



Monitoring Plan

2009

Sacramento Watershed Coordinated Monitoring Program (SWCMP)

February 2009

The SWCMP is a coordinated monitoring effort between Department of Water Resources (DWR) and the Central Valley Regional Water Quality Control Board.



www.waterboards.ca.gov/swamp

Monitoring Plan
Sacramento Watershed Coordinated Monitoring Program (SWCMP)

SWRCB Agreement 08-53-150

Plan Prepared by

Scott McReynolds, Peter Coombe, and Fraser Sime
California Department of Water Resources

Address Correspondence to:

Fraser Sime
DWR Northern District
2440 Main Street
Red Bluff, CA 96080
simef@water.ca.gov
(530)529-7374

February 19, 2009

I. Introduction

This plan documents the key aspects of the Sacramento Watershed Coordinated Monitoring Program (SWCMP). The SWCMP is a coordinated monitoring effort between the Department of Water Resources (DWR) Northern District and the Central Valley Regional Water Quality Control Board (Regional Board). This program will monitor and assess ambient water quality of the Sacramento River and its larger tributaries at incremental locations from upstream of Lake Shasta, south to Verona, as well as the lower ends of all of the larger tributary streams to the Sacramento River.

The SWCMP is designed to meet the monitoring needs of the Regional Board's Surface Water Ambient Monitoring Program (SWAMP) and the DWR Northern District's Water Quality and Biology section. Coordination allows both agencies to maximize the use of their limited resources.

The purpose of the SWAMP is to implement comprehensive statewide water quality monitoring. The primary objective is to provide information to the State Water Board and Regional Board to enable effective management of the State's water resources. This program will provide data to enable the Regional Board to assess ambient water quality, water quality trends, and the effectiveness of management activities.

The DWR Northern District has monitored water quality at sites throughout the Coastal, Lahontan and Central Valley areas for several decades. This monitoring data is input to a database that is useful for determining long-term changes in water quality, as well as to determine effects from catastrophic events (e.g. flood, fire, landslides) and for water development planning. The DWR Northern District has employed a tributary-based approach to characterize the Sacramento River, as well as larger tributary inputs to the Sacramento River. Long-term monitoring sites were selected at major tributary inputs and on the mainstem Sacramento River, and “focused” monitoring sites were placed at other locations of interest in the watershed (such as above and below specific land uses, point sources, best management practices, or other areas in need of characterization). In recent years budget cuts have forced the DWR Northern District to scale back their monitoring efforts. This program will help DWR to maintain a monitoring network in the Sacramento River Watershed.

Fiscal Year (FY) 2008-09 will mark the initial year of the SWCMP. The DWR Northern District’s Water Quality and Biology section will conduct the field monitoring and sample collection activities in collaboration with the Regional Board. A general description of the monitoring efforts that will be implemented through this collaborative effort over the next three years is provided in this document. Specific monitoring planned for 2008-09 is described in more detail.

The overall program goals include:

- Creating an ambient monitoring program using consistent and objective monitoring, sampling, and analytical methods and consistent data quality assurance protocols.
- Documenting ambient water quality conditions in both potentially clean and polluted areas.
- Providing data to indentify specific water quality problems and evaluate the overall effectiveness of water quality regulatory programs in protecting beneficial uses of the State.
- Establishing a database with which to track long-term changes in ambient water quality.

II. Background

The Sacramento River Watershed, covering approximately 27,000-square-miles, consists of a major valley (Sacramento Valley) bounded by several mountain ranges: the Coast Range to the west, the Cascade and Klamath Ranges to the north and the Sierra Nevada Mountains to the east.

