March 2003

State Water Resources Control Board

# REPORT TO THE GOVERNOR AND LEGISLATURE

## A COMPREHENSIVE GROUNDWATER QUALITY MONITORING PROGRAM FOR CALIFORNIA


**STATE OF CALIFORNIA**
*Gray Davis, Governor*

**CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY**
*Winston H. Hickox, Secretary*

**STATE WATER RESOURCES CONTROL BOARD**
*P.O. Box 100 Sacramento, CA 95812*
*(916) 341-5250*
*Homepage: http://www.swrcb.ca.gov*

*Arthur G. Baggett, Jr., Chair*
*Peter S. Silva, Vice Chair*
*Richard Katz, Member*
*Gary M. Carlton, Member*
*Nancy H. Sutley, Member*

*Celeste Cantú, Executive Director*

State of California
STATE WATER RESOURCES CONTROL BOARD

# A COMPREHENSIVE GROUNDWATER QUALITY MONITORING PROGRAM FOR CALIFORNIA

Assembly Bill 599
Report to the Governor and Legislature

March 2003

# ACKNOWLEDGEMENTS

The State Water Resources Control Board (SWRCB) would like to thank the many individuals from state, federal and local agencies, organizations, and interested parties who participated in the AB 599 stakeholder process.

The SWRCB would like to thank the AB 599 Public Advisory Committee (PAC) members who shared their experiences and expertise: Chair William (Bill) Mills (Orange County Water District); Co-Chair David Beckman (Natural Resources Defense Council); Steve Arita (Western States Petroleum Association); William Bazlen (California Manufacturers & Technology Association/ MFG, Inc); Ivo Bergsohn (South Tahoe Public Utilities District); Fred Douma (Independent Milk Producer); William Gedney (Southern California Water Company); Rick Heimes (U.S. Geological Survey); Keith Hennesay (Tulare County Farm Bureau); Elizabeth Janes (U.S. Environmental Protection Agency); John Rossi (Chino Basin Watermaster); Roger Sherrill (Rio Alto Water District); and Marguerite Young and Lena Brook (Clean Water Action/ Clean Water Fund).

We would also like to acknowledge the important contributions made by the AB 599 Interagency Task Force (ITF) members Dan Gallagher (Department of Toxic Substances Control), Carl Hauge (Department of Water Resources), John Troiano (Department of Pesticide Regulation), Al Vargas (Department of Food and Agriculture), Gary Yamamoto (Department of Health Services), and Lisa Babcock (SWRCB).

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We are grateful to Neil Dubrovsky and Ken Belitz of the U.S. Geological Survey (USGS) for their valuable technical collaboration on this project. Finally, thanks to Steve Ekstrom (The Results Group) for his fine work facilitating the AB 599 Interagency Task Force and Public Advisory Committee meetings.

## AB 599 PAC ENDORSEMENT LETTER

Mr. Art Baggett, Jr., Chair
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

APR 1 2003

Dear Mr. Baggett:

We are writing as Chair and Vice-Chair of the Public Advisory Committee (PAC) established by the State Water Resources Control Board (SWRCB) pursuant to AB 599 the *Groundwater Quality Monitoring Act of 2001*. After nearly a year of hard work, we believe that the SWRCB has produced a report and program that we can strongly support. In addition, SWRCB staff has done a great job in managing this process.

We, as representatives of the PAC, feel very strongly that this program (Comprehensive Groundwater Quality Monitoring Program) is essential because of the importance of groundwater in California - approximately 30% to over 40% of California's water supply come from groundwater. In addition, over 8,000 public water supply wells have been shut down, many for water quality reasons since the mid-1980s. The MTBE scare of the late 1990s is being supplanted by concerns over perchlorate and other emerging chemicals.

In order that California's precious groundwater resources can be managed and protected for the benefit of all citizens, it is imperative that California immediately establish a baseline of groundwater quality and groundwater use for each groundwater basin/subbasin in the state. Such a baseline can then be used as a reference for local management decisions, basin to basin comparisons, as well as establishing regulatory priorities for surface contaminant cleanup.

The goal of AB 599 is to improve comprehensive groundwater monitoring and increase the availability of information about groundwater quality to the public. AB 599 requires that the SWRCB, in coordination with an Interagency Task Force (ITF) and Public Advisory Committee (PAC), integrate existing monitoring programs and design new program elements, as necessary, to establish a comprehensive statewide groundwater quality monitoring program.

This report presents an implementable plan for comprehensively monitoring and assessing the quality of all groundwater basins/subbasins in the state. The program has five integrated elements:

- Accelerate and supplement the existing monitoring and assessment program (GAMA) established by the SWRCB pursuant to the Budget Act of 1999. The program relies on enhancing groundwater quality information collected in existing public supply wells through testing at a subset of those wells for groundwater age-dating and low-level volatile organic compounds (VOCs). This information can then be the basis for developing consistent hydrogeologic assessments for each basin/subbasin or basin groups.

- Conduct the monitoring and assessment program in accordance with the prioritization of basins/subbasins. A water-use criterion places those basins most heavily used for drinking water as first priority.

- Increase coordination among state, as well as federal and local, groundwater agencies. To the extent that multiple agencies continue to monitor groundwater quality, efforts should be made to coordinate their roles and share data.

- Maintain groundwater quality information for conducting monitoring and assessments in the SWRCB's Geotracker database. This Internet accessible database already stores all water quality information submitted to the state Department of Health Services (DHS) by public water purveyors as well as groundwater contaminant information for over 40,000 cleanup sites.

- Provide useful access to monitoring and assessment information to the public while maintaining appropriate security measures.

The recommended prioritized monitoring program is estimated to cost $50 million over a 10-year time frame. The recommended program assesses the groundwater basins that account for over 75% of all public supply wells in the state and over 90% of all groundwater use. (The estimated cost to assess 100% of groundwater basins and priority groundwater-use areas outside basins is estimated to be $92.4 million.) The Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50) provides for up to $50 million for implementation of the plan, and this sum is sufficient to implement the recommended program.

Stewardship of the state's groundwater resources is the shared responsibility of all levels of government as well as individual and corporate citizens. The program will benefit all responsible participants by enabling them to make informed decisions. In addition, it will provide groundwater agencies with trends and long term forecasting which are essential for groundwater management plan growth and preparation, especially if remedial actions become necessary.

Should you have any questions, please do not hesitate to contact either William Mills at (714) 577-1194 or David Beckman at (323) 934-6900.

**Sincerely,**

William Mills
Chair
AB 599 Public Advisory Committee

David Beckman
Vice-Chair
AB 599 Public Advisory Committee

cc: Honorable Carol Liu
California State Assembly
State Capitol, Room 4112
Sacramento, CA 94249

Mr. William Mills, Chair
AB 599 PAC
5141 Siesta Lane
Yorba Linda, CA 92886

Mr. David Beckman, Vice-Chair
AB 599 PAC
Natural Resources Defense Council
6310 San Vicente Boulevard, Suite 250
Los Angeles, CA 90048

Mr. Steve Arita
AB 599 PAC
Western States Petroleum Association
1115 11th Street, Suite 150
Sacramento, CA 95814

Mr. William R. Bazlen
AB 599 PAC
MFG, Inc.
180 Howard Street, Suite 200
San Francisco, CA 94105

Mr. Ivo Bergsohn
AB 599 PAC
South Tahoe Public Utilities District
1275 Meadow Crest Drive
South Lake Tahoe, CA 96150

Ms. Lena Brook
AB 599 PAC
Clean Water Action
814 Mission Street, Suite 602
San Francisco, CA 94103

Mr. Fred Douma
AB 599 PAC
Milk Producers Council
470 Laurelwood Lane
Ripon, CA 95366

Mr. William C. Gedney
AB 599 PAC
Southern California Water Company
630 East Foothill Blvd.
San Dimas, CA 91773

Mr. Rick Heimes
AB 599 PAC
US Geological Survey
6000 J Street
Sacramento, CA 95819-6129

Mr. Keith Hennesay
AB 599 PAC
California Farm Bureau Federation
3419 West Casa Loma Court
Visalia, CA 93277

Mr. John V. Rossi
AB 599 PAC
Chino Basin Watermaster
8632 Archibald Ave., Suite 109
Rancho Cucamonga, CA 91730

Mr. Roger Sherrill
AB 599 PAC
Rio Alto Water District
P.O. Box 4068
Cottonwood, CA 96022

Mr. John Ungvarsky
AB 599 PAC
US Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105-3901

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# COMPREHENSIVE GROUNDWATER QUALITY MONITORING PROGRAM

California relies on groundwater for approximately 30 percent of its water supply. During statewide droughts, that reliance can rise to over 40 percent.

