid foundation for monitoring. This is followed up with quality control, a series of actions (i.e. audits of proper field and lab procedures, etc.) which ensure that the quality of data collected meets the highest standards. Writing a QAPP is labor intensive, but necessary for citizen groups to do if they want their data to be comparable with other statewide programs. Quality control requires consistent effort and oversight.

Citizen groups who are dependent upon state grants are required to create and follow a QAPP, but there are other citizen monitoring groups with no QAPP who collect long-time trend data which could also be useful to the state. These groups may not know about QAPPs, may not know who to go to for help in writing them, may think QAPPs are too difficult and/or time-consuming to write, and/or may think that the scope of the QAPP is out of reach for their monitoring program. SWAMP has developed and online tool called the SWAMP QAPP Advisor designed to help monitoring programs draft QAPPs specific to their projects and it includes all of the necessary QAPP elements.

The California Data Upload and Checking System is being developed to facilitate the transfer of water quality data from monitoring programs to the California Environmental Data Exchange Network. The current data upload tool being built for citizen groups includes a registration page which documents the presence or absence of a QAPP. The upload tool takes a "tiered" approach

for all data submitted as to the quality, complexity, and available documentation. "*Tier" breaks will be established as development of the upload tool evolves*. The upload tool is SWAMP-comparable and encourages the standardization of language used by varying data generators. By including these features, the obstacles of language standardization and QA/QC is addressed. This is an important first step towards making citizen data universally accepted and available.

Recommendations to encourage the continued improvement of citizen group QA/QC will be addressed in the new Cal DUCS for citizen monitoring data upload. The system will contain the following components;

- Technical oversight and direction by SWAMP so that citizen group data will comply with SWAMP's QA/QC program.
- QA/QC 'tiering' for citizen groups via Cal DUCS registration page
- Technical support via the SWAMP Help Desk to ensure quality data

In addition, it is highly recommended that citizen monitoring groups conduct annual or biannual field and lab audits. An interim audit checklist (SWAMP is currently developing one) has been developed by the Citizen Monitoring Program Technical Advisory Committee can be found in Appendix 1.

6. Data Management

How much data the state receives from citizen monitoring groups is dependent upon well planned and executed data management. Acquisition of statewide citizen monitoring data will be extremely successful if the data upload system is user-friendly, has support help, feeds a statewide database and provides online access to the data. Managing the data flow from citizen groups to the state via a central data repository requires the clear delineation of roles and responsibilities at local, regional and state levels.

Table 4. Data Management Roles and Responsibilities for state and CM groups

Organization	Data Responsibilities
Citizen monitoring programs	• Follow SWAMP comparable monitoring protocols. • Thoroughly document and manage data. • Become familiar with and include data management protocols for the upload tool. • Include the data management protocol in their QAPPs.
SWAMP/CWT or RWQCB	• Provide training and written instruction to citizen groups for upload tools.
California Environmental Data Exchange Network (CEDEN)	• Provide a Help Desk for questions about upload tools and IT information to operate Cal DUCS. • Transfer citizen data to statewide database in a timely manner.
California Water Quality Monitoring Council	• Flag data for use in SB1070 theme-based portals. • Disseminate data through online query tools. • Incorporate CM data into theme portals related to water quality conditions.

7. Data Analysis and Assessment

The Cal DUCS system has been developed to facilitate upload of citizen monitoring data into a statewide data management system. Once the data flow begins, access to the data is of the utmost importance to ensure that resource agencies, researchers and all monitoring programs have access to the statewide data set.

Once the flow of data is streamlined into a central statewide database, there will be many opportunities to use the data. It must be in a format conducive to answering various questions related to water quality conditions. SWAMP will use the data to assess attainment of beneficial uses. The Statewide Monitoring Council will use the data to populate the theme based web portals. Scientists will use the data to answer specific environmental questions related to their research. CM groups will use the data to compare conditions in their watersheds to those around the state.

Needs and recommendations of data analysis and assessment are the following;

- Identify the level of quality assurance required to utilize CM data.
- Identify the gaps in information that CM groups can fill for use by resource agencies.
- Develop guidance by the Statewide Monitoring Council to incorporate CM data into theme based web portals.
- Provide spatial assessment and tracking of management measures to better explain changing water quality conditions.
- Provide statistical tools for improved analysis and understanding of monitoring data.

8. Reporting

Citizen Monitoring programs each have their own means of reporting monitoring results based on grant requirements, monitoring objectives and information sharing. Those mechanisms will be program specific and most likely will remain that way. Examples of how citizen monitoring programs report their results include newsletters, annual reports, online summaries, workshops, and email Listserves, to name a few. However, by creating a mechanism to share regional data with a statewide audience, that data will become increasingly more valuable. A statewide database of comparable information will provide for more statistically rigorous and meaningful reporting.

As demonstrated by the Central Coast Regional Water Quality Control Board, the access to a larger collection of water quality data resulted in a significant increase of proposed waterbody listings for the next 305(b) report and 303(d) list. Without the compilation of multiple datasets, this would not have been possible. It goes without saying that access to additional monitoring data will provide a more comprehensive understanding of the conditions of both surface and ground water throughout the state.

The internet offers an opportunity to provide a large amount of up to date information that is accessible to the masses. The California Environmental Data Exchange Network (CEDEN) website and California Water Quality Monitoring Council's web portals will not only make data more accessible but it will make it much more valuable. Citizen monitoring groups will be more inclined to take the extra steps to ensure quality data and upload it through Cal DUCS knowing it will be used to better inform resource managers and improve water quality conditions. Online

tools such as maps and graphs will reduce the need for traditional annual reports and summaries. Statistical analysis available at the touch of a button will revolutionize the ability of resource managers to make timely management and policy decisions to better protect natural resources. This will increase efficiency and reduce the time it used to take to analyze and develop reports.

9. Programmatic Evaluation

As described in Section 5. Quality Assurance, it is recommended that each CM organization do a programmatic evaluation on an annual or bi-annual basis (Appendix 1). Programs should always be looking for ways to improve and strengthen their program to best meet their objectives. The Cal DUCS upload tools will provide a review of data management efforts and whether they meet the requirements of SWAMP comparable data. The upload templates identify the meta-data that is important to document for each result. The checker tools indicate the data meets the criteria for inclusion into a statewide database. These efforts will require CM programs to evaluate how they manage their data.

There must be support at the state level for the Cal DUCS upload tools. It is a new system that will require improvements and changes based on the various user groups and data upload needs. If the program isn't supported and recommendations by users implemented, the system will fail and the flow of data to a statewide database will cease. The Cal DUCS website provides opportunity for comments through a wiki (http://www.ccamp.info/ceden/php/ceden_menu.php). This type of evaluation is highly recommended because it provides a written list of suggestions to improve the upload tool. These recommendations can be addressed as time allows and will ensure the best upload process possible.

The Statewide Monitoring Council is just beginning its process to provide meaningful information and answers related to important environmental and societal questions. This process has a long way to go, but should seriously take advantage of the data available from CM programs. As the data upload framework is developed, CEDEN and the State Monitoring Council should build in tools that flag all data pertinent to a particular portal to facilitate mining of pertinent data. All websites should provide a mechanism for evaluation and suggestions from the user groups visiting the sites. There are many ways to evaluate and portray monitoring information. The websites should be as flexible as possible to accommodate the many questions and stories the data can provide.

Evaluation of the working relationship between CM groups and the state is important to continue the flow of information and data. CM monitoring programs need to have a contact at their Regional Board for questions and guidance. A Citizen Monitoring Communication and Outreach Committee has been established to facilitate dialogue among CM programs and between CM programs and agency staff (Communications Strategy, 2007). Even this committee will require some commitment from agency staff to coordinate meetings and ensure follow through with recommendations.

10. General Support and Infrastructure Planning for CM Groups

The SWAMP Comprehensive Strategy lists four overarching tactics "to promote an efficient increase in the amount of usable water quality information that is available." Two of these four tactics are particularly applicable to citizen water quality monitoring;

1. "Build stronger partnerships with agencies, watershed groups, ***citizen monitors***, and others to facilitate the sharing of information, the collection of comparable data, and the use of monitoring tools. This includes working closely with the newly-formed Nonpoint Source Tracking and Monitoring Council."

2. "Continue working with monitoring programs currently coordinated through the CA Environmental Data Exchange Network. This coordination will ***increase data comparability, increase the potential for true collaboration with other entities collecting ambient water quality information, and will make data available to the public."***

In order to build stronger partnerships and sustain viable citizen monitoring efforts, increased collaboration is necessary. Citizen monitoring is a valuable resource that has been underutilized by the state in its comprehensive monitoring strategy. Below is the breakdown of needs that are necessary to make this effort successful in the future:

- Identification of data needs by the state that citizen groups can accomplish and the knowledge that their data is being used.
- A communication infrastructure between citizen groups and between citizen groups and agency staff.
- Centralized resource stations by which to acquire and share reference materials, equipment, monitoring information, etc.
- Technical support for a data integration program (Cal DUCS) which allows data flow between citizen groups, RWQCBs and other data users.
- Online accessibility and analysis of current water quality data.