The Sacramento River is the largest river in California, with an annual average stream flow volume of 22 million acre-feet (27 km³/yr). The river is also the longest in the State, extending over 327 miles (526 km). Major tributaries to the Sacramento River include the Feather, Yuba, American, and Pit Rivers. Although it is not a tributary nor is it in the watershed, some of the Trinity River flow is diverted into the Sacramento River. Dams have been constructed over the past century on the Sacramento River downstream of the confluence with the Pit River (Shasta Dam) and on each of the other major tributaries (Oroville Dam on the Feather River and Folsom Dam on the American River). The reservoirs provide flood protection and allow the storage of water during dry years, but the placement of dams at the reservoirs has blocked migration routes for salmonid fish. In total, there are over one thousand lakes and reservoirs throughout the watershed. River diversions are also common for transferring water to municipal and agricultural users and for flood control in the Central Valley.

The Sacramento Valley has the greatest population of any part of the basin, and it is there that the greatest effects or potential effects on surface water quality are likely to occur from land-use activities. There are about 2.5 million people living in the watershed, with over half of the urbanized population located at the southern end in Yolo, Placer, and Sacramento Counties. The Sacramento Valley is also the area of greatest water use in the basin, mostly for irrigation agriculture.

Land uses in the mountainous regions of the basin are forests and rangeland, comprising 59% and 17% of the land area, respectively. Nearly two million acres of the Sacramento Valley is used for irrigation agriculture. The major crops are rice, fruits, nuts, tomatoes, corn, alfalfa, and wheat. Dairy products also are an important agricultural commodity.

The average annual precipitation for the entire Sacramento River basin is 36 inches, most of which falls as rain or snow during November through March. Because little or no rain falls during the summer growing season, irrigation is required for successful agriculture. Precipitation amounts in northern California are variable and dependent on the location of the Pacific jet stream. The average annual rainfall at the city of Sacramento is about 18 inches.

III. Overview

The California Department of Water Resources (DWR) has monitored water quality at sites in the Northern Sacramento River Watershed of California since its formation in 1956. Water quality data in the region had been collected previously by the Department's water quality predecessor, the Division of Water Resources of the Department of Public Works since the early 1900's.

Water quality data collected by DWR is used by a wide range of individuals, public and private agencies, and is ultimately the foundation on which these agencies base water planning and management decisions. This monitoring

provides data and reports that are useful for determining long-term changes in water quality, as well as to determine if water quality parameters are meeting Basin Plan Objectives established by the California Regional Water Quality Control Boards.

Due to technological improvements and budgetary constraints, parameters assessed have varied over the course of monitoring throughout the northern Sacramento River Watershed. During much of the earlier monitoring at water quality stations, field measurements were taken and samples were submitted for laboratory analyses for mainly a few mineral parameters only when a general indicator such as conductivity was outside the range of previous measurements. This practice tended to skew the data to the extremes outside of normal measurements and provided data on only a very limited set of parameters.

Currently samples are collected on a more regular basis where timing plays a key role in providing representative data. Samples and field data are collected quarterly at defined water quality stations in the Northern Sacramento Watershed. DWR now has the ability to analyze a wide range of physical, chemical, and biological parameters with its own in-house lab, Bryte Laboratory, located in West Sacramento.

As the importance and scope of water quality regulations increase over time in the California, we will need to provide the State and its constituents with easily accessible, current, and defensible water quality data in the DWR's Water Data Library (WDL). The WDL database is managed by DWR which has streamlined the process of organizing and distributing water quality data. (www.wdl.water.ca.gov).

A coordinated monitoring program has been initiated between the Central Valley Regional Water Quality Control Board and the Northern District office of the Department of Water Resources to continue water quality data collection in the Northern Sacramento Region. The new monitoring program has been designed to coincide with many of DWR's historical water quality stations. Several new stations which are of concern to the Regional Board have been added. The program will include 41 stations selected to meet the requirements of the Program Design Concept.