Since the mid-1980s, over 8,000 public water supply wells have been shut down, many for water quality reasons. The MTBE scare of the late 1990s is being supplanted by concerns over perchlorate and other emerging chemicals.

In order that California's precious groundwater resources can be managed and protected for the benefit of all citizens, it is imperative that California immediately establish a baseline of groundwater quality and groundwater use for each groundwater basin/subbasin in the state. Such a baseline can then be used as a reference for local management decisions, basin to basin comparisons, as well as establishing regulatory priorities for cleanup of surface contaminants affecting groundwater.

Recognizing the need to comprehensively address groundwater, the Governor approved Assembly Bill 599 (AB 599), establishing the *Groundwater Quality Monitoring Act of 2001.* The goal of AB 599 is to improve comprehensive groundwater monitoring and increase the availability of information about groundwater quality to the public. AB 599 requires that the State Water Resources Control Board (SWRCB), in coordination with an Interagency Task Force (ITF) and Public Advisory Committee (PAC), integrate existing monitoring programs and design new program elements, as necessary, to establish a comprehensive statewide groundwater quality monitoring program.

This report, requested by the Legislature in its passage of AB 599 in 2001, presents a plan for implementing a program to comprehensively monitor and assess the quality of all groundwater basins/subbasins in the state. The program has five integrated elements:

- Accelerate the monitoring and assessment program established by the SWRCB pursuant to the Budget Act of 1999 and described in Chapter 2. This comprehensive groundwater quality monitoring program enhances the water quality information currently collected from public supply wells through the additional testing of those wells for groundwater age-dating and low-level volatile organic compounds (VOCs). This information can then be the basis for developing consistent hydrogeologic assessments for each basin/subbasin or basin groups.

- Conduct the monitoring and assessment program in accordance with the prioritization of basins/subbasins set forth in Chapter 4 of this report. A water use criterion places those basins most heavily used for drinking water in first priority.

- Increase coordination among agencies involved in groundwater management. To the extent that multiple agencies continue to monitor groundwater quality, efforts should be made to coordinate their roles and share data.

- Maintain groundwater quality information for conducting monitoring and assessments in the SWRCB's Geotracker database as described in Chapter 3. This Internet accessible database already stores all water quality information submitted to the state Department of Health Services (DHS) by public water purveyors as well as groundwater contaminant information for over 40,000 cleanup sites.

- Provide useful access to monitoring and assessment information to the public while maintaining appropriate security measures. Recommendations for public access are described in Chapter 5.

The recommended prioritized monitoring program is estimated to cost $50 million over a 10-year time frame. The recommended program assesses the groundwater basins that account for over 75 percent of all public supply wells in the state and over 90 percent of all groundwater use. (The estimated cost to assess 100 percent of groundwater basins and priority groundwater-use areas outside basins is estimated to be $92.4 million.) The Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50) provides for up to $50 million for implementation of the recommended program.

Finally, this report strongly recommends that the Department of Water Resources (DWR) establish water budgets to correspond to each of the groundwater water quality assessments for basins/subbasins. Further, this report recommends that a single "Groundwater Report" be jointly and biennially prepared by the SWRCB and DWR.

**Benefits of a Comprehensive Groundwater Quality Monitoring Program**

Stewardship of the state's groundwater resources is the shared responsibility of all levels of government as well as individual and corporate citizens. The comprehensive groundwater quality monitoring program recommended in this report will provide the following key benefits to enable informed decision-making among all responsible participants. The following are possible benefits of AB599 Program:

- Provides for a common base communications medium for agencies to utilize and provides groundwater quality data at multiple levels.

- Provides the mechanism to unite local, regional, and statewide groundwater programs in a common effort. Currently, most local agencies cannot effectively communicate with other local agencies or coordinate common elements on a regional level.

- Knowledge and better understanding of local, regional and statewide water quality issues and concerns will provide agencies at all levels better information to, in turn, deal with the concerns of consumers and consumer advocate groups.

- Provides groundwater agencies with trends and long term forecasting which is essential for groundwater management plan growth and preparation, especially if remedial actions become necessary.

- An effective statewide comprehensive groundwater quality program may provide motivation to small and medium-sized agencies to begin their own monitoring programs.

- This program may help inter-basin agencies that have basin-wide or regional management objectives. Especially those agencies that have intricate and overlapping jurisdictions via their physical or political location in a basin or aquifer.

- A comprehensive groundwater quality program will improve relationships between state agencies like SWRCB, DWR, DHS, and local agencies. The dissolution of local and state institutional barriers regarding data sharing will benefit all agencies.

# CHAPTER 1
# INTRODUCTION

## Groundwater Quality Monitoring Act of 2001

Groundwater is one of California's most valuable natural resources. Nearly half of California's population depends on groundwater for its drinking water supplies. In addition, groundwater is vital to California's agricultural industry. Unfortunately, comprehensive information regarding California groundwater quality is lacking. This lack of information impairs the ability of regulators and the public to protect and manage the state's groundwater basins/subbasins.

Recognizing the importance of maintaining and monitoring a safe groundwater supply for California, in October 2001, Governor Davis signed Assembly Bill 599 (AB 599) – Groundwater Quality Monitoring Act of 2001 (see Appendix A for bill text). Introduced by Assembly Member Carol Liu, the two main goals of AB 599 are to:

- Improve comprehensive groundwater monitoring; and
- Increase the availability of information about groundwater quality to the public.

This report reviews the current groundwater programs in California and, as requested by the Legislature, presents an implementable program for comprehensively monitoring and assessing the quality of all groundwater basins/subbasins in the state.

## Background

AB 599 requires the State Water Resources Control Board (SWRCB - see Appendix B for further information on the SWRCB), in coordination with an Interagency Task Force (ITF) and Public Advisory Committee (PAC), to design a Comprehensive Groundwater Quality Monitoring Program that integrates existing groundwater monitoring programs and new program elements, as necessary.

More specifically, AB 599 requires that the SWRCB, in consultation with the ITF shall:

- Integrate existing programs (specifically the SWRCB's Groundwater Ambient Monitoring and Assessment Program - GAMA) and design new elements to establish a program capable of assessing each groundwater basin - through direct and other statistically reliable sampling approaches;
- Determine the constituents to be included in the program;
- Incorporate existing data and assess if additional monitoring is necessary;
- Prioritize groundwater basins that supply drinking water;
- Identify measures to increase coordination among state and federal agencies and, as necessary, restructure existing monitoring programs;
- Design a database compatible with Geotracker to support the program;
- Develop a ranked list of actions to increase the effectiveness of monitoring;

- Estimate funding necessary to implement the program and recommend an ongoing source of funds; and
- Identify the means to make monitoring information available to the public.

AB 599 mandated the creation of the ITF to identify actions necessary to establish the Comprehensive Groundwater Quality Monitoring Program along the above mentioned bullet points. The ITF was specified to consist of representatives from each of the following entities:

- State Water Resources Control Board (SWRCB);
- Department of Water Resources (DWR);
- Department of Health Services (DHS);
- Department of Pesticide Regulation (DPR);
- Department of Toxic Substances Control (DTSC); and
- Department of Food and Agriculture (CDFA).

In addition to the ITF, AB 599 specified that a public advisory committee (PAC) be convened. The PAC consists of a membership from a wide array of groundwater stakeholders from the following groups:

- Two representatives of appropriate federal agencies;
- Two representatives of public water systems, one of which shall be a representative of a retail water supplier;
- Two representatives of environmental organizations;
- Two representatives of the business community;
- One representative of a local agency that is currently implementing a plan pursuant to Part 2.75 (commencing with Section 10750);
- Two representatives of agriculture; and
- Two representatives from groundwater management entities.

The AB 599 ITF and PAC met on several occasions from February 2002 to February 2003 to provide input on comprehensive groundwater quality monitoring in California. This report is a result of those discussions and presents a Comprehensive Groundwater Quality Monitoring Program for California.

**What is groundwater?**

Groundwater is water that is found underground in fractures and voids of rock and soil (i.e., an aquifer). It can be found as shallow as one foot, to as deep as hundreds of feet below the surface of the ground.

Rain and snowmelt are the natural means of recharging groundwater supplies. However, man-made methods can recharge groundwater supplies with surface water. The depth below the ground surface to groundwater (water table) may rise or drop depending on many natural and artificial factors, including drought and overpumping from water wells.