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Appendix 1 – Quality Assurance Checklist

California Citizen Monitoring Quality Assurance Checklist

In order for citizen data to be better utilized by the Water Board and other groups towards satisfying the state's water quality objectives, the quality control (QC) of how data is collected, analyzed, and stored by all citizen monitoring groups must be documented. Although many citizen monitoring groups already practice rigorous QA/QC protocol, this process is not practiced state-wide, and/or is practiced but not documented. In such cases, there is no assurance for potential data-users (ie. other citizen groups, NGOs, state and federal agencies) of the quality of citizen-generated data, or assurance that the state-approved protocol written in a QAPP has been followed. Thorough checklists help avoid the causes of unacceptable data (Table 5).

Ideally, citizen monitoring programs should be reviewed annually by an independent party who is familiar with SWAMP protocols. The categories included in the checklist below are; pre-field checks; field checks; post sampling activities; packaging and shipping; lab checks; and data management. Addressing these categories help to satisfy QA/QC requirements while increasing the validity of data and its usability.

Table 5. Most popular reason for bad data

MOST POPULAR REASONS FOR BAD DATA…
1. Non-functioning or improperly calibrated equipment
2. Lack of clear communication in the field
3. Lack of legible and complete data entry forms (i.e. legible numbers, correct sig figs, and UNITS)
4. Incorrectly labeled sample containers
5. Contaminated samples
6. Out-of-date reagents
7. Incorrect holding times of samples sent to lab
8. Incorrect temperature of samples in transit to lab
9. Lab errors
10. Monitoring sites don't accurately represent reach conditions (due to lack of access to private property)
11. Inconsistent and/or incorrect data entry
12. Insufficient data management system/lack of documentation

Lead reviewer	Date
Lab Manager	QA Officer
Organization	
Address	
City	
State	Zip Code
Phone	Email
Project website	
Project type (i.e. ambient, storm water, etc)	
Duration (on-going or one-time only)	
Project start date:	Project end date:
Project Purpose (why?)	
Study area (where?)	
Study design (how?)	
Circle data type; water quality sediment quality transect flow stream profiles benthic bioassessment toxicity physical habitat other_____	

STEP 1 = PRE-FIELD CHECKS	yes	no	n/a	Comments
1.1 QAPP (quality assurance plan program)				
a) Do you have a QAPP?				
b) Regional or State Water Board approved?				
c) When was QAPP last updated?				
d) Are the SOPs listed in your QAPP?				
e) Are sub-contractors aware of your QAPP?				
1.2 Instrument calibration & maintenance				
a) Are instruments properly calibrated according to SOPs?				
b) Are results and opened reagents kept in separate notebook?				
c) Is the expiration date on all reagents and standards?				
d) Are calibrations documented?				
e) Are SOPs for equipment followed?				
f) Are there back-up parts for instruments?				
1.3 Gear				
a) Are containers and chests used to hold gear clean?				
b) Are containers and chests used to hold gear labeled?				
c) Is sampling set up in a way to prevent contamination?				
d) Is spare gear packed?				
e) Is there a check list for gear in pack before it goes out?				
1.4 Field Data Sheets				
a) Are sheets specific to data type (ambient, toxicity, bio)				
b) Do data sheets have name, date, time, location (lat & long), equipment ID and sample ID?				
c) Is there a space for the results of field measurements?				
d) Is there a space for water and weather conditions?				
e) Is there a comment section?				
1.5 Permission to access sites				
a) Do samplers have permission to access sites?				
b) Do samplers have access to locked gates and other closed entries?				
1.6 Tidal and temporal flow				
a) Are creeks assessed for presence/absence of flow or water?				
1.7 Safety				
a) Do you take safety precautions while sampling?				
b) Do you have a safety plan for accidents in the field?				
c) Are flow conditions taken into consideration before going into the field?				
1.8 Instructions				
a) Are important instructions reviewed with volunteers before going out?				

STEP 2 = IN THE FIELD	yes	no	n/a	Comments
2.1 Field documentation				
a) Is *verbal* confirmation used between sampler and note-taker?				
b) Are all field sheets complete and all spaces filled (i.e. "0" or n/a)				
2.2 Decontamination procedures				
a) Are gloves worn?				
b) Is cross-contamination avoided between sites?				
c) Are clean surfaces used in the field?				
d) Are intermediate sampling devices cleaned between sampling sites?				
2.3 Sample containers				
a) Are containers clean and/or uncontaminated?				
b) Is appropriate container used for sample type?				
c) Is size of container correct?				
d) Are containers rinsed (if required) and filled to appropriate level?				
2.4 Sampling and field procedures				
a) Do you follow written protocols?				
b) Are samplers aware of holding times?				
c) Are samples properly preserved?				
d) Are samples collected in appropriate location of stream for project objective?				
e) Is sampling depth, flow, and velocity taken into account?				
f) Are water samples collected first and sediment samples second?				
g) Is each sample labeled with sample ID, date, location, and time?				
h) Is data flagged when instruments out of range?				
2.5 Quality control samples				
a) Are travel blanks included with samples?				
b) Are appropriate sources of H2O used for the blanks of each analyte?				
c) Are equipment blanks run when new equipment is used or equipment has just been cleaned?				
d) Are field blanks collected at a rate of 5% for the length of the project or for trace-metals, Hg, aqueous VOA, sediment VOA, aqueous DOC and bacteria?				
e) Are field blanks for all remaining analytes collected at the beginning of the sample period?				
f) Are field duplicates collected for at a rate of 5% for the length of the project or once per field event?				
g) Are samples collected for MS/MSD purposes first composited and then split?				
h) Are QA samples submitted "blind" to the laboratories?				
i) Are there SOPs that specifically describe field procedures for QC samples?				
j) Who is responsible for QA sample frequency and volume requirements?*				
k) Are copies of QC sample results available?				
2.6 Quality control samples (cont.)	**yes**	**no**	**n/a**	**Comments**
a) a) If QC samples identify a problem, are corrective actions taken prior to future sampling events?				
b) percentage of: dups____splits____blind____replicates___				
2.7 Aqueous sample collection				
a) Are containers rinsed 3X with site water prior to filling (excluding pathogen and preserved samples)				
b) Are whirl packs filled ¾ with pathogen samples?				
c) Are aqueous samples taken prior to other sample types?				
d) Is care taken not to disturb bottom sediment during sample collection?				
e) Are clean hands procedures used for trace metal and				

STEP 3 = POST SAMPLING SITE/FIELD ACTIVITIES	yes	no	n/a	Comments
3.1 Equipment count				
a) Is all equipment accounted for?				
3.2 Aquatic Introduced Species decontamination				
a) Is decontamination protocol in QAPP followed?				
3.3 Field Data Sheet Review				
a) Is form complete (i.e. have ALL spaces filled in, incl "0" or n/a)				
b) Is form legible (i.e. in neat print, numbers readable)				
c) Are numbers written to include all significant figures?				
d) Do data sheets have a proper storage location?				
e) Is there proper use of vocabulary (no abreviations)				

STEP 4 = PACKAGING AND SHIPPING	yes	no	n/a	Comments
a) Is there a chain of custody?				
b) Is a COC enclosed in each shipment?				
c) Verify holding time compliance				
d) Are courier services able to deliver to lab on time?				
e) Has receiving lab had problems with temp of samples?				
f) Verify sample preservation				
g) Are sample containers sealed with tape?				
h) Are glass bottles cushioned to prevent breakage?				
i) Are ice chests sealed before shipping?				

STEP 5 = LAB (independent)	yes	no	n/a	Comments
5.1 QAPP that includes;				
a) EPA approved methods?				
b) Follow QA from "Manual for Certification of Labs Analyzing Drinking Water" and "Standard Methods for Examination of water and waste water"				
c) Validation with certified lab (via cross checks)?				
d) Chain of custody				
e) Spikes				
f) Replicates				
g) Duplicates				
h) Splits				
i) Blanks				
j) QA dependency				
k) Proper number of blanks, dups, splits, standards sent (i.e for nitrates)				
5.2 How does lab follow- up with errors?* (i.e. out of range, false positives, etc)				
5.3 Is there a chain of custody?				
a) Verify holding time compliance?				
b) Verify sample preservation?				

STEP 6 = DATA MANAGEMENT	yes	no	n/a	Comments*
6.1 Oversight				
a) Is there a QA officer?				
b) Is there documentation from a QA officer?				
c) What is supervisory protocol (if interns are used?)*				
d) If consultant is used, what is their protocol?*				
6.2 Data entry				
a) Is data sheet complete?				
b) Is data checked for transcription errors?				
c) What % of data is hand-checked (for data entry)?				
d) What % is checked for lab data?				
6.3 What is checked? (circle all that apply) units, conversions, out-of-range numbers, same vocabulary, checks for duplicates, splits, QAPP- acceptable limits				
6.4 How are the following checked?*				
a) Verification (*i.e.*)				
b) Validation (*i.e.*)				
c) Precision (*The repeatability of a measurement.*)				
d) Accuracy (*The closeness of a measurement to the true value of the parameter measured.)*				
6.5 How are anomalies handled?* (i.e. out of range samples, non-detects, matrix spikes, replicates, outliers, etc.)				