DWR staff prepared this monitoring plan and are responsible for coordinating and performing the sampling events, including providing sampling equipment, obtaining sample containers from the labs, taking field notes, and ensuring delivery of samples to the analytical laboratories. The Regional Board will be responsible for providing containers for pathogens, bioassessment and water column toxicity samples, when taken. The following sections provide details of the plan, including constituents to be monitored, monitoring locations (stations), frequency, and identification of the sampling team. A separate document, the SWCMP Quality Assurance Program Plan (QAPP) will discuss the details of how

the samples are collected to provide data that are representative and scientifically defensible (QAPP section 11.0).

Although not part of this coordinated monitoring program, DWR collects additional water chemistry data at all of its monitoring stations. This data is not covered by this Monitoring Plan or the SWCMP QAPP, but it is collected concurrently with the data for the SWCMP. A list of the additional constituents currently collected by DWR can be found in Appendix B.

IV. Monitoring Objective

This monitoring effort will address long term water quality issues and 303(d) reporting needs of the Northern Sacramento Watershed. The effort will provide critical water quality data needed to determine if stream and river conditions over time are getting generally better or worse. Two key questions will be addressed in this Monitoring Program:

1. What are the ambient water quality conditions and are current management activities protecting beneficial uses?
2. What does the evaluation of trends with respect to water quality and the biological communities tell us about the state of the watershed?

In order to answer these questions monitoring work will be performed at designated stations on a quarterly basis. The SWCMP QAPP describes the protocols that will be used to ensure data quality will be sufficient to answer these questions.

V. Water Quality Sampling

Sampling Locations

Monitoring site selection is based on several factors, including the following:

- selection of at least one site in all major tributary watersheds in order to characterize water quality from that area
- sites that are readily accessible
- where possible, sites that have established flow gaging which is required for load determinations

Forty-one monitoring sites have been selected for the SWCMP (Table 1). The map of the monitoring sites, (cross-referenced with Table 1), is located in the Appendix.

For all sites, safety and all-weather access are priorities for quarterly monitoring activities. Many sites are located at bridges, from which sampling devices can be

suspended during periods of high flow. Based on field conditions, the program may be modified by the project team during the sampling event to provide for field safety and make the collection accurate and thorough. Any changes made to the plan will be documented on the field sheet and added to this Monitoring Plan as Appendices. Significant changes will be reported as part of the quarterly report to the Contract Manager.

Site selection targets the primary discharge point of major tributaries which drain the major sub-watersheds, and multiple locations along the main stem, usually upstream from major tributary inputs. Some sites are also situated above and below areas of significant human activity, including urban development,