Groundwater is brought to the surface naturally through a spring or discharges into lakes and streams. It can also be extracted by placing a water well into the aquifer. Wells may go dry if the water table falls below the bottom of the well (see Figure 1).

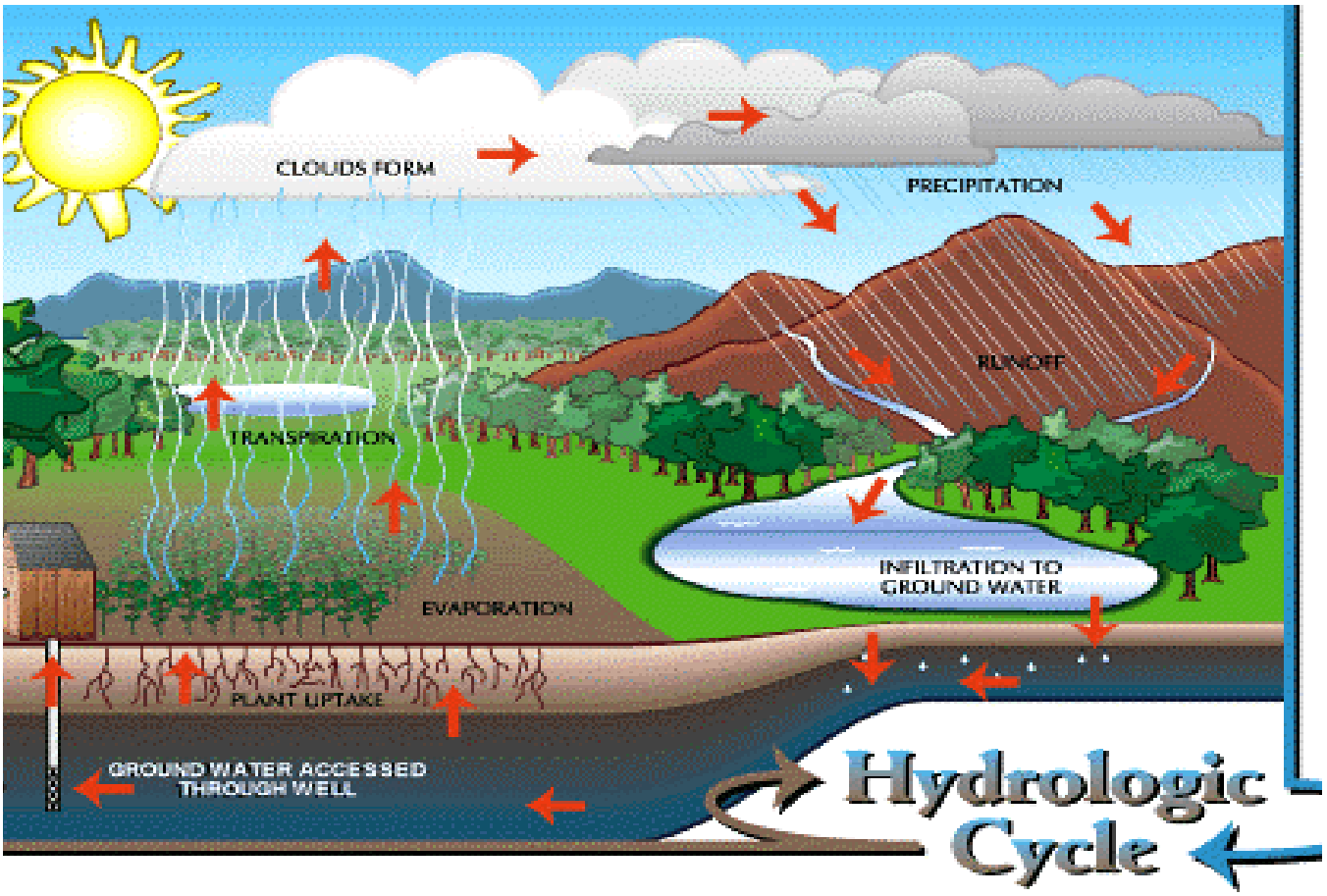



Figure 1: Hydrologic Cycle
*Source: http://www.epa.gov/bioindicators/images/hydrocyc.gif (2/2003)*

**Why is groundwater important?**

Groundwater is one of California's most important natural resources. California's cities, farms, and businesses rely on water from both groundwater and surface water. Surface water projects, which capture and deliver rain and snow runoff, provide a major portion of the state's total water supply. California's rapidly growing population -- estimated to reach 47.5 million by 2020 (See Figure 2) -- is putting more pressure on the state's water supplies (DWR Bulletin 160-98).

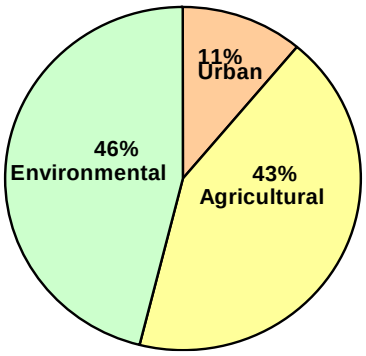
Groundwater is the source of about 30 percent of the water for urban and agricultural use in average years and can increase to about 40 percent when surface supplies are reduced in drought years (See Figure 3). The amount of water stored in California's aquifers is far greater than that stored in the state's surface water reservoirs, although only a portion can be extracted economically and practically (DWR Bulletin 160-98). It is likely that the projected population increase will result in the increased usage of groundwater**.**

To the extent groundwater basins become unusable due to impacts to water quality, additional pressure is placed on surface water supplies. Though groundwater supplies a smaller portion of the total water supply than surface water, if contaminated, it takes longer and is more difficult to cleanup. In addition, it takes longer, on the order of decades, for the water cycle to displace the contaminated groundwater with clean water. In contrast, surface water, if contaminated, can be displaced with clean water in a few years. To date, most chemical contaminated drinking water sources are groundwater.

**Figure 2 - California Water Usage** (From DWR Bulletin 160-98, *The California Water Plan Update*)

| | *1995* | *2020 Forecast* | *Change* |
|---|---|---|---|
| Population (millions) | 32.1 | 47.5 | 15.4 |
| Irrigated crops (million acres) | 9.5 | 9.2 | -0.3 |
| | | | |
| **Water Use (in million acre-feet)** | | | |
| Urban | 8.8 | 12.0 | 3.2 |
| Agricultural | 33.8 | 31.5 | -2.3 |
| Environmental | 36.9 | 37.0 | 0.1 |

**1995 Water Use**




**2020 Water Use Forecast**

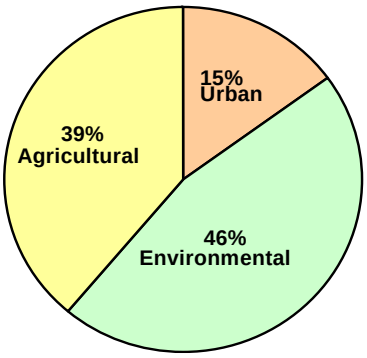
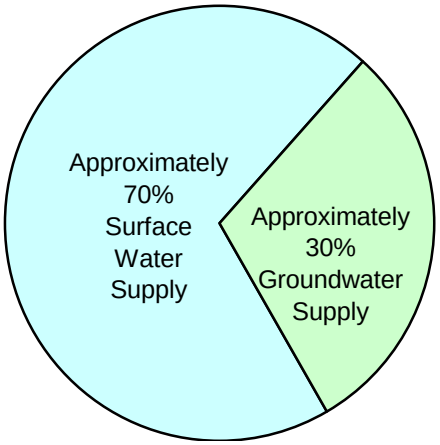



**Figure 3**

## Surface and Groundwater Usage - Agricultural and Urban

***Average Years***




***Drought Years***

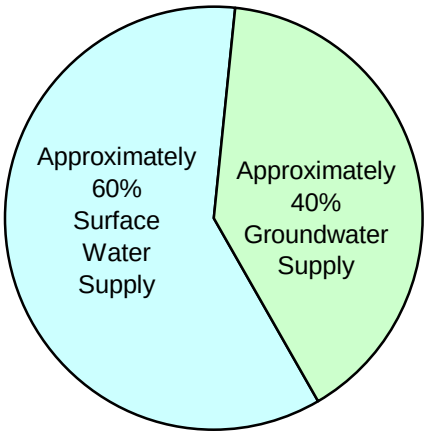



Figure Source Data: DWR Bulletin 160-98, *The California Water Plan Update (Table ES3-1 and text on page ES3-5)*

**Why monitor groundwater?**

Monitoring is an important component in determining our progress toward preserving, enhancing, and restoring groundwater resources. Monitoring is the tool that helps assess the resource and measure the success of groundwater management and protection.