Appendix 2 – Data Users

Citizen data is used by local groups, organizations, and state and federal agencies (Table 6). Audiences use this data for several purposes;

- To fulfill state water quality grants,
- to work with Fish and Game on salmonid restoration,
- to work with cities on NPDES permitting,
- to provide data for the 303d listing (and the 305b report),
- to establish ambient baseline data,
- to monitor e-coli to be used by the Department of Public Health,
- to keep track of river flow rates,
- and to educate the public about watersheds and citizen group project results.

As of 2007 there are over 200 citizen monitoring groups statewide with, on average, 66 volunteers per group who monitor an average of over 32 sites and over 232 data points per group. These groups are trained to meet SWRCB-approved protocol, including the creation of QAPPs. Citizen groups oftentimes provide data to several organizations and agencies at the same time. For example, the Friends of the Van Duzen River in Region 1 works with the SRWCB, CA Fish and Game, Friends of the Eel River, local community stakeholders, Mendocino Redwood Co. and Salmon Forever. In addition, they work with local school groups as part of their education and outreach program.

Table 6. Key Audiences for Citizen Water Quality Data

Key audience category	Key audience groups
Federal	• National Marine Sanctuary Program • National Estuary Program • National Marine Fisheries Service • Bureau of Land Management • US EPA • United States Geological Survey
State	• CA Department of Fish and Game • State Water Resources Control Board • CA Regional Water Quality Control Board • CA State Parks
Academia	• K-12 Watershed education • State Universities and Colleges • Cooperative Extension programs • Local High Schools • Local Elementary Schools
County	• County Environmental Health Departments • Resource Conservation Districts
Cities	• Public Works
Town	• Town Council • Town Parks
Non-government organizations	• Salmon Forever • Surfriders • Keeper Programs • National Resource Defense Council • Sierra Club
Other	• California Stormwater Quality Association • Bay Area Stormwater Management Agencies Association

Appendix B
SWAMP Assessment Framework

SWAMP Assessment Framework

Introduction

The purpose of this report is to present a statewide framework for monitoring and assessment that will address the State Water Board's strategic goals through approaches that:

- Increase the amount of usable, quantitative data and information regarding water quality and beneficial uses
- Reliable and consistently translate data into useful information
- Coordinate the collection and reporting of water quality information among Water Board programs, agencies, and stakeholders

The SWAMP was created in 2000 to address a set of fundamental problems undermining the overall effectiveness of the large amount of ambient water quality monitoring conducted by the State and Regional Water Boards, including:

- A lack of standardized or comparable questions, indicators, methods, assessment thresholds, data management procedures, and reporting processes for Water Board programs
- Poor coordination among Water Board programs and among State and Regional Boards
- An inefficient and insufficiently rigorous process for creating periodic 303d / 305b reports

The SWAMP has succeeded in developing a number of standardized monitoring methods and key assessment strategies, and has assumed responsibility for several statewide assessments (e.g., perennial wadeable streams, sportfish tissue contamination). This experience has contributed to the development of an overarching infrastructure for monitoring and assessment that can organize continued efforts to address the three fundamental problems listed above. However if SWAMP is to fully meet the goals laid out for the program, it must focus additional effort on integrating SWAMP policies and infrastructure into the larger context of other Water Board programs.

The audience for this report is Water Board management, the Water Board's program managers, the Executive Officers of the Regional Water Boards, and the caseworkers, that is, staff with the responsibility for fulfilling the Water Board's strategic goals and the management authority to ensure that the framework's procedures and recommendations are implemented. In particular, this report also speaks to SWAMP Coordinators at the Regional Water Boards who will have responsibility for implementing the principles of this Assessment Framework at the regional level.

Water Board Monitoring / Assessment Scope

Water Board programs are structured around the protection of beneficial uses, with water quality monitoring intended to assess the status of core beneficial uses for all water body types, as illustrated in the conceptual overview in Table 1. A primary SWAMP goal is to coordinate the collection and reporting of such monitoring information among Water Board programs. In support of this goal, the SWAMP has made great strides in developing the monitoring infrastructure (i.e., indicators, methods, standard operating procedures, QA/QC, information management) needed to assess beneficial uses in surface waters, and these procedures are used by SWAMP staff at Regional Water Boards and by the SWAMP in their three statewide programs.

However, the SWAMP will never have the resources itself to monitor all of the state's water bodies for all core beneficial uses (i.e., all the cells in Table 1). Instead, there is a complex array of programs, both within the Water Boards and across multiple state and federal agencies, to protect and assess beneficial uses in various water bodies across the state at local, regional, and statewide scales. An evaluation of the major regional and statewide monitoring and assessment programs, using performance measures adapted from the USEPA's Elements of a State Water Monitoring and Assessment Program (Appendix 3, CWQMC 2008), confirmed that significant problems exist in terms of the comparability of monitoring methods, the availability of consistent assessment approaches, coordination among programs, and the ability to readily access data for reporting. The California Water Quality Monitoring Council is addressing coordination with other state and federal programs to address these problems. Within this larger context, it is clear that the Water Boards could contribute substantially to resolving these problems and provide more information to managers and the general public by coordinating the monitoring and assessment activities of the various Water Board programs (e.g. NPDES, NPS, TMDLs etc).

The SWAMP Statewide Assessment Framework presented here is an infrastructure for organizing key aspects of all Water Board monitoring and assessment for all cells in Table 1, even if they are not conducted by the SWAMP itself. It also defines the SWAMP's role in supporting appropriate monitoring standardization and coordination across Water Board programs for all cells of Table 1.

Table 1. Water quality monitoring, assessment, and reporting planning matrix, illustrating the potential combinations of water body type and beneficial use categories that are or could be addressed by the Water Board or its partners. Each cell in the table could be monitored, assessed, and reported on at a range of spatial scales, from local to regional and statewide. National efforts by federal agencies (e.g., USEPA, USGS, FWS) may also provide information for specific cells.

	Core Beneficial Use				**Stressors & Processes**
Water Body Type	**Aquatic Ecosystem Health**	**"Swimmable"**	**"Fishable"**	**"Drinkable"**	
Wadeable Streams					
Large Rivers					
Lakes					
Estuaries					
Ocean, Coastal, Bays					
Wetlands					

Assessment Framework Overview

Effective monitoring and assessment requires attention to several aspects of program design and implementation. Figure 1 illustrates which of these should be standardized at the statewide level and which may use other, scale-dependent methods that are more appropriate to a particular region or locality. The SWAMP's role is to ensure that standardized methods and/or relevant scale-dependent approaches are available for each cell of Table 1, taking the lead to develop such methods where the SWAMP has primary responsibility for statewide assessment (e.g., perennial streams, sportfish consumption). The role

of Water Board managers is then to implement needed standardization and coordination across all Water Board programs, with SWAMP Coordinators in each Regional Water Board playing an organizing and facilitating role for such efforts at the regional level.

Figure 1 illustrates the main steps in the SWAMP's coordination function. Beneficial uses (Box 1) are defined in Basin Plans and these define a starting point for developing more program-specific questions for specific beneficial use-water body combinations (Box 2). Monitoring designs to address these more specific questions may differ depending on the scale and/or site-specific circumstances (Box 3). Even such site-specific monitoring designs, however, can often use standardized core indicators (Box 4) and standardized sampling, quality assurance, and data management methods (Boxes 5 and 7). SWAMP has developed such standardized indicators and methods for the beneficial uses it has primary responsibility for, and will ensure that such standardized tools for all core beneficial uses (Table 1) are communicated to Water Board programs as needed. Even where site-specific assessment approaches (Box 8) are used, beneficial use status should be evaluated with respect to standardized thresholds and assessment endpoints (Box 6). Depending on the indicator, thresholds and endpoints may be strictly numeric, strictly narrative, or narrative statements supported by numeric thresholds. In several cases, the State Water Board is developing biological thresholds to assist programs in interpreting monitoring data. Finally, individual programs make the ultimate decision about how to use monitoring information and how it should be reported (Box 9).

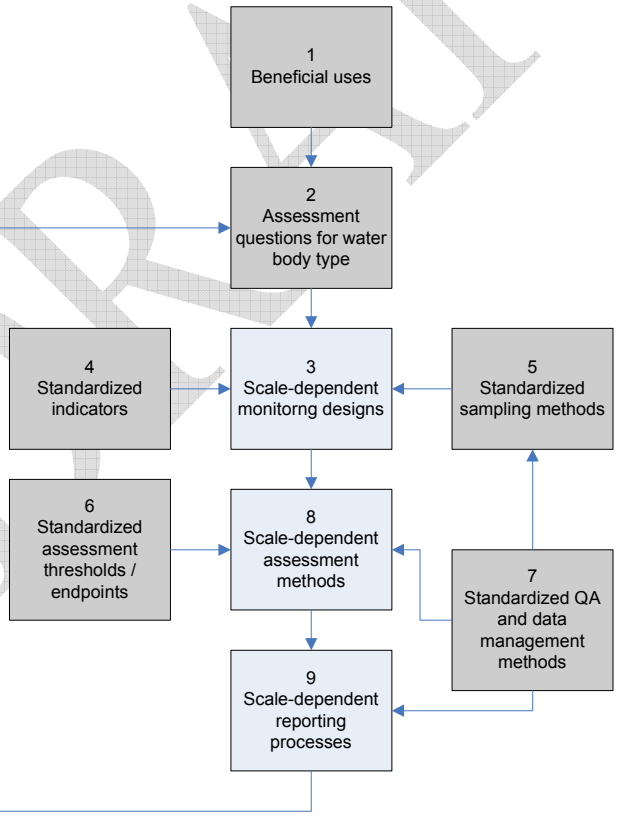

Figure 1. Key elements of monitoring design and assessment. Gray boxes are those elements for which SWAMP is responsible for ensuring the availability of standardized methods and/or approaches. Blue boxes are those elements that may use either standardized statewide methods or other methods that are more appropriate to a particular region or locality.