Table 1. SWCMP Sampling Locations

Map #	Station Name	DWR Station #	LATITUDE	LONGITUDE
1	North Fork Pit River at Alturas	A1210000	41.48198393	-120.5385893
2	South Fork Pit River near Alturas	A1415000	41.46114992	-120.5499788
3	Pit River near Canby	A1168000	41.40009903	-120.9349596
4	Fall River at Glenburn	A1723000	41.08848464	-121.4931669
5	Pit River at Pittville*	A1127000	41.04555265	-121.3317534
6	McCloud River above Shasta Lake	A2215000	40.94034040	-122.2452817
7	Sacramento River at Delta	A2130000	40.93828017	-122.4169114
8	Pit River near Montgomery Creek	A1102000	40.84027902	-122.0163045
9	Cow Creek near Millville	A4811000	40.53210129	-122.2384127
10	Clear Creek near mouth near Redding	A3601000	40.50922234	-122.3799984
11	Churn Creek near Anderson	A0079000	40.48031800	-122.3067090
12	Stillwater Creek near Anderson	A0079500	40.47981100	-122.2590940
13	Bear Creek near Anderson	A0407000	40.44772800	-122.1966070
14	Sacramento River at Balls Ferry*	A0281500	40.41761741	-122.1933392
15	Battle Creek at Jelly's Ferry Road Bridge	A4708000	40.39197613	-122.1785906
16	Cottonwood Creek at Cottonwood	A0352050	40.37636267	-122.2824620
17	Paynes Creek near Red Bluff	A4605001	40.31462347	-122.0712628
18	Sacramento River at Bend Bridge	A0278500	40.26363967	-122.2231135
19	Sacramento River below Red Bluff	A0275890	40.15336978	-122.1993204
20	Red Bank Creek at Highway 99W near Red Bluff	A0025800	40.14158373	-122.2121252
21	Antelope Creek near mouth near Red Bluff	A0452050	40.10900306	-122.1102875
22	Elder Creek at Gerber	A0332000	40.05086555	-122.1666056
23	Mill Creek near mouth near Los Molinos	A0442050	40.04294563	-122.1002747
24	Thomes Creek at Hall Road	A0321800	39.97557881	-122.2233350
25	Deer Creek at Hwy 99E near Vina	A0432101	39.94680910	-122.0533036
26	Sacramento River at Vina bridge	A0270000	39.90881935	-122.0918883
27	Sacramento River at Hamilton City*	A0263000	39.75110185	-121.9979773
28	Big Chico Creek at Chico*	A0425000	39.72716425	-121.8630784
29	Butte Creek below Western Canal Siphon	A0416000	39.72573570	-121.7088705
30	Stony Creek at The Nature Conservancy	A0290000	39.69427000	-121.9896040
31	Honcut Creek at Highway 70	A0571001	39.30929300	-121.5954400
32	Sacramento River at Colusa*	A0242000	39.21414646	-122.0003096
33	Butte Slough near Meridian*	A0297200	39.17007343	-121.9004622
34	Yuba River at Marysville*	A6101050	39.12862241	-121.5970337
35	Bear River near mouth*	A6501050	38.95135045	-121.5610630

36	Sacramento River above CBD near Knights Landing	A0223002	38.80502695	-121.7237114
37	Colusa Basin Drain near Knights Landing*	A0294710	38.79923112	-121.7250358
38	Feather River near Verona*	A5101050	38.79251941	-121.6275467
39	Sutter Bypass at RD-1500 Powerplant*	A0292700	38.78455606	-121.6543868
40	Sacramento River at Verona	A0215000	38.77965008	-121.6037306
41	Sacramento River below Knights Landing	A0219501	38.76064223	-121.6782414

*Integrator Sites for SWAMP Statewide Stream Contaminant Trend Monitoring

agriculture, and point source discharges. Rationale used for monitoring site selection is discussed in more detail in the QAPP (QAPP section 10.0).

Monitoring Methods

DWR uses a variety of sampling approaches to characterize status and trends at monitoring sites. Sample events are timed to represent the winter runoff, spring snowmelt, irrigation and dry seasons. The SWCMP design includes quarterly monitoring (February, May, August, and November), for conventional water quality and flow at all gauged sites. At a subset of sites, other monitoring approaches will be applied. These may include water column toxicity, pathogens, and bioassessment if funding is available.

DWR uses a multi-analyte probe to measure several basic parameters in the field, and collects grab samples to be analyzed by DWR's Bryte Laboratory, the Regional Board, and the Regional Board's contract laboratories. A YSI 85 multianalyte meter/probe is used to collect data for dissolved oxygen (mg/L), conductivity ($\mu\text{mhos/cm}$), and water temperature ($^{\circ}\text{C}$); A Hach Senslon meter/probe is used to collect pH, and turbidity (ntu) is measured using a Hach 2100P turbidimeter. All field equipment is calibrated using certified calibration standards and following the manufacturer specifications prior to and following each sampling event. Calibration records are maintained at the DWR Northern District office and are used to determine instrument accuracy. Continuous temperature recorders (15-minute intervals in $^{\circ}\text{C}$) will be maintained at all sites.