**Is all groundwater monitoring the same?**

Groundwater monitoring can be defined as a scientifically designed groundwater surveillance system of continuing measurements and observations, including data evaluation procedures. However, depending on the purpose, groundwater monitoring can take different forms.

The U.S. Environmental Protection Agency (USEPA) has identified two types of groundwater monitoring: 1) Ambient and 2) Compliance. Ambient monitoring is focused on assessing the overall quality of groundwater resources, including areas that may be impacted. Compliance monitoring has a more narrow focus on the impacts and the influence of specific activities may be used to support regulation and enforcement, and tends to be site-specific.

In addition to addressing the needs of a specific groundwater program, the details of a groundwater monitoring program may differ depending on:

- Aquifer type (Alluvial, Fractured, Karst);
- Size of area;
- Hydrogeologic conditions (seepage velocity, infiltration, aquifer size);
- Climate;
- Land use (Urban, Agricultural);
- Beneficial use (Drinking, Irrigation, Industrial);
- Existing or potential contamination; and
- Available funding.

**What is ambient groundwater monitoring?**

Ambient groundwater monitoring collects physical, chemical, or biological information and data in order to answer specific questions about the status and trends in those characteristics.

Ambient groundwater monitoring can evaluate the status of groundwater resources, trends of improvement or deterioration in groundwater quality and can focus attention on priority areas where groundwater quality protection or restoration efforts are necessary.

Ambient groundwater monitoring is a long term, continuous process that includes a wide range of groundwater quality parameters and constituents that are sampled at various scales (local, regional, basin-wide, statewide) and frequency (one-time survey, every year, every 10 years).

A detailed analysis of the data is conducted to assess the resource and used to refine future monitoring activities.

**What are the uses of ambient groundwater monitoring information?**

Ambient groundwater monitoring provides information that enables stakeholders to:

1. Assess the current status of groundwater quality
2. Track long-term spatial and temporal trends in groundwater quality associated with the natural environment and/or changes in land use
3. Identify impacts to groundwater resources
4. Assign priorities for groundwater management
5. Implement groundwater quality management programs
6. Evaluate the effectiveness of groundwater management programs
7. Modify actions to improve groundwater program effectiveness

**Goals of a Comprehensive Groundwater Quality Monitoring Program**

In addition to the goals identified in AB 599, the ITF and PAC have developed additional goals to be used to develop the Comprehensive Groundwater Quality Monitoring Program. These program goals are as follows:

**Goal 1. The Comprehensive Groundwater Quality Monitoring Program must be multi-purpose and useful at various scales**.

These scales include:

- Site Specific and Local Scale: A monitoring program should provide information on a site specific (e.g., a specific municipal water well, an underground fuel storage tank site) and local scale.
- Regional Scale: Tools should be developed to assess impacts at larger spatial scales, such as on a regional scale. For example, detections of a constituent of concern could be investigated for an entire groundwater basin/subbasin. These detections could be used to compare the distribution of constituents and its relationship to other variables, such as general soil type. In addition, a query of a geographical information system (GIS) database could evaluate if one or more wells reported detections during a specific timeframe. Using this information, a comparison could be made between soil types and detections of specific constituents of concern in a particular groundwater basin/subbasin.
- Statewide Scale: Monitoring data available from all basins/subbasins statewide should be aggregated, queried, and displayed geographically.

**Goal 2. The Comprehensive Groundwater Quality Monitoring Program must provide information for making various groundwater assessments.**

Monitoring data should allow for the following assessments to be made:

- Assessment 1 - Describe Constituents Affecting Groundwater Quality:
  - Constituents of concern present in the groundwater
  - Location of the constituents of concern
- Assessment 2 - Identify Trends in Groundwater Quality:
  - Current water quality trends
  - Potential future water quality trends
- Assessment 3 - Identify Emerging Constituents of Concern:
  - Focus on areas with potential contaminating activities
  - Consider groundwater flow system and constituent transport
  - Use new laboratory methods with the lowest possible detection limits
  - Use results from new health effects assessments
- Assessment 4 - Relate Groundwater Quality to Human and Natural Factors:
  - Groundwater quality may be influenced by naturally occurring constituents or by human activities.
  - Identify whether constituents result from natural or man-made sources.
  - Identify impacts on industrial, agricultural and urban uses.
- Assessment 5 - Identify Data Gaps:
  Examples of data gaps may include:
  - Lack of sufficient historical data
  - Lack of spatial data coverage.
  - Additional constituents of concern

**Goal 3. The Comprehensive Groundwater Quality Monitoring Program must be accessible and "user friendly."**

The comprehensive groundwater quality program requires a database that is accessible and usable to not only the decision-makers and regulators, but also to the general public. Data accessibility is described in Chapter 3: *Data Management Needs and Public Access*.

**Goal 4. The Comprehensive Groundwater Quality Program must include an on-going process to ensure effective interagency coordination and collaboration on new and existing groundwater issues.**

Interagency coordination is addressed in Chapter 2: *Existing Groundwater Monitoring Programs and Interagency Coordination*.

**Goal 5. The Comprehensive Groundwater Quality Monitoring Program must include mechanisms for justifying ongoing resource needs.**

AB 599 requires an estimate of funding to assess current resource needs to implement the Comprehensive Groundwater Quality Monitoring Program based on the recommendations from the ITF. This goal is to ensure an ongoing assessment of resource needs. Some examples of issues associated with resource needs include limited resources and uncertain future funding, innovative funding opportunities, and changing priorities due to state budget reductions.

# CHAPTER 2
# EXISTING GROUNDWATER MONITORING PROGRAMS AND INTERAGENCY COORDINATION

## Existing Groundwater Monitoring and Assessment Programs and Resources

California's groundwater resources are currently regulated by more than one agency. State and federal agencies each approach groundwater quality issues from the perspective of their own mandate. As a result, each agency collects different types of groundwater data and information. Despite the volume of groundwater-related monitoring statewide, there is very limited, if any, overlap between agencies of actual data collected for groundwater quality.

The state agencies that implement groundwater-related monitoring programs are the SWRCB and Regional Water Quality Control Boards (RWQCBs), DWR, DHS, DTSC, and DPR. These agencies are represented on the ITF. Federal agencies that implement groundwater-related monitoring programs include the USEPA, Bureau of Reclamation, and the United States Geological Survey (USGS).

ITF agencies have programs and generate data that are critical to the comprehensive evaluation of the state's groundwater resources. The sharing, integration, and evaluation of the rich data repositories of these agencies would be a logical step towards a comprehensive assessment of this vital resource. The ITF agencies are also the state agencies most capable of analyzing groundwater data and determining the extent and types of data (spatial and temporal) necessary to adequately specify the nature and details of a comprehensive statewide assessment.

## Groundwater Ambient Monitoring and Assessment (GAMA)

Governor Davis and the Legislature, as well as private citizens are very concerned about public water supply well closures due to the detection of chemicals, such as methyl tertiary butyl ether (MTBE) and perchlorate. Because of the increased concern over groundwater quality, the Supplemental Report of the 1999 Budget Act required the SWRCB to develop a comprehensive ambient groundwater monitoring plan.

To meet this mandate, the SWRCB created the GAMA Program. The primary objective of the GAMA Program is to assess the water quality and relative susceptibility of groundwater resources.

The GAMA Program has two sampling components: the California Aquifer Susceptibility (CAS) Assessment which addresses public supply drinking water wells and the Voluntary Domestic Well Assessment Project which addresses private drinking water wells. The GAMA Program is being directed out of the SWRCB's Groundwater Special Studies Unit.

The CAS assessment utilizes low-level VOCs and age-dating analyses to assist in the evaluation of the hydrogeologic conditions within the groundwater basin/subbasin.

The GAMA Program is also focused on an effort to identify and centralize the many sources of groundwater data and information available in the state. As part of this effort, the SWRCB has joined with other groundwater agencies to form a Groundwater Resources Information Sharing Team. The various groundwater data sets will be made accessible to the public and interested agencies within a Groundwater Resources Information Database.

**Existing ITF Groundwater Monitoring/Assessment Data**

The tables in Appendix C describe the various groundwater monitoring and assessment programs at the ITF agencies, including program objectives and the portion of the total resources (amount of staff and annual funding) allocated specifically for groundwater monitoring and assessment activities (such as review and evaluation of groundwater monitoring data). The information presented in these tables was provided by the ITF agencies and provides a general overview of their programs.