Figure 1 also illustrates that monitoring, assessment, and reporting is not a static process. Assessment results often lead to new questions as problems are solved, new problems arise, or scientific understanding improves. Thus, articulating assessment questions (or monitoring objectives) (Box 2) is a critically important piece of the monitoring and assessment puzzle because it provides the functional link between broader concerns about beneficial uses and the technical specifications of monitoring designs. Without clearly defined questions, monitoring programs can easily waste valuable resources collecting data that addresses the wrong question or no question at all. Thus, the development of a question-driven mindset throughout the Water Boards is an essential aspect of SWAMP's assessment framework.

Question-Driven Monitoring

As Figure 1 illustrates, clearly stated assessment / management questions, or monitoring objectives, are an essential prerequisite for effective monitoring designs, something that is universally emphasized in guidance on monitoring and research design. Assessment questions can be framed at three levels of detail (Figure 2). At the highest level, the SWAMP and the Monitoring Council have adopted the following five questions associated with core beneficial uses and the stressors that affect them (i.e., the top row of Table 1):

- Is our water safe to drink?
- Is it safe to swim in our waters?
- Is it safe to eat fish and shellfish from our waters?
- Are our aquatic ecosystems healthy?
- What stressors and processes affect our water quality?

For each of these questions there are is a second level of more specific management subquestions about the status of beneficial uses that provide additional focus for monitoring design:

1. What is the quality of waters relative to beneficial uses (i.e., are uses impaired)?
2. To what extent are conditions changing over time (i.e., are conditions getting better or worse)?
3. What is the magnitude and extent of any problems?
4. What are the sources of stressors threatening uses (i.e. what's causing the problem)?
5. How effective are projects and programs to protect beneficial uses (i.e., are solutions working)?

Comment [BB1]: This list differs a bit from the list of core questions in the Strategy on pp. 11-12. ID of sources is an important monitoring question (included here an not in Strategy) and Level of Protection (in Strategy but not here) seems more like a policy than a monitoring question.

These two sets of broad management questions are universally applicable across all water body types and all spatial scales for each core beneficial use. They provide a common starting point and an important level of consistency across programs and regions.

However, there is one additional set of more detailed questions (Bernstein et al. 1993) that include the technical perspective needed to guide the design of monitoring programs to ensure they provide meaningful and useful information:

- What is the management goal (e.g., no effects greater than X, no change from present condition, find problem areas, estimate percentage area in different conditions)?

- What monitoring strategy is suitable (e.g., measure one indicator, measure multiple indicators, track trends)?
- What degree of certainty and precision is required (e.g., qualitative information, minimal certainty/precision, extreme certainty/precision)?
- What reference conditions are appropriate (e.g., reference location, reference time, standards, model prediction)?
- What spatial scale is appropriate (e.g. site-specific, regional, statewide)?
- What temporal scale is appropriate (e.g., immediate, months, year-to-year, years to decades)?

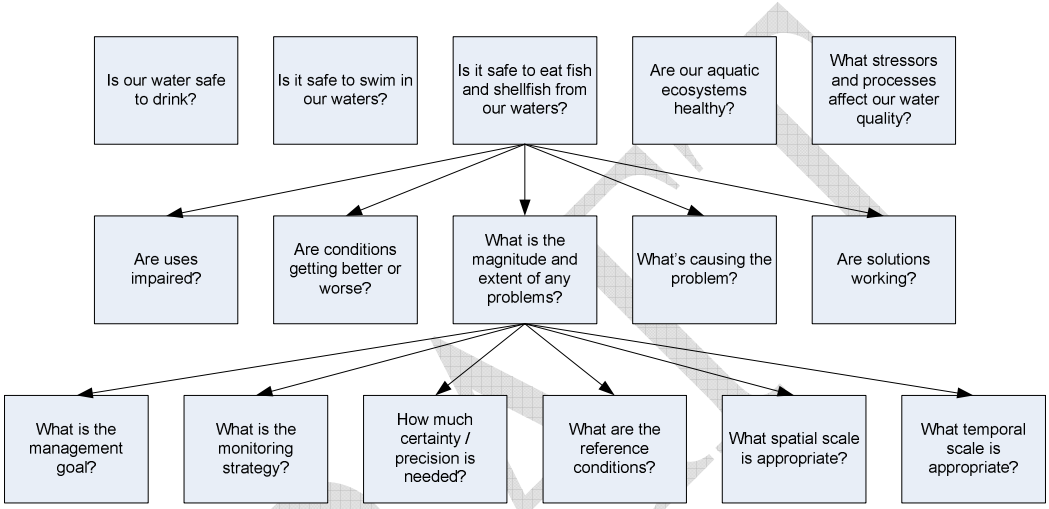

Figure 2. The three levels of questions (i.e., monitoring objectives) needed to develop effective monitoring designs, showing how each question in a higher level must be addressed by all questions at the next lower level. The top two levels of questions are universally applicable to all water body types and all spatial scales. The lowest level of questions must be addressed separately for each monitoring design.

An example from a National Research Council report on environmental monitoring (NRC 1990) illustrates the difference between management questions at each of the three levels of detail, related to a planned dam development on a Canadian river:

1. What would be the impacts of a proposed dam on the fish resources of the river (equivalent to Are our aquatic ecosystems healthy)?
2. Will spawning habitat be impacted (equivalent to Are uses impaired)?
3. What percentage of the Arctic char spawning habitat would be lost given a 0.5 meter reduction in the water level of the river during the month of September? (detail needed for monitoring design)

Another example, from a different regulatory arena (offshore oil platform decommissioning), also illustrates the nested levels of management questions needed for effective monitoring design:

1. What is the impact of decommissioning on commercial fishing?
2. What is the impact of vessel traffic on commercial fishing operations in the immediate vicinity of the project?

3. Does vessel traffic associated with decommissioning reduce commercial fishing activity by more than 25% within five miles of the project during decommissioning?

By question-driven monitoring, the SWAMP thus means the integrated application of the three levels of questions described above, with monitoring programs at the statewide and regional scale more likely to use standardized monitoring designs, and programs at more localized scales more likely to add features that tailor monitoring designs to their specific needs. A key part of the SWAMP's role is to work with Water Board programs, at statewide, regional, and local levels, to apply these questions to meet the specific needs of the individual Water Board programs and their monitoring efforts. (The SWAMP Strategy describes these efforts in more detail.) A more consistent application of such question-driven monitoring design across Water Board programs will help ensure that data collected at certain sites and times can be used for more than one program. This will produce logistical and cost benefits by reducing duplication of effort and enabling monitoring designs, indicators, and methods to be used more widely across programs and at different spatial scales (Figure 3). In addition, this will improve the value of assessments for decision making as programs at larges spatial scales provide needed context for interpreting monitoring results from programs operating at smaller spatial scales. Conversely, more localized monitoring efforts should provide detail useful in understanding how broad patterns operating at statewide and regional scales play out at finer spatial scales.

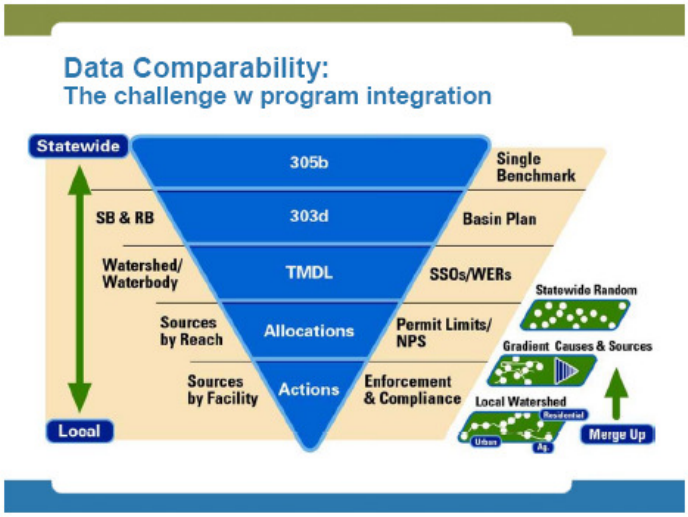

Figure 3. Water Board monitoring programs that use a question-driven approach to produce comparable data (i.e., based on standardized monitoring designs, indicators, and methods) can provide data that can serve the needs of multiple Water Board programs that operate at a range of spatial scales, from the local to statewide.