Field probe measurements are recorded on SWAMP compatible field sheets printed on waterproof "Rite in the Rain" paper in the field, scanned to PDF format, and archived electronically upon returning to the office. All field measurements of basic water quality parameters are included on the Bryte Laboratory Chain-of-Custody and are included with the laboratory chemistry results from the grab samples. Field-measured basic water quality measurements are included with the chemistry results on DWR's Water Data Library database. In the field, observations of weather conditions, air temperature, algal growth, scum, odor, and other indications of water and habitat conditions are also recorded. Flow is estimated using a number of means. Wherever possible, sites are located near existing county, state and USGS gages. When flow is not measurable it is estimated using stream profiles, stage gages and flow calibration curves. In some locations flow measurements are not possible.

Samples to be analyzed by the DWR Bryte Laboratory, the Regional Board, and the Regional Board's contract laboratories are collected at each site in clean bottles provided by the appropriate laboratory. Blind field replicates are collected for 5% of samples collected. Water samples are bottled as appropriate and held at 4 °C, before being transferred to the laboratory for analysis. Chain-of-Custody (COC) documentation is maintained for all samples. Grab samples are collected for the analytes shown in Table 2.

Table 2. Minimum Constituents to be monitored

Constituent	Purpose	Collection and Determination
Water Temperature	Constituent of concern for impacts to aquatic biota(<i>I would make this change on all the below</i>)	Measured every 15 minutes via continuous recording temperature data loggers at each sampling location
pH	General water quality constituent.	Measured with calibrated pH meter on each sample collection event.
Electrical Conductivity (EC)	General water quality constituent.	Measured with calibrated EC meter on each sample collection event.
Dissolved Oxygen (DO)	Constituent of concern for aquatic habitat degradation.	Measured with calibrated DO meter on each sample collection event.
Turbidity	Constituent of concern for aquatic habitat degradation.	Measured with calibrated turbidimeter on each sample collection event.
Total Suspended Solids	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Total and Dissolved Arsenic	Constituent of concern for aquatic habitat degradation, drinking water quality.	Grab sample; laboratory analysis.
Total and Dissolved Copper	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Alkalinity	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Total Hardness	Required in conjunction with metals samples to determine comparability with criteria thresholds.	Grab sample; laboratory analysis.
Total Ammonia as Nitrogen	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Total Kjeldahl Nitrogen	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Total Organic Nitrogen	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Dissolved Ammonia	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Dissolved Nitrate + Nitrite	Constituent of concern for aquatic habitat degradation, drinking water quality.	Grab sample; laboratory analysis.
Dissolved Ortho-phosphate	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Total Phosphorus	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Total Organic Carbon	Constituent of concern for drinking water quality.	Grab sample; laboratory analysis.

Dissolved Organic Carbon	Constituent of concern for drinking water quality.	Grab sample; laboratory analysis.
--------------------------	--	-----------------------------------

As funding permits, the Regional Board may choose to analyze the constituents listed in Table 3. DWR will collect these samples according to the methods in the QAPP. The Regional Board will be responsible for all costs associated with the transport and analyses of these constituents.

Table 3. Optional constituents to be monitored as determined by available funding

Constituent	Purpose	Collection and Determination
Benthic Macroinvertebrates	Constituent of concern for aquatic habitat degradation.	Collected in the field using the SWAMP SOP; Laboratory analysis.
Water Column Toxicity	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.
Pathogens	Constituent of concern for recreation and drinking water quality.	Grab sample; laboratory analysis.

Bioassessment sample collection will follow SWAMP’s *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California*. Samples will be collected using the reachwide benthos (RWB) procedure. A modification of this procedure, the margin-center-margin (MCM), may be used at low gradient sites. BASIC physical habitat characterization data will be collected. Duplicate samples will be collected at 10% of sample sites. Benthic macroinvertebrate samples will be analyzed at the CA Department of Fish and Game’s Aquatic Bioassessment Lab (ABL).