These various groundwater monitoring and assessment programs collect a significant amount of groundwater-related data in various coverage and formats (Table 1). Table 2 shows the type of program for which the data are used: Surveys are one-time data collection efforts; Monitoring is ongoing data collection but with limited analysis; and Assessment is ongoing data collection with detailed analysis. In addition, Table 2 provides information on data format (hard copy or electronic), and whether spatial location – geographic information system (GIS) – data are available.

Hard copy data are not easily accessible to other agencies. Data in different electronic formats may not be as valuable as a single database of information. The lack of data comparability and sufficient data sharing significantly hampers oversight of groundwater resources.

It is noteworthy that the DHS public water supply well database is the best available and readily usable source of groundwater data for groundwater quality assessment in the State of California. This database contains results of regular water quality monitoring, required by federal and state laws and regulations, for numerous chemical, radiological, and bacteriological contaminants. The laws and regulations applicable to the public supply wells establish numerical water quality criteria for these contaminants, called Maximum Contaminant Levels (MCLs), to protect public health. The DHS database contains water quality data and locational data for over 16,000 public supply wells in the state. Approximately 12,000 public supply wells are within the DWR-defined alluvial groundwater basins/subbasins. Use of the DHS public supply well data, as part of the Comprehensive Groundwater Quality Monitoring Program, is described in Chapter 4.

## Interagency Coordination for Groundwater Monitoring Programs

AB 599 requires that the ITF identify measures that would increase coordination among state and federal agencies that collect groundwater contamination information. Coordination is essential for the success of a Comprehensive Groundwater Quality Monitoring Program. Increased coordination will also benefit all agencies through data sharing, training costs, and project responsibilities.

The emphasis should be on increasing collaboration to effectively expand existing programs to cover a wider range of sampling, analyses, and evaluation efforts. The following measures will result in increased basic interagency coordination and communication on groundwater programs:

- Share data (e.g., GIS Coverages);
- Share data collection responsibilities;
- Develop minimum sampling and analytical protocols;
- Share specialized training;
- Collaborate on data interpretation;
- Share laboratory facilities and share information on laboratory methods;
- Continue the ITF to ensure interagency coordination / communication;
- Meet on a periodic basis to achieve these listed elements; and
- Develop a standardized data format for electronic submittal of groundwater monitoring data.

## Lead Agencies for Water Quality and Water Quantity

The SWRCB has the statutory mandate under California Water Code Division 7, Sections 13000 – 14598 to develop statewide water protection plans and establish water quality standards.

Similarly, the DWR is the primary state agency mandated to address water quantity (water supply) information.

# CHAPTER 3
# DATA MANAGEMENT NEEDS AND PUBLIC ACCESS

## Data Management Needs

A data management strategy and an effective data management system are critical components of a Comprehensive Groundwater Quality Monitoring Program. The data management strategy will integrate all of the major factors critical to a successful program, including hardware, software, data, staff, and the collaborating agencies themselves. A relational database with a geographic information system (GIS) interface is necessary for the storage, retrieval, and evaluation of the large quantities of complex data needed for the Comprehensive Groundwater Quality Monitoring Program. A distributed relational database structure allows individual agencies to manage their own data locally.

The variety of groundwater data collected by the state agencies involved in groundwater issues is discussed in Chapter 3. The agencies participating in the Comprehensive Groundwater Quality Monitoring Program will maintain ownership of the data that they collect and contribute to the data warehouse. They will also be involved in efforts to ensure that the data quality is of the highest possible standard, and that proper data documentation is maintained. One way to accomplish this would be to form a groundwater data subcommittee, comprised of several members of the PAC and ITF. The subcommittee would be able to periodically collaborate on tasks such as:

- Identifying data sets that should be added to the data warehouse;
- Resolve data ownership/stewardship issues;
- Creation of a metadata library; and
- Oversee data updates.

The hardware and software required to handle all of the needs of a Comprehensive Groundwater Quality Monitoring Program must have a range of capabilities that can meet the needs of each government agency and its general public stakeholders. Not only must they be able to act as a storage place for the large and diverse sets of groundwater data generated in the state, but they must also allow for data transactions such as data input, data querying, data visualization, data analysis, and data download. Since groundwater data has a strong spatial nature, GIS functionality is a valuable and essential component to the data management system.

## Geotracker

AB 599 specifies that the database to support the Comprehensive Groundwater Quality Monitoring Program is to be compatible with Geotracker. Geotracker is an Internet accessible environmental management database system. The Geotracker database structure was created by Lawrence Livermore National Laboratory (LLNL) for the SWRCB [pursuant to AB 592/ SB

1189 (Kuehl/Hayden, 1997)] and was applied to support the SWRCB's Underground Storage Tank (UST) program.

The ITF, at the request of the PAC, examined different types of web-enabled data management systems. Geotracker was compared to other well-known systems such as USEPA's EnviroMapper, and the Environmental Defense Council's ScoreCard. All three systems use Oracle software for their underlying database platform and ESRI GIS software (ESRI's ArcIMS or Map Objects) for the user interface. The web-based GIS client software allows for network connectivity and e-commerce or e-government applications.

Geotracker was found to have the most functionality out of the systems examined. All systems are scalable in terms of raw storage and processing ability, as well as the types of tools and functions available to users.

Geotracker provides flexibility in the available data dissemination methods. Users can upload or download data to the Geotracker database by File Transfer Protocol (FTP) technology. General users can visualize data through the thin client web-based GIS software, while more technical users can download whole data files for incorporation into more powerful GIS software programs and more intensive analysis.

Specifically, groundwater data management system should have the following functionality:

- Facilitates electronic data exchange;
- Facilitates the use of data standards;
- Assures data quality;
- Includes description of data source;
- Spatially-referenced;
- Incorporates tools for all user communities, including:
  - Consumer's / Private Citizens
  - Water Purveyors
  - Regulators
  - Local / State / Federal Agencies
  - Researchers
  - Legislators;
- Includes historical retention of records and the ability to analyze data over various timeframes;
- Provides public access to groundwater data and information; and
- Supports business to government transactions.

To achieve the functionality outlined above, the PAC approved using the SWRCB's Geotracker. Geotracker has the following features:

- Data Warehouse (Geotracker, Oracle-based);
- GIS Capabilities (Geotracker, ESRI-based);
- Internet Accessible 24 hours a day (Geotracker, ESRI-based);

- Integrates data from multiple programs and agencies; and
- Case management capabilities for state agencies.

Both the ITF and PAC concluded that Geotracker is a database capable of supporting the Comprehensive Groundwater Quality Monitoring Program. Geotracker already effectively integrates groundwater data from multiple state agencies (for example, public water system data from DHS, and leaking UST data and GAMA program ambient groundwater quality and vulnerability data from SWRCB). While Geotracker does not currently have the capability to handle all groundwater data anticipated for the Comprehensive Groundwater Quality Monitoring Program, it is easily expandable to meet those eventual needs and to accommodate the tools that will help manage and analyze the data.

Geotracker already provides effective tools to allow users to analyze data over the Internet. One very useful and powerful tool in Geotracker is its relational database query capabilities. For example, the attribute tables of a selected set of features can be queried and those features that meet the specified criteria can be visualized in map format on the computer screen.

Another useful tool is being able to select a feature such as a public water supply well from a map on the computer screen, automatically retrieving previous data and regulatory compliance records for the well, and then plotting detected chemical trend graphs.

Intrinsic functions/tools in Geotracker include:

- Zoom and pan around an on-screen map;
- Identify and select features;
- Create buffer zones around features;
- Query attribute tables;
- Measure approximate distances;
- Print Maps;
- Export Maps and Images; and
- Extract reports/data from links.

**Future Database Flexibility**

New tools and applications can be programmed into Geotracker, providing flexibility for the future. The SWRCB is currently evaluating the addition of new tools for GAMA on Geotracker, including multiple criteria querying capability.

Some of the necessary additions to Geotracker identified by the ITF to meet the needs of the comprehensive groundwater quality program include:

- Database Query Tools:
  - Ability to query a large set of groundwater quality data (e.g. constituent, concentration, area, time, depth to groundwater, screened interval) with the user able to specify single or multiple fields for the query.
  - Ability to query by DWR hydrogeologic subbasins.

- Data/Information:
  - Additional GIS coverages as necessary for analysis (e.g. land use, rainfall).
  - Groundwater elevation data, well construction data, lithology, etc.
  - Non-UST contaminant sites (e.g. landfills, wastewater ponds; all other cleanup sites with local, state, and federal regulatory lead).
  - Potential contaminating activities (DHS's Drinking Water Source Assessment and Protection Program (DWSAP) data and/or business plan data for hazardous materials storage).