Indicators, Methods, and Thresholds

One of the ultimate goals of the SWAMP assessment framework is to ensure the availability and use of standardized indicators, sampling methods, and assessment thresholds or endpoints (Figure 1) for each cell in Table 1. The SWAMP and other Water Board programs have made significant progress in defining

indicators, methods, and assessment thresholds and in organizing these into a conceptual infrastructure to guide the future development of these monitoring tools. For example, Table 2, from SWAMP's current Strategy, lists recommended water quality indicators for general designated use categories.

Table 2. SWAMP recommended water quality indicators for general designated use categories (modified from USEPA 2007).

	Core indicators	**Supplemental/diagnostic indicators**
Aquatic life and wildlife	*Conventionals* Temp, conductivity, pH, nutrients *Toxics* Metals, bioaccumulation *Toxicity* Water and/or sediment *Biological condition* Invertebrates (streams) Chlorophyll (lakes, streams, estuaries) Algae Wetlands *Physical habitat* Phab (streams) CRAM (wetlands)	 Other chemicals of concern in water column or sediment TIEs (water and/or sediment) Health of organisms Landscape/landuse Flow
Fish/shellfish consumption	*Chemical indicators* Mercury, chlordane, DDTs, PCBs *Fecal indicators (for shellfish)* Total and fecal coliform	Other chemicals of concern in water column or sediment Landscape/landuse
Recreation	*Fecal indicators* Enterococci total and fecal coliform (seawater) E. coli, enterococci (freshwater) *Other* Secchi depth (lakes0 Nuisance plant growth Chlorophyll a Microcystis/microcystin	Landscape/landuse Other chemicals of concern in water column or sediment Flow Nutrients
Drinking water	Trace metals Pathogens (DW Rule, BP language) Algae (microcystis) Nitrates Salinity Sediments/TDS	Other chemicals of concern in water column or sediment

Standardized methods and assessment thresholds exist for many of these indicators. For example, the California Toxics Rule establishes thresholds for many chemical indicators for protecting aquatic health, OEHHA has developed fish contaminant goals and advisory tissue levels for protecting fish and shellfish consumption, and CADPH has developed standards to protect drinking water that are included in all Basin Plans. In addition, standardized monitoring approaches exist for the assessment of some categories of biological condition in some waterbody types. Some of these standardized monitoring and assessment elements have been developed by the SWAMP, some by other State Board programs and/or USEPA, and still others by broader collaborative efforts involving several state and federal agencies. Although such efforts include entities beyond the SWAMP, promoting their consistent use across all Water Board programs is a core responsibility of the SWAMP and the SWAMP Coordinators at the Regional Water Boards.

While indicators and assessment thresholds do exist for many of the beneficial use / waterbody combinations in Table 1, there are still gaps to be filled:

- Not all indicators in Table 2 within a beneficial use category are equally applicable to all waterbody types
- Indicators do not exist for all beneficial use / waterbody combinations
- Some indicators do not yet have thresholds to guide the assessment of monitoring results

Filling these gaps will be challenging. For example, in terms of aquatic life and wildlife, there are many kinds of ecosystems and populations within each waterbody type, with estuaries (as just one example) containing benthic infauna and macrofauna, a variety of fishes, birds (many threatened or endangered), and several habitats. Developing scientifically rigorous and practical assessment approaches that are applicable statewide is demanding. The State Water Board's ongoing efforts to develop consistent sediment quality objectives (SQO) for bays and estuaries, biological objectives for wadeable perennial streams, and numeric nutrient endpoints (NNE) for estuaries and freshwater are representative of the type of multi-year commitment typically required.

The SWAMP will play a range of roles in developing and applying standardized monitoring and assessment elements, including:

- Leading the development for selected beneficial use / waterbody combinations (e.g., biological objectives for wadeable perennial streams)
- Providing technical support to development efforts led by other programs (e.g., wetlands monitoring and assessment)
- Developing comprehensive monitoring and assessment approaches, and related permit requirements, for selected Water Board programs (e.g., stormwater)
- Acting as a source of readily available information on standardized sampling and assessment methods

In addition to these means of improving coordination and consistency across regions and programs, the SWAMP can use its role in reviewing quality assurance program plans (QAPP) to foster a more rigorous approach to the design of monitoring and assessment programs. Quality assurance is too often assumed to include only issues narrowly related to sampling and sample processing (e.g., laboratory methods, detection limits). Modern quality assurance and quality control approaches, however, focus more broadly on all aspects of the process that can affect the overall quality of the final product, the assessments that answer key management questions. Thus, if laboratory procedures follow standard methods but the wrong

assessment threshold is used, the assessment is of poor quality. Or, if standard sampling methods are used but the monitoring design is unsuited to the question(s) that motivated the monitoring effort, the assessment is of poor quality. The SWAMP, along with Water Board managers, should emphasize that quality assurance encompasses all aspects of monitoring and assessment programs, and should be judged by the utility of the final assessment product.

The State Water Board is in the process of finalizing a Quality Management Plan that describes the State and Regional Water Boards' quality assurance management policies and procedures, which will apply to programs within the three State Water Board Divisions and the nine Regional Water Boards, as well as any contractors, other state or local agencies working as partners with the State or Regional Water Boards, grantees or contractors working for any of these organizations. All data collection and data analysis activities, including biological, physical habitat, and chemical monitoring; use of data from secondary sources; and data analysis and modeling efforts, are to be guided by the principles of this Quality Management Plan:

- The intended use of environmental data and the level of data quality necessary to support decisions made using that data will be established by State and Regional Water Board staff prior to the design and initiation of all data collection activities
- All State and Regional Water Board programs generating, using, or receiving environmental data will adhere to the policies outlined in the Quality Management Plan
- All data generated by or for the State and Regional Water Boards, include those produced by other agencies, contractors, grant recipients and regulated parties, will be of known and documented quality (with "quality" broadly defined as above)
- Adequate resources and staff will be provided by the State and the Regional Water Boards to meet the quality assurance and quality control requirements of the Quality Management Plan

Programs are encouraged to develop specific Program Plans that define data quality objectives, decisions or goals, and measurement quality objectives that apply to all data generated under the program. In essence, this involves answered the nested set of questions described above (Figure 2). The SWAMP is developing its Program Plan and other State Water Board programs collecting ambient surface water data may use elements of the SWAMP Program Plan that are appropriate to their needs.

Data Management and Access

The SWAMP has developed a set of standardized formats and tables for storing and transmitting ambient monitoring data. Tables have been developed for chemical constituents (water, sediment, and tissue), toxicity results (water and sediment), biological communities (fish and macroinvertebrates), and habitat measures (grain size, physical habitat). These are used internally by the program and by those wishing to meet SWAMP comparability requirements.

The SWAMP has also developed the California Environmental Data Exchange Network (CEDEN) to support the storage of and access to monitoring and assessment data for all Water Board programs across the state. CEDEN will enable Water Boards, permittees, and other sources of monitoring data to upload their data to one of several regional data centers linked as a statewide data network. Users will then be able to use CEDEN to readily find and obtain data based on a variety of search criteria such as location, program, or constituent. In addition, an important part of the SWAMP's strategy is to provide technical support to users through staff at the regional data centers. CEDEN is a critical prerequisite for the reporting element of the assessment framework described in the next section.

Reporting

As Figure 1 illustrates, the ultimate goal of monitoring and assessment activities is to report on information that will answer key management questions and assist in making decisions. Recognition of this ultimate use of monitoring data underlies all the SWAMP's efforts at improving the designs, indicators, and thresholds used in Water Board programs. At the statewide level, the integrated 305b/303d report is the state's primary means of addressing needs for statewide assessment and for tracking trends in environmental condition over time. At regional and local scales, a variety of other reporting processes are used to address scale-depending assessment and decision needs. For all such processes, ready availability of high-quality and consistent monitoring data and assessment results at a range of spatial scales is key to improving their efficiency, rigor, and credibility and for identifying, prioritizing, and managing risks to water quality and associated beneficial uses.

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Appendix C
SWAMP Needs Assessment

Appendix D
Regional Fact Sheets

SWAMP Monitoring Strategy

Santa Ana Regional Water Board

Since the inception of the Surface Water Ambient Monitoring Program (SWAMP) in 2000, the Santa Ana Regional Water Board focused resources to obtain data in waterbodies that lacked the necessary data to determine compliance with water quality objectives. These waterbodies included Anaheim Bay, Huntington Harbor, Lake Elsinore, and Canyon Lake. In each of these waterbodies, we learned about their seasonal differences in biology, and toxicity and used the data to refine their status on the Clean Water Act's Section 303(d) list of impaired waterbodies.

Our current strategy is to evaluate streams in the region against the Southern California Index of Biological Integrity. For those streams that score "poor", prioritized actions such as additional monitoring may be done. To this end, we conduct bioassessment monitoring of our rivers and streams in the region using a probabilistic design. This monitoring is scheduled to be completed in 2011. We plan to use the findings from this study to identify the areas of concern in our region, which will aid in developing waste discharge requirements, specifying conditions for water quality certifications, updating the Integrated Report and in commenting on environmental documents.