A set of selection criteria (below) has been developed to be applied when selecting sites for bioassessment collection. Site selection will be made by joint agreement between DWR and Board staff. Sites will be prioritized using the following criteria:

1. Accessibility to site from nearest public road (or through private property, if landowner permission is obtained).
2. Wadeability of stream (flow conditions).
3. Sites that have elevated water quality concerns.
4. Sites that have some historic BMI data from other sources.
5. Sites where a less rigorous protocol is being used for BMI sampling (e.g. by citizen groups), to calibrate results with the more rigorous SWAMP protocol.

BMI sampling will be conducted during a sampling event following the standard water quality run, and will be normally scheduled for completion in late May – early June (following the early May water quality sampling event). If stream flow at a site is still too high and unsafe for field crews, sampling will be rescheduled as soon as safe conditions exist.

Water column toxicity samples will be analyzed at the UC Davis Marine Pollution Studies Laboratory (MPSL) at Granite Canyon. Our priority will be to collect water column toxicity at the eleven stations that are being studied for sediment toxicity as part of the SWAMP Statewide Contaminant Trend Monitoring at Integrator Sites (see Table 1).

Pathogen samples will be analyzed for total coliform and E. Coli by the Regional Board. Sample collection and analysis will comply with the QAPP and the Regional Board's *San Joaquin River Procedures Manual*. All sites will be analyzed for bacteria, with the possible exception of the sites in the Pit River watershed (Stations 1-8 in Table 1). Travel times to these stations may prevent samples being returned to the laboratory within the holding time.

Quality assurance procedures at the laboratories are consistent with SWAMP approved quality assurance requirements and follow U.S. EPA approved methods. The QAPP specifies target reporting limits for specific analyses (QAPP section 16.0).

VI. Reporting and Assessment

All data from this Program will be made available to the public. Field data and data generated from samples analyzed at DWR Bryte Laboratory will be made available through the DWR Water Data Library at <http://www.wdl.water.ca.gov/>. Data generated by the Regional Board and its contract laboratories will be stored in the SWAMP Information Management System and made available through the California Environmental Data Exchange Network (CEDEN) at <http://ceden.org/about.php>. More details on data management are provided in the QAPP.

All data collected from this Program will be assessed in the 2010 or 2012 cycle of the Clean Water Act Section 305(b) and 303(d) Integrated Report. Data will be assessed based on the criteria in *The Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin* and the listing criteria for the current Integrated Report cycle.

DWR will submit annual reports to the Regional Board summarizing all analytical data collected to date. The Regional Board will prepare Fact Sheets highlighting analytical results and findings. All Fact Sheets will be made available to the public on the Regional Board's SWAMP website at

http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/index.shtml.

Where potential water quality problems are identified, this information will be provided to the appropriate Regional Board program for follow-up study. Source identification is not an objective of this Program.