- Consumer Information:
  - Links to DHS / USEPA websites.
  - Links to local water agency websites.
  - Demonstration web page on local groundwater quality.
  - Links to groundwater assessment reports (e.g. SWRCB's groundwater quality portion of the USEPA's 305b Report; DWR's Bulletin 118; SWRCB's GAMA assessments).

Once established, representatives from the PAC/ITF agencies contributing data should meet periodically to:
- Address maintenance duties and needs
- Evaluate the performance and progress
- Interface with other stakeholders.

**Public Access Requirements**

The Internet has been selected as the optimal route of access to the database supporting the Comprehensive Groundwater Quality Monitoring Program. The Internet provides access to the data warehouse by a large portion of the user community. Potential users that do not have access to a computer or the Internet, should be able to access the data at their local public library, most of which have publicly available computers linked to the Internet.

**Public Access Considerations**

Some of the data contributed by participating agencies may be considered sensitive due to security or other concerns. Access to specified portions of the data warehouse content can be regulated by the database administrator at the request of the agency/entity contributing data. An example of this capability can currently be observed on Geotracker. Due to heightened security concerns, DHS requested that the geographic coordinates of the public water supply wells be

removed from general public access. The SWRCB promptly complied with the request, but kept the information available to registered users (such as regulatory agency staff), who had an important need for the information, through password access.

**Data Security Tiers**

Data security concerns can be addressed by creating levels or "tiers" of access to the database. On the basic end of access capabilities, a consumer/private citizen access tier can be created and accessed through an Internet address that links an appropriate software application to the database. This basic access level would have a general assortment of the most commonly used database and GIS tools, and access to only non-sensitive data, available to the user. The agency responsible for the data (e.g. DHS for public supply well locations) will make the determination on the level of security and access for their specific portion of the dataset.

Passwords will only be known to the individuals who are granted access to confidential data. The data will be managed by the agency that contributes that piece of data. Database users would be able to download data with their level of password clearance. Data download would likely occur by FTP access and allow the user to receive packets of data in a format that can be imported into the most common database, spreadsheet, and GIS software programs. In this fashion, users will have the potential to subject the data to even more analytical tools than the standard tools available on the web client, which will likely benefit those with such needs as regulators, consultants, and academia.

Public access to detailed location information may pose a risk to these public water supplies. The ITF acknowledged that a strictly controlled, tiered password protocol was essential for this type of database. It would be possible to visually represent the location data in a modified manner through the GIS, such that even the most general user can evaluate the data associated with those locations, and draw regional conclusions, without being given the exact location of the features.

The web client application can be developed such that it is accessible by a common Internet browser. The application would be platform independent, as to be accessible by users with various computer operating systems. Geotracker is currently outfitted with this type of functionality.

# CHAPTER 4
# COMPREHENSIVE GROUNDWATER QUALITY MONITORING PROGRAM

## Program Summary and Scope

In order to make informed decisions concerning sustained groundwater use, including groundwater transfers and groundwater banking, it is imperative that a baseline for both groundwater quality and quantity be established for groundwater basins/subbasins in the state. This chapter presents a program to effectively monitor, assess, and report to the public on a continuing, regular basis the quality of groundwater in California. In addition, a discussion is included which summarizes a plan by the DWR to establish water budgets for the groundwater basins/subbasins in the state.

More specifically, this chapter describes, in detail, the approach to the Comprehensive Groundwater Quality Monitoring Program and includes guidelines for the selection of groundwater monitoring points, monitoring network design, and sampling density. In addition, a method for groundwater basin/subbasin prioritization is presented to ensure that the highest priority groundwater basins/subbasins are assessed first. Because it is not feasible to sample for all constituents everywhere, a tiered approach to target constituents is also recommended. The tiered approach to target constituents applies various intensity levels of constituents to various percentages of monitoring points. The "high intensity" constituent tier, in which the greatest amount of constituents is sampled in a subset of wells, would aid in evaluating groundwater quality trends. Finally, data gaps and additional data needs are identified.

It is important to note that the emphasis of the program presented in this chapter is on the used groundwater resource, as represented by public and private water supplies. Appendix E contains a detailed technical report by the USGS (*Framework for a Ground-Water Quality Monitoring and Assessment Program for California*) on the Comprehensive Groundwater Quality Monitoring Program described in this chapter.

## Program Goal

The primary goal of the Comprehensive Groundwater Quality Monitoring Program is to:

1. Improve comprehensive groundwater monitoring and,
2. Increase the availability of groundwater quality information to the public.

The program goals are described in detail in earlier chapters.

**Program Benefits and Products**

Consistent with AB 599, implementing the Comprehensive Groundwater Quality Monitoring Program has the following benefits:

- Provides additional protection for the source of up to 40 percent of California's water supply;
- Improves comprehensive groundwater quality monitoring;
- Increases the coordination among agencies that monitor groundwater;
- Takes maximum advantage of existing resources and data;
- Identifies existing groundwater monitoring data gaps;
- Enhances the understanding of groundwater;
- Creates a database to provide tools to aid in making groundwater assessments; and
- Maximizes cost savings associated with monitoring the resource.

In addition to the benefits identified above, implementing the Comprehensive Groundwater Quality Monitoring Program will yield the following products:

- Biennial California Groundwater Report
  A single report that regularly reviews the condition of California groundwater will include the groundwater quantity information provided in the DWR Bulletin 118 and the groundwater quality information from the SWRCB deliverable to the USEPA 305(b) Report.
- Groundwater Basin Assessments
  Groundwater basin/subbasin assessments will be completed for each individual priority basin/subbasin. It is estimated that approximately 5 to 10 priority basin/subbasin assessments will be completed per year over a ten-year period. The resulting assessments will be made available to the public.
- Groundwater Database (Geotracker)
  Groundwater quality information and data (including the Biennial Groundwater Report and basin/subbasin assessments) will be made available in a centralized groundwater database that is accessible via the Internet.
- Interagency/Stakeholder Coordination Groups
  The PAC and the ITF will continue to meet to discuss groundwater issues and promote interagency and stakeholder coordination.

**Comprehensive Groundwater Quality Monitoring Program Approach**

Consistent with AB 599, the Comprehensive Groundwater Quality Monitoring Program addresses the following objectives:

- The program should be multi-purpose and useful at various scales - local, regional, and statewide;

- The program monitoring network design should be able to make various groundwater quality assessments; and
- The program should maximize the use of existing groundwater resources and data.

The ITF and PAC identified the types of assessments that should be conducted to achieve these objectives with the data collected by the Comprehensive Groundwater Quality Monitoring Program. These include:

- Status: Assessments that describe the quality of the groundwater resource;
- Trends: Assessments that detect changes in water quality, including emerging contaminants; and
- Impacts: Assessments that relate groundwater quality impacts to human and/or natural sources.

Each of these types of groundwater quality assessments is most efficiently accomplished by applying uniform and consistent study design and data collection protocols to the entire state. Past research has shown that it is extremely difficult to conduct a meaningful assessment by aggregating groundwater quality data collected for different purposes. These difficulties result from the differences in sample collection and analytical methods, as well as the variability introduced by differences in the type and location of the sampling point.

**Groundwater Monitoring Network Design: Randomized Network of Public Supply Wells**

One of the first steps to designing a groundwater quality monitoring program is to develop a network or "map" of the points at which you plan to collect samples. The Comprehensive Groundwater Quality Monitoring Program will select sampling points using a spatially distributed, randomized network of public supply wells throughout the state.

Groundwater quality data will be collected in groundwater basins/subbasins. These groundwater basin scale data can be aggregated to conduct regional and statewide assessments and groundwater quality in basins/subbasin and regions can be compared.

In order to collect data that will allow the various types of assessments to be made on different scales, the Comprehensive Groundwater Quality Monitoring Program will employ a consistent study design in all basins/subbasin. Important groundwater monitoring elements that will be consistent among basins/subbasins include:

- well type,
- spatial density,
- sample collection protocols,
- analytical methods, and

- temporal frequency.

This consistency will permit assessment at a variety of scales by producing data sets that address the basic objectives at the basin/subbasin scale, but more importantly, can be aggregated to produce regional and statewide assessments. The ability to aggregate data for groups of basins/subbasin is critical because groundwater resource planning issues are mainly regional in nature and involve groups of basins/subbasins. This aggregation is best accomplished by using a spatially distributed, randomized sample of wells in each basin/subbasin. Similarly, many important findings will only be evident by making comparisons among basins/subbasins or groups of basins, which also requires a consistent and random design. Deviating from a randomized selection approach will compromise the ability to conduct meaningful assessments on groups of basins, and hence it will not be able to answer questions of regional and statewide importance.