We also plan to continually reach out to citizen groups, and non government entities that monitor waterbodies in our region to educate them about quality assurance, sampling and data management protocols, and where possible to establish partnerships that will allow our monitoring funding to extend to its fullest potential. For example, we are coordinating with and contributing funds to the multi-regional

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bioassessment monitoring being headed by the Southern California Coastal Water Research Project for the stormwater management agency coalition in Southern California. The coalition is a partnership of the Southern California stormwater agencies that, together with the Southern California Regional Boards, have embarked on a multi-regional monitoring study that aims to answer watershed related questions in Southern California's 15 watersheds. We plan on using this data to determine the water quality condition of streams in our four major watersheds, the major stressors to aquatic life, and pollutant trends. Further, we are in the nascent stages of developing and coordinating the regional monitoring program for the Upper and Middle Santa Ana River Watershed with our point source dischargers. The data generated will answer status and trends questions and will be assessed during the update of our Integrated Water Quality Assessment Report and, if applicable, to update the Clean Water Act Section 303(d) List of our region's impaired waters. The goal is to have improved monitoring coordination ensuring that management and protection of the Upper and Middle Santa Ana River watersheds is conducted appropriately.

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Colorado River Basin Regional Water Board

Colorado River Basin – Description

The Colorado River Basin Region covers approximately 13 million acres (20,000 square miles) in the southeastern corner of California. It includes all of Imperial County and portions of San Bernardino, Riverside, and San Diego Counties. The Colorado River Basin Region is located in the most arid area of California. The majority of the Region's surface waters are located in the Imperial Valley and East Colorado River planning areas, with a few situated in the Coachella Valley, Lucerne, Anza-Borrego, and Hayfield planning areas. Hence, the ambient surface water-monitoring program focuses on the water bodies in the Imperial Valley and the Lower Colorado River planning areas.

The Salton Sea Trans-boundary Watershed contains five of six, 303(d)-listed impaired surface water bodies. Water from the Colorado River has created an irrigated agricultural ecosystem throughout this watershed. Wildlife and aquatic species are dependent on habitat created and maintained through the discharge of agricultural return flows. Major water bodies in the watershed include the Salton Sea, Alamo River, New River, Imperial Valley Agricultural Drains, and Coachella Valley Storm Water Channel. San Felipe Creek and Salt Creek also occur in this watershed and provide critical habitat for the endangered species. The designated beneficial uses of the waters in the Watershed include agricultural supply, aquaculture, cold freshwater habitat, groundwater recharge, hydroelectric power generation, industrial, municipal and domestic, rare and endangered species, warm freshwater habitat, water contact recreation, and non-contact recreation, and wildlife habitat. At the

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Water Quality Control Plan all the water quality objectives for the region are specified.

Goals and Objectives

Goal. The goal of Region 7's SWAMP program is to monitor the surface water bodies within the Region's watersheds in order to evaluate if beneficial uses are being protected and to establish a baseline for water quality trend monitoring.

Objectives:
1. to identify impaired water bodies as required by Section 303 (d) of the Federal Clean Water Act
2. to collect additional information at sites that are known to or suspected of having water quality problems.
3. to evaluate the effectiveness of specific management practices (MP) employed to improve water quality of impaired water bodies
4. to coordinate and share information with other monitoring efforts at the region.

Methods of Achieving Objectives

The Regional Board selected 13 strategic sampling locations to assess water quality. The strategic sites are along the Lower Colorado River, New River, Alamo River, Whitewater River, and Salton Sea, which are the five surface water bodies of major interest in the Region. These water bodies are the focus on priority TMDLs for sediments, nutrients, selenium, pesticides, and pathogens. Physical, chemical, and biological parameters are used as water quality indicators. Monitoring data collected include conventional water quality parameters, organic chemistry, trace metals, bacteria indicators and aquatic toxicity at the water column. The monitoring data collected for sediments include organic chemistry, trace metals and sediment toxicity. The monitoring events are, most of the time, conducted biannually. Information gathered through the SWAMP Program is used to support Basin Planning activities and objectives, and will complement other past and present studies conducted at the Region. SWAMP will provide a comprehensive view of changes that occur with MP implementation and will help with TMDL development.

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SWAMP Monitoring Strategy

Lahontan Regional Water Board

The Lahontan Region is unique in that its Water Quality Control Plan ("Basin Plan") contains numerous site-specific numeric water quality objectives, most of which were adopted in the early 1970s but (prior to SWAMP) never monitored. The Region also is unique in that it has many interstate waters (which flow into the State of Nevada). The primary objectives of SWAMP monitoring at the Lahontan Region are to:

1. Determine whether ambient water quality at selected sites is in compliance with the chemical and physical water quality objectives contained in the Water Quality Control Plan for the Lahontan Region (Basin Plan) and the "California Toxics Rule".
2. Determine (to the extent to which funding is available) whether water flowing from the Lahontan Region into the State of Nevada meets Nevada's water quality objectives.
3. Develop and implement tools to assess the biological integrity of the Region's streams and rivers based on instream macroinvertebrate and algae assemblages (i.e., "bioassessment").

The available funding has allowed for chemical monitoring at about 30 sites throughout the Region on a quarterly basis. All data and a summary report on the first five years of work (i.e., years 2000-05) are available at the Region's SWAMP webpage.

In addition to ongoing, routine monitoring at the selected sites, the Region's SWAMP staff spends considerable time on other related tasks, such as: (1) designing and maintaining a user-friendly website

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to make monitoring data and assessment reports accessible to the public; (2) coordinating water and fish monitoring projects with other public agencies and NGOs; (3) testing for contaminants in fish tissue where screening studies indicate potential exceedances of human health thresholds; (4) coordinating bioassessment methods and approaches throughout the State; and (5) other special projects, such as monitoring the success of restoration efforts, developing biological objectives for use in assessing stream health, and assisting Water Board staff and others in using bioassessment techniques.

Due to funding limitations, the quality of many surface waters in the Lahontan Region remains unassessed. As funding allows, the Region would like to conduct additional targeted and probabilistic assessments of the regions 700+ lakes, 3,000+ miles of streams, and numerous wetlands.

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SWAMP Monitoring Strategy

Central Valley Regional Water Board

The Central Valley Regional Water Quality Control Board has four overarching goals for its SWAMP efforts:

- Evaluate ambient water quality, beneficial use protection and potential sources of impairment.
- Evaluate effectiveness of the Water Board water quality improvement policies.
- Coordinate internal and external monitoring efforts to leverage limited resources.
- Ensure timely availability of monitoring results.

During the first five years of SWAMP, the Central Valley Regional Water Board coordinated with and built off of existing frameworks within each individual basin (San Joaquin River, Upper and Lower Sacramento River, and Tulare Lake) in order to leverage limited resources. Separate approaches were developed based on each basin's unique characteristics, existing monitoring programs, and water quality issues. SWAMP resources were also used to purchase equipment and developed standard operating procedures to perform in-house water sample analyses for total coliform and *E. coli* bacteria.

Following the statewide SWAMP scientific review in 2005, Central Valley Water Board staff re-evaluated the program. The revised focus aims to better coordinate internal monitoring efforts and data assessments (including supporting the region's 303d/305b Integrated Report development), ensure regional efforts are aligned with the statewide strategy and assessment framework, and facilitate a region-wide program.

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Dec, 2010

To meet these objectives staff initiated region-wide trend monitoring that builds off of 30 Central Valley integrator sites identified by the statewide Stream Pollution Trends monitoring. The region-wide effort will allow seasonal evaluation at key sites, more detailed evaluation of the Sacramento, San Joaquin and Tulare Lake Basins on a rotating basis, and a consistent framework for coordination efforts. Key findings from earlier monitoring have been used to inform the current monitoring designs.

Coordination is still a primary goal of the Central Valley Water Board's SWAMP and includes but is not limited to:

- Staff support to coordinate the development of the Sacramento-San Joaquin Delta Regional Monitoring Program, as well as funding for Delta monitoring and tool development studies.
- Continued monitoring and data management support for the multi-agency Grassland Bypass Project.
- Coordinated trend monitoring with the Department of Water Resources in the upper Sacramento River Basin—focused on measuring ambient water quality at lower watershed integrator sites and coordinated with the statewide SWAMP Stream Pollution Trends.
- Safe to swim studies that monitor and assess bacteria concentrations at popular swimming holes throughout the Central Valley in coordination with local watershed groups—follow-up studies attempt to identify sources and specific pathogens at sites with elevated bacteria levels.
- Data management support for the Irrigated Lands Regulatory Program to streamline data transfers to CEDEN and improve data quality.
- Development of the web-based Central Valley Monitoring Directory to improve internal and external coordination.

The Central Valley SWAMP has created a five year plan that identifies and prioritizes projects for funding for fiscal years 10/11 through 14/15. This plan simplifies budgeting and aids transparency of how resources are allocated. The five year plan and detailed information on the Central Valley Water Board SWAMP, including links to over 40 water quality assessment reports, water quality data for the San Joaquin River Basin, and historic and current program information, is available on the Central Valley Water Board SWAMP website.