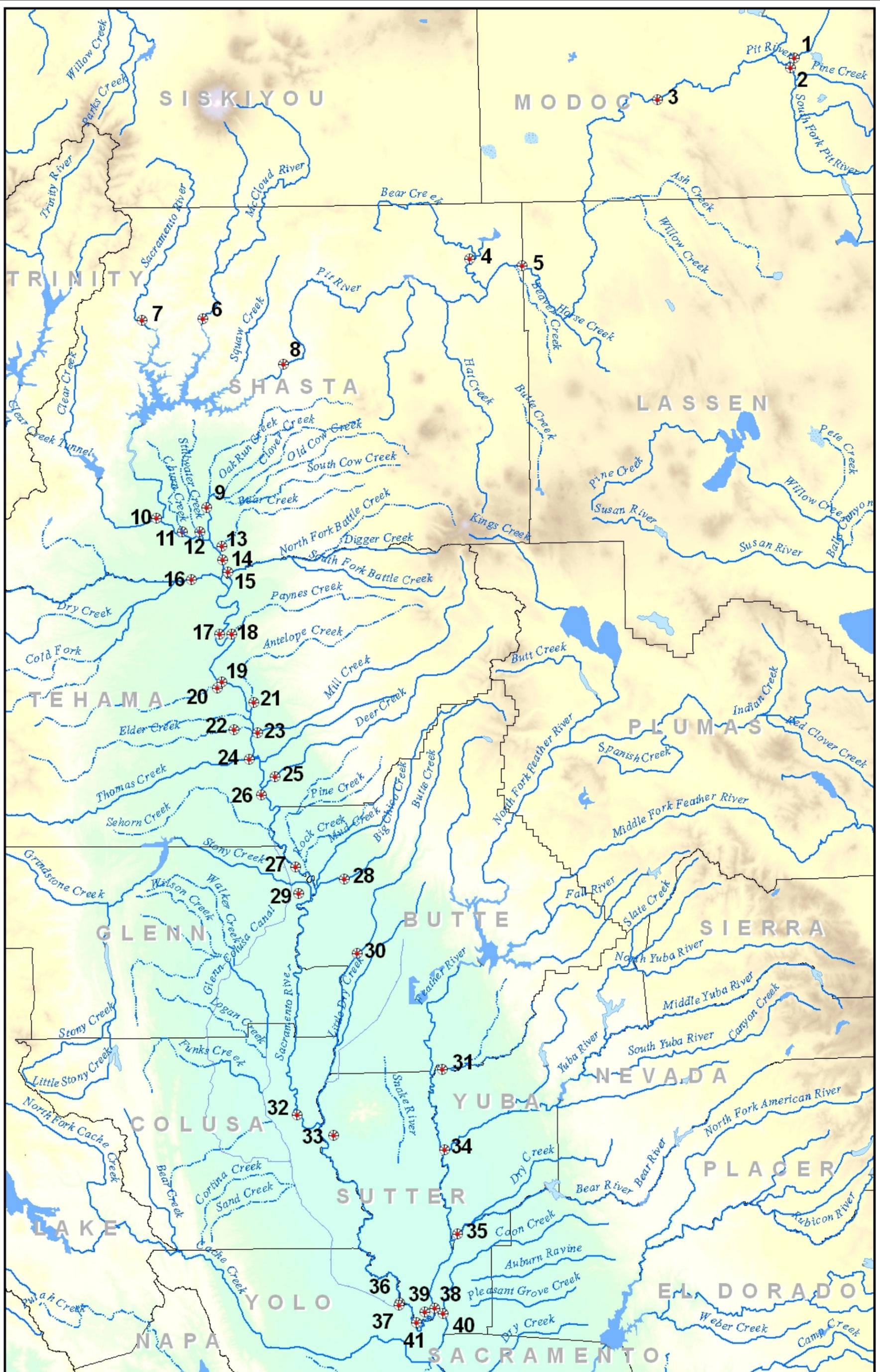
This monitoring plan will be reviewed annually, prior to the August sampling run, revised as needed and submitted to the Contract Managers for approval of the amended plan.

Appendix B

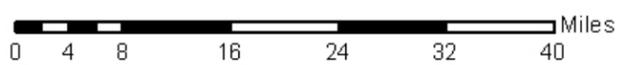
DWR Northern District currently collects additional water quality samples at all of their monitoring stations. These constituents are not part of the SWCMP and so are not covered by the SWCMP Monitoring Plan or QAPP.

Constituents currently monitored by DWR independent of the SWCMP

Minerals	Metals
Total Calcium	Total and Dissolved Aluminum
Dissolved Calcium	Total and Dissolved Cadmium
Total Magnesium	Total and Dissolved Chromium
Dissolved Magnesium	Total and Dissolved Iron
Dissolved Sodium	Total and Dissolved Lead
Dissolved Potassium	Total and Dissolved Manganese
Dissolved Sulfate	Total Mercury
Dissolved Chloride	Total and Dissolved Nickel
Dissolved Boron	Total and Dissolved Selenium
Dissolved Hardness	Total and Dissolved Silver
	Total and Dissolved Zinc



Sacramento Watershed Coordinated Monitoring Program Sampling Locations



⊗ Water Quality, Thermograph