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Los Angeles Regional Water Board

During the first five years of the Surface Water Ambient Monitoring Program (SWAMP), the Los Angeles Regional Water Board focused on funding monitoring in each of our 10 watersheds on a rotating basis. Due to funding constraints, we spent most of our resources on monitoring wadeable streams, relying on a triad of indicators to assess whether the aquatic life beneficial use is being supported (benthic macroinvertebrate community, water column toxicity, water column chemistry). We assessed 6 of the 10 watersheds: Calleguas Creek, Santa Clara River, Santa Monica Bay, Los Angeles River, San Gabriel River, Dominguez Channel. We also monitored a few estuaries (Calleguas Creek, Santa Clara River, Los Angeles River, San Gabriel River), harbors (Los Angeles/Long Beach Harbor, Port Hueneme), and marinas (Ventura Marina, Channel Islands Harbor) and lagoons to assess protection of aquatic life. We were only able to monitor one lake to assess protection of aquatic life (Lake Machado).

Following SWAMP's scientific review, we shifted our strategy to augment statewide SWAMP programs. In 2007, we sampled 32 lakes and reservoirs in the Los Angeles Region in conjunction with the statewide study of contamination in fish from lakes to assess whether it is safe to consume sportfish from these waterbodies. In 2008, we sampled 6 watersheds with the triad of indicators mentioned above in conjunction with the SWAMP Perennial Stream Assessment (PSA) initiated in 2008 and to begin early implementation of the PSA-based design adopted by the Southern California Stormwater Monitoring Coalition (due to begin in 2009). In 2008, we also contributed to the Bight'08 regional monitoring

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program to survey coastal waters in the Southern California Bight. In 2009, we are sampling in two watersheds (Santa Monica Bay, Santa Clara River) to help implement the Southern California Stormwater Monitoring Coalition watershed monitoring program and we expect to continue this support in 2010 and subsequent years.

In 2009, we contributed funding to augment the SWAMP's study of contamination in sportfish in coastal waters, bays and estuaries to assess whether it is safe to consume sportfish from these waterbodies. We also set aside funds to conduct follow-up work on lakes with high fish tissue contamination levels to provide sufficient data for the Office of Environmental Health Hazard Assessment (OEHHA) to evaluate the need for fish consumption advisories. This monitoring probably will begin in 2010.

In addition to routine SWAMP matters, staff time has been spent on planning activities associated with the periodic regional Bight surveys of coastal waters, bays and estuaries (1998, 2003, 2008) and coordinating development and implementation of watershed-wide monitoring programs (Calleguas Creek, San Gabriel River, Los Angeles River) that integrate NPDES-mandated monitoring, TMDL monitoring, SWAMP monitoring, volunteer monitoring and other efforts into more useful comprehensive monitoring programs with defined objectives.

The Los Angeles Regional Water Board produced reports on SWAMP monitoring for the Santa Clara and Calleguas Creek Watersheds, the Santa Monica Bay Watershed Management Area, the Dominguez Channel/Los Angeles-Long Beach Harbor Watersheds, and the San Gabriel River Watershed. These reports are available online. A fact sheet providing an overview of the Los Angeles Region also is available online.

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Central Coast Regional Water Board

Watershed Monitoring

The Central Coast Ambient Monitoring Program (CCAMP) has been monitoring the Central Coast Region's five watershed areas on a rotational basis for over ten years, beginning in 1998. The CCAMP program design is focused on supporting regulatory decision-making with water-body scaled status assessments, and detecting change at both a watershed and sub-watershed scale. Our study design emphasizes relatively high data density with repeated visits to a network of fixed monitoring locations. Sites are typically placed at the lower ends of major tributaries and along the main stem, so that we can readily identify which tributaries are of greatest concern for regulatory attention.

Each of five Central Coast watershed areas are sampled on a five-year rotation. Conventional chemistry and flow are monitored monthly at approximately 30 watershed sites during each rotation year. In addition, 33 coastal stream confluences are monitored monthly on a continuous basis for the detection of trends. A subset of sites are sampled and on a less frequent basis for water and sediment toxicity, invertebrate bioassessment, and occasionally, bioaccumulation.

Special Studies

In addition to the CCAMP's basic watershed sampling mandate, the CCAMP participates in a variety of other Regional monitoring projects. The CCAMP conducted an assessment study of Central Coast harbors in collaboration with a U.S. EPA assessment of the Morro Bay National Estuary. In this study, harbors were evaluated

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using a probabilistic approach for sediment chemistry, sediment toxicity, benthic invertebrate assemblages, water column chemistry and fish and mussel tissue chemistry. A report of this study is available at: http://www.ccamp.org/ccamp/Reports.html. The Central Coast Regional Board is planning follow-up studies with the Office of Environmental Health Hazard Assessment (OEHHA), of several lakes that were identified by the State-wide SWAMP Bioaccumulation Program, as having elevated levels of chemicals in fish tissue. The Central Coast Regional Board also participated in research

Data Use

Data from the basic monitoring program is used for many purposes, including development of assessment reports, comprehensive 303(d) listing and 305(b) assessment, enforcement actions, NPDES permit requirements, watershed planning, grants prioritization, evaluation of Basin Plan objectives, and other Water Board staff activities. It is also heavily used by the public, consultants, and other agencies through our web site (www.ccamp.org). CCAMP Hydrologic Unit assessment reports and other related publications are available on the website at: http://www.ccamp.org/ccamp/Reports.html. Planned assessment reports include an overview of agricultural impacts in our region, and a general regional status report.

Data Management and Tool Development

CCAMP has invested significant staff time in development of data management and assessment tools. The website (www.ccamp.org) makes data available online through Google maps, and in chart and tabular form. We process all of our data electronically using a data checking and uploading tool that prepares it for delivery to SWAMP. This tool is also used by the Central Coast Cooperative Monitoring Program for Agriculture and by regional grants programs to deliver data to us in a format that we can move to our website and to SWAMP. This upload tool has been deployed for use by volunteer data gatherers and is now being adapted for CalFED and other grant data delivery through a grant with DFA. Other CCAMP software scans data for water quality exceedances and creates "Lines of Evidence" for submittal into the State's Water Quality Assessment Database to support the "Integrated Report" for 305(b) assessment and 303(d) listing/delisting. This software is also being adapted for use at a statewide level for the 2012 listing process.

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Leveraging

CCAMP leverages our program through coordinated monitoring design. For example, an additional network of 50 long-term trend sites are monitored through the Cooperative Monitoring Program for Agriculture, the agricultural industry's monitoring program to comply with regulatory discharge requirements. This adds to our ability to detect change and to understand agricultural impacts in our Region. Our single Phase 1 storm water permit has a similarly structured monitoring program. Major Monterey Bay area dischargers have coordinated with CCAMP in implementing the Central Coast Long-Term Environmental Assessment Network (CCLEAN). We also coordinate with the Monterey Bay National Marine Sanctuary program to bring data from other monitoring sources, including volunteer groups, local agencies, and universities, into a comparable format that can then be moved into the California Environmental Data Exchange Network, into the Integrated Report scanning tool, and eventually onto our website.

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San Francisco Bay Regional Water Board

During the first five years of SWAMP, the San Francisco Bay Regional Water Board's program focused on monitoring watersheds throughout the region on a rotating basis and conducting studies to measure the concentrations of contaminants in fish caught and consumed by fishers in places other than San Francisco Bay. Since the San Francisco Estuary Regional Monitoring Program (RMP) conducts monitoring in San Francisco Bay, we decided to concentrate our limited resources primarily on evaluating whether the beneficial use of aquatic life was protected in wadeable streams and whether it was safe to consume fish from water bodies other than San Francisco Bay. A description of the San Francisco Bay Region, as well as our regional SWAMP activity, monitoring goals and vision, and collaborative efforts are available in our regional fact sheet.

To assess whether aquatic life was protected in wadeable streams, we used a suite of indicators including bioassessments, physical habitat assessments, continuous basic water quality monitoring, water column chemistry and toxicity, and sediment chemistry and toxicity. In five years of monitoring we assessed whether aquatic life was protected in 34 wadeable streams. Three interpretive reports on the water quality condition of these streams can be found on the Regional Water Board SWAMP website. We also developed a trash assessment method, used this method to assess trash at 26 sites, in 14 water bodies, and documented this information in a technical report.

To assess whether it is safe to eat the fish, we conducted studies measuring contaminants in fish in Tomales Bay, along the San Mateo coast and in 10 lakes in the Region. A report interpreting the data

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is available online. To better inform the public of potential risks associated with eating fish from these reservoirs, we formed a committee consisting of the Office of Environmental Health Hazard Assessment (OEHHA), the California Department of Public Health, county environmental health departments, East Bay Regional Parks and other responsible parties to develop advisories for consuming fish, translating advisories in to several languages, and developing signs and other materials for education and outreach. In subsequent years, we collected additional data so that OEHHA could refine fish advisories for the lakes we sampled. All of the creek and fish data collected over this 5-year period was used in the 2006 and 2008 water quality assessment process and resulted in a total of 30 water bodies being listed as impaired.

In 2008 we modified our SWAMP creek strategy based on needs identified during previous monitoring. Our current strategy is to monitor water quality conditions and biotic assemblages, and the spatial and temporal variability of those conditions, at minimally disturbed reference sites and at urban sites that represent “best attainable” conditions. Our peer reviewed design is available online. The purpose of this monitoring is to: 1) provide context for creek monitoring that will be conducted by the Regional Monitoring Coalition, made up of storm water programs and the regional SWAMP; 2) collect data that can be used for developing bioassessment protocols, indices of biological integrity, biological objectives and nutrient criteria; and 3) identify long-term trends associated with climate change.

In 2010 we started a study to measure nutrients, chlorophyl a and the phytoplankton community in Suisun Bay in the spring/summer. Results of previous research has indicated that elevated levels of ammonium may be inhibiting diatom production and preventing the development of phytoplankton blooms that feed the food chain in the San Francisco Estuary. Results from our 2010 study showed relationships that were consistent with this hypothesis. In 2011-2012 we plan to conduct a more intensive study to measure these parameters, as well as primary production and nutrient uptake, at 4 different depths in Suisun Bay.

In addition to the studies conducted by the regional program, the San Francisco Bay Regional Water Board SWAMP spends significant staff resources coordinating monitoring in the region.

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This provides an opportunity to leverage SWAMP funding and to form coalitions that can provide consistent water quality information targeted at answering specific water quality management questions, while maximizing efficient use of resources. SWAMP staff has been working with a coalition of programs that collect bioassessment data, the Bay Area Macroinvertebrate Bioassessment Information Network (BAMBInet), to further develop information on water quality in wadable streams. BAMBInet meets to: 1) discuss and standardize bioassessment data, 2) input all regional bioassessment data in to one database, and 3) analyze regional data for the purpose of developing a Bay area Index of Biotic Integrity (IBI). Regional SWAMP staff is also working with storm water programs, as an outgrowth of the regional MS4 permit, to develop a watershed monitoring coalition (Regional Monitoring Coalition) so that watershed monitoring will be coordinated throughout the region and with SWAMP statewide.

To develop information on water quality in the San Francisco Estuary, SWAMP staff has been integral to the establishment and development of the San Francisco Estuary Regional Monitoring Program (RMP). The RMP is a world-class water quality monitoring program targeted at the highest priority questions faced by the San Francisco Bay Water Board and the regulated community. Currently, the RMP is working collaboratively with SWAMP to monitor contaminants in fish in bays and estuaries of the state. Regional SWAMP staff also plays an advisory role in TMDL monitoring, NPDES mandated monitoring and volunteer monitoring in order to provide consistency, enhance coordination and foster a comprehensive approach to water quality monitoring in the region.

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North Coast Regional Water Board

During the first five years of the Surface Water Ambient Monitoring Program (SWAMP), the North Coast Regional Water Board focused on funding monitoring in each of our 6 watershed management areas. We established 80 rotating stations and 29 long-term trend monitoring stations on 49 rivers and streams throughout the North Coast Region. Due to funding constraints, we have spent most of our funding allocation on monitoring wadeable streams and large rivers, relying upon water column chemistry to assess whether the aquatic life beneficial use is supported. An interpretive report on this data is available through the State Water Board website.

Our Regional SWAMP efforts were initially coordinated to provide information to the North Coast Watershed Assessment Program and the Total Maximum Daily Load program as well as to provide information to managers and decision makers where limited or no data was previously available. These efforts provide almost all of the Regional ambient monitoring data that we use to assess the general health and condition of our waters. SWAMP data have proven to be especially valuable for assessing the many unpopulated areas of the Region where other entities are not actively monitoring. We also are using these data to prepare the 303(d) and 305(b) Integrated Water Quality Assessment Report. Over 60% of the "Lines of Evidence" used to evaluate the North Coast waterbodies for the Integrated Water Quality Assessment Report were based on Regional SWAMP data.

In addition, the North Coast Regional Water Board utilized SWAMP funding to investigate MTBE concentrations in two North Coast lakes and to conduct a screening study of estrogenic endocrine disrupting

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chemicals in two major rivers in the North Coast in conjunction with the Central Valley Water Regional Board.

Currently we are involved with the development of the Klamath River Water Quality Monitoring Group, a regional monitoring program comprised of members from Federal, State, County, Tribal agencies, and local non-governmental organizations. We also provide training, staff time, and equipment to local and Tribal entities throughout the Region to increase their involvement in data collection, analysis, and assessment.

The North Coast Regional Water Board is re-evaluating the direction of our Regional SWAMP efforts for fiscal year 2010-2011. We are evaluating all of the data collected to date by SWAMP and other entities to determine where additional information is needed and where additional investigations are warranted.

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SWAMP Monitoring Strategy

San Diego Regional Water Board

The San Diego Region's SWAMP is designed to support and expand water quality assessments in the regions' waterbodies. The first several years of SWAMP monitoring in the San Diego region focused on perennial streams on a rotational basis. In 2007 and 2008, the program focused its efforts on bioassessment on high-quality and impaired sites in perennial streams. Since 2009, the San Diego Region's SWAMP supports several programs: (1) Probability-based surveys, (2) Improved monitoring coordination of watersheds and waterbodies, (3) An information management system, and (4) Special studies. It also will continue and increase leveraging with other San Diego Water Board programs, several dischargers, universities, and non-profit organizations in the San Diego region. In addition, the San Diego Region's SWAMP will focus some efforts to develop assessments in form of watershed report cards.

Rotational Watershed Monitoring: From 2000-2005, the San Diego Regional Board has been monitoring the Region's 11 hydrologic units on a rotational basis. Water chemistry, water and sediment toxicity, benthic macroinvertebrate community, physical habitat, and on occasion tissue contamination, were assessed in perennial streams at multiple targeted sites twice during dry and wet season. Data from the rotational watershed monitoring were analyzed and watershed reports were produced for each hydrologic unit by the Southern California Coastal Water Research Project. In addition, a synthesis report was produced for an assessment of all 11 hydrologic units and for an evaluation of the current SWAMP program of the San Diego region. The synthesis report gives four main recommendations: (1) Use appropriate indicators; (2) Design a

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probability based study to address the ecological health of wadeable streams; (3) Improve integrative and coordinated regional monitoring to increase cost-efficiency, and (4) Build an information management system. All four recommendations are addressed in the SWAMP monitoring design since 2007.

Appropriate Indicators: In 2007 and 2008, the San Diego regions' SWAMP program focused its efforts on bioassessment (both with benthic macroinvertebrates and algae) in perennial streams. The study included sampling on Reference sites to protect high quality sites, and produce information on the development of bio-objectives. Sampling for Reference sites will continue in 2011. In 2008, targeted impaired sites within all 11 hydrologic units were sampled to compare past data with current conditions, and to include algae as additional indicators. The report on those data is currently under development.

Probability Survey for Perennial Streams: Since 2009, the SWAMP program of the San Diego region participates in the SMC study (a probability-based study in Southern California through the Stormwater Monitoring Coalition (SMC)) by devoting regional SWAMP allocations towards the study to support eleven monitoring sites in perennial streams. For five years, SWAMP regional allocations will support the SMC study.

Improved Coordination in Watershed and Waterbodies: In 2010 and 2011, the San Diego Region's SWAMP funding supports the coordination of monitoring in the San Diego River watershed to develop a cost-effective and coordinated monitoring and assessment program. In 2011 and 2012, SWAMP allocations in the San Diego region will be used to develop a cost-effective and coordinated monitoring program for coastal wetlands.

Information Management System: Data from San Diego Region's SWAMP are disseminated to the public by a Regional Data Portal. The data portal was developed by funds from the Cleanup and Abatement Account. Monitoring data from dischargers, non-profit organizations, and other agencies in the San Diego region are included into the data portal. The San Diego Region's SWAMP website will link to the Regional Data Portal.

Special Studies: Currently, the San Diego Region's SWAMP is focusing on Contaminants of Emerging Concern (CECs) for its special studies. In 2010, the San Diego Region's SWAMP started a study on the occurrence and extent of

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pharmaceuticals and personal care products (PPCPs) in areas with discharge of treated wastewater, with septic tanks, with untreated human waste water, and at Reference sites. In 2012, the occurrence of cyanobacteria and microcystin will be studied in different waterbodies in the San Diego region.

Monitoring of Freshwater Wetlands, and Non-Perennial Streams: From 2011-2013, the San Diego Region's SWAMP is funding a freshwater wetlands monitoring program. This probability-based monitoring program will focus on depressional wetlands in the San Diego region. Starting 2013, the San Diego Region's SWAMP will focus future funding on non-perennial streams in the region.

Collaborations: The Region 9 SWAMP program has leveraged the program considerably with collaboration efforts. The San Diego Region's SWAMP collaborated in a post-fire study in the San Diego region with the CA Department of Fish and Game and Chico State University, and in a coastal wetlands eutrophication study with the Bight '08 program and the Southern California Coastal Water Research Project. Additionally, the San Diego Region's SWAMP collaborates with several dischargers in the San Diego Region (municipal stormwater and agricultural dischargers), San Diego State University, and two non-profit organizations (San Diego Stream Team, and the San Diego Coastkeeper).

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