While a randomized approach is the basis of the study, many basins/subbasins may have local considerations for which a more spatially targeted well selection would be better suited. These local considerations may be hydrologeologic in nature (focused recharge or systematic changes in geology) or related to potential contaminant sources. Regulatory monitoring programs address local groundwater quality questions related to contaminant sources. These are usually small scale, and often too numerous to address individually.

Some of these local considerations may be common to groups of basins/subbasins within a major aquifer system, and hence be relevant to regional assessment. As a result, the monitoring network may consider evaluating a preeminent local feature or gradient in up to 25 percent of the wells in that specific basin/region. Results of these local assessments will contribute to understanding groundwater contaminant sources and transport, and understanding contrasts in groundwater quality between basins/regions.

**Groundwater Monitoring Points and Sampling Density**

Once a monitoring network has been designed, monitoring points must then be selected. AB 599 places a relative emphasis on groundwater basins/subbasins that supply drinking water. Thus, the Comprehensive Groundwater Quality Monitoring Program relies on existing public supply wells as monitoring points for the major groundwater aquifers. From a technical standpoint, public supply wells are appropriate monitoring points because they generally have extensive well screen lengths (i.e., screened intervals) and high pumping capacities, and sample a larger volume of the aquifer than wells with shorter screened intervals (domestic and monitoring wells). Public supply wells are also widely distributed wherever there are population centers. In addition, public supply well data (locations and drinking water quality compliance data) are available in electronic format in the DHS database.

Information from monitoring and domestic water supply wells is also important and should be reviewed. Available information for these wells should be incorporated into

the SWRCB's Geotracker database, as has been done for monitoring wells under the SWRCB Underground Storage Tank (UST) Program and public supply wells in the DHS database. This is especially true for domestic wells, as they are an important source of drinking water. Past investigations have shown that data from domestic wells can be used to make meaningful assessments, and examination of the DHS public supply well database has shown the great value of a statewide digital database. Various groundwater programs sample domestic wells. The following programs monitor domestic wells and are valuable sources of data for a domestic well database: SWRCB GAMA – Voluntary Domestic Well Assessment Program, DPR Groundwater Protection Program, DTSC Cleanup Sites, DWR Groundwater Information Database, and the USGS National Water Quality Assessment Program (NAWQA).

Just as state agency data are being incorporated into a comprehensive database, local groundwater quality data may also assist in basin/subbasin and larger scale assessments. It is anticipated that the amount of local data is significant in some basins/subbasins. However, additional effort is necessary to identify the types of local data available and to assess whether or not incorporating these data into a central groundwater database is beneficial. Partnerships and effective coordination with the local agencies will be an important part of the Comprehensive Groundwater Quality Monitoring Program.

The sampling or monitoring density describes how many monitoring points are to be chosen for each groundwater basin/subbasin for assessment purposes. To optimize data collection, the following sampling density will be used as a guide for the Comprehensive Groundwater Quality Monitoring Program:

| **Comprehensive Groundwater Quality Monitoring Program Sampling Density** |
|---|
| • Wells will be sampled at a density of **one well per 25 square kilometers** (9 square miles). |
| • For basins less than 500 square kilometers (180 square miles), the recommended sampling density would provide fewer than 20 wells). However, to achieve statistically significant results, **no fewer than 20 wells** will be sampled in any priority basin. |
| • For basins/subbasins larger than 1500 square kilometers (540 square miles), the recommended sampling density would require sampling more than 60 wells. However, to maintain cost-effectiveness, **no more than 60 wells** will be sampled in any priority basin/subbasin. |

**Prioritization of Groundwater Basins/Subbasins and Other Areas**

In a state as large as California, it is important that the Comprehensive Groundwater Quality Monitoring Program establish a methodology to prioritize groundwater basins/subbasins for assessment purposes. Hydrogeologic provinces help provide a basis for prioritizing groundwater basins/subbasins, and for evaluating the groundwater resource that occurs outside of mapped groundwater basins/subbasins (see Figure 4). Hydrogeologic provinces are large regions that share similar climatic, geologic, and hydrologic characteristics. Ten hydrogeologic provinces have been recognized: Northern Coast Ranges, Klamath Mountains, Northern California Volcanics and Quaternary Sediment (i.e., Modoc Plateau and Cascades), Central Valley, Sierra Nevada, Southern Coast Ranges, Transverse and selected Peninsular Ranges, Basin and Range, San Diego Drainages, and Desert.

DWR recognizes 525 groundwater basins and subbasins in California (see Figure 5). It is important to note that groundwater use also occurs outside these mapped groundwater basins/subbasins. For the purposes of prioritization, and with the exception of the Sacramento and San Joaquin Valleys, groundwater subbasins were evaluated as part of the larger groundwater basin that contains it. In the Sacramento and San Joaquin Valleys, subbasins are relatively large, and therefore the subbasins were evaluated as if they were basins. This results in 472 basin areas that are further evaluated for prioritization.


*Figure 4 - California's Hydrogeologic Provinces (USGS)*

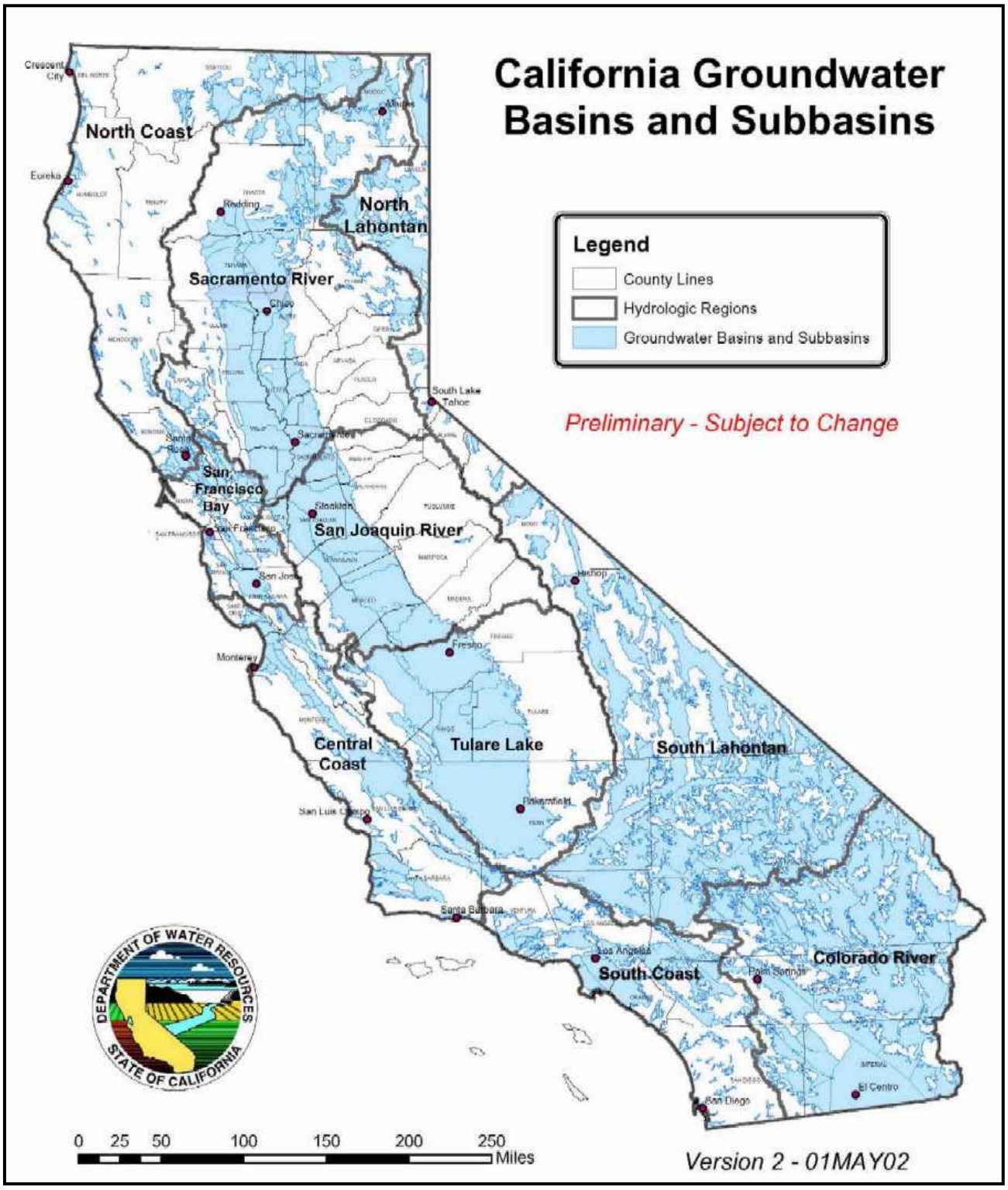



*Figure 5 - California's 525 Groundwater Basins (DWR)*

Several characteristics are useful when considering a groundwater basin/subbasin prioritization scheme. The number of public supply wells, the population using groundwater, and the volume of agricultural pumping each provide information relevant to the currently used groundwater resource. The number of leaking USTs and sections with pesticide applications provides information on the potential impact of human activity on the groundwater resource. In addition, the areal extent of a groundwater basin/subbasin provides some information on the volume of the groundwater resource. The Comprehensive Groundwater Quality Monitoring Program Basin/Subbasin prioritization factors are shown below:

| Groundwater Basin/Subbasin Prioritization Factors |
|---|
| 1. Number of Public Supply Wells |
| 2. Population Relying on Groundwater |
| 3. Volume of Agricultural Pumping |
| 4. Number of Leaking Underground Storage Tanks (USTs) |
| 5. Number of Pesticide Application Sections |

The number of public supply wells within a basin/subbasin is chosen as the primary factor for prioritizing basins/subbasins because it is a direct present measure of the importance of groundwater as a drinking water resource. In addition, public supply well information is relatively comprehensive and readily available in the DHS database.

Other factors that contribute to the groundwater basin/subbasin prioritization are providing for representation of the range of hydrogeologic conditions in the state and efficiencies associated with grouping neighboring basins/subbasins.

Using the factors described above, six categories have been developed for the purposes of basin prioritization. These categories are shown below:

| Prioritization Category | Basis for Prioritization |
|---|---|
| **1 and 2 (Priority Basins)** | Number of Public Supply Wells |
| **3 and 4 (Priority Basins)** | Number of Public Supply Wells, plus additional factors. |
| **5** | Non-Basin Groundwater-Use Areas (mountainous) |
| **6** | Low Groundwater-Use Basins |

Four categories of priority basins were recognized (see table in Appendix D). Category 1 and 2 basins were selected based on the number of public supply wells. Category 3 and 4 basins were selected based on the number of wells and secondary factors.

The four priority categories (Categories 1 - 4) include 116 basins. These 116 basins include 75 percent of all public supply wells in California, and 95 percent of all public supply wells that are located in groundwater basins. The 116 priority basins also include 98 percent of the municipal pumping, nearly 90 percent of the agricultural pumping, 70 percent of the USTs, and 70 percent of the square-mile sections with pesticide applications.

A fifth, "non-basin groundwater-use areas," category (Category 5) accounts for the groundwater resource that occurs "outside" of mapped basins (e.g., mountainous regions of the state). About 20 percent of all public supply wells in California are located outside of mapped groundwater basins. In addition, about 20 percent of the leaking tanks and 20 percent of the square mile sections with pesticide applications are located outside of mapped groundwater basins.

A sixth category (Category 6) is recognized to account for the 356 low groundwater-use basins. Although these basins account for about 40 percent of the total area mapped as groundwater basins, they account for lesser amounts of the used or potentially impacted resource. These low groundwater-use basins account for about 5 percent of the public supply wells, 2 percent of the municipal pumping, 12 percent of the agricultural pumping, 10 percent of the leaking underground fuel tanks, and 10 percent of the square-mile sections with pesticide applications. About 200 of the 356 low groundwater-use basins have no public supply wells.

**Groundwater Quality Constituents**

A variety of constituents may be sampled in groundwater. A tiered approach that targets constituents is recommended that balances analytical intensity with spatial coverage and cost, and is iterative in time to allow reconsideration of the analytical objectives of the Comprehensive Groundwater Quality Monitoring Program.

The constituents considered for analyses address three specific goals:

- Protection of beneficial uses, including use as drinking water or for agriculture;
- Interpretation of processes controlling water quality and groundwater flow (using environmental tracers such as age-dating and environmental isotopes and low-level VOC analyses); and
- Detection of unregulated compounds (unregulated chemicals requiring monitoring or UCRMs) that have been identified as potential concerns, the so-called "emerging contaminants."

AB 599 requires the Comprehensive Groundwater Quality Monitoring Program to maximize the use of existing data, cover drinking water contaminants, and be comprehensive. Existing groundwater programs collect data on some of the above categories, but no statewide program collects data on all of these categories.

One example of a groundwater program that samples for a broad range of constituents is the SWRCB's GAMA Program. As described in Chapter 2, GAMA was designed to assess the water quality and relative susceptibility of groundwater to surface contamination that serves as a source for public drinking water supplies. The SWRCB, with assistance from the USGS and LLNL, collects data to evaluate the use of environmental tracers, including groundwater age-dating and low-level VOC concentrations, as indicators of the susceptibility of groundwater to contamination. Age-dating provides information on the presence of young, presumably more susceptible to contamination, groundwater and low-level VOC analysis provides an "early warning" for potential VOC contamination.

The three tiers of constituent coverage intensity for the Comprehensive Groundwater Quality Monitoring Program are shown below:

| Tier | Constituent Coverage |
|---|---|
| **I** | **Low Intensity**–<br>Selected wells will be assessed using information from the existing DHS analytical results database. |
| **II** | **Moderate Intensity**–<br>A subset (approximately 75 percent) of the selected basin wells is to be analyzed for GAMA constituents and pesticides. GAMA constituent analyses include low-level VOCs and age-dating. |
| **III** | **High Intensity**–<br>A subset (approximately 25 percent) of the selected basin wells is to be analyzed for the USGS NAWQA suite of constituents and emerging contaminants. |

The three tiers of constituent coverage intensity (mentioned above) are proposed for the statewide groundwater monitoring network. Due to the high cost of laboratory analyses for some environmental tracers and emerging contaminants, it is not feasible to be comprehensive for both spatial and analytical intensity. Tiering the constituent intensity balances the need to achieve comprehensive spatial coverage with the desire to obtain comprehensive constituent coverage.

This tiering will result in spatially comprehensive data for DHS required constituents, which are currently analyzed at public supply wells, and somewhat decreased spatial coverage for Tiers II and III. Data necessary for protection of beneficial uses (Tier I) will

be the most spatially comprehensive. Environmental tracers will be sufficiently dense to develop an understanding of processes controlling the geochemical evolution and groundwater flow on a regional and basin scale; and the ability to identify threats of emerging contaminants to groundwater quality will be attained on a regional scale.

**Groundwater Quality Trend Assessment**

Assessing whether or not groundwater quality is improving or degrading requires a systematic approach. Because of the relatively slow rate of groundwater movement in some basins, frequent sampling is often unnecessary. There is the potential for seasonal variability in shallow systems with rapid transport, but these cases are generally rare and beyond the scope of the Comprehensive Groundwater Quality Monitoring Program. To assess groundwater quality trends, re-sampling a subset of the wells analyzed with the "high intensity" constituent tier every three years will provide a general picture of the change (improvement or degradation) in groundwater quality.

It is important to note that when a public supply well is taken out of service for water quality reasons, typically monitoring at the well is discontinued. Thus, an important groundwater monitoring point is lost. In many cases, these wells may have had MCL exceedences. These wells are removed from service and placed on inactive status or in some cases, destroyed. To date, approximately one-third of the state's public supply wells has been taken out of service (approximately 8,000 of 24,000 public supply wells). Because these wells are no longer monitored, it gives the impression that the number of wells exceeding MCLs is declining. A means to continue to monitor these wells is necessary, especially for the Comprehensive Groundwater Quality Monitoring Program.

The effort to describe trends makes extensive use of the second tier of analytical intensity: constituents analyzed to aid in interpretation of chemical processes and groundwater flow (i.e., low-level VOCs and age-dating). The trends assessment will also be greatly enhanced when comprehensive water quality for wells in the shallower portion of the major aquifers (domestic and monitoring wells) are available in digital format.

The GAMA program recognized the value of public supply wells used in a monitoring network to assess groundwater that is used for drinking water purposes. By enhancing the analytical information already collected by the local purveyors, GAMA further analyzes for low-level VOCs and age-dating in order to assist in assessing the hydrogeology in areas that are vulnerable to surface contamination as well as be an early warning indicator of impacts. The GAMA program has already begun to assess these high priority areas as shown on Figure 6.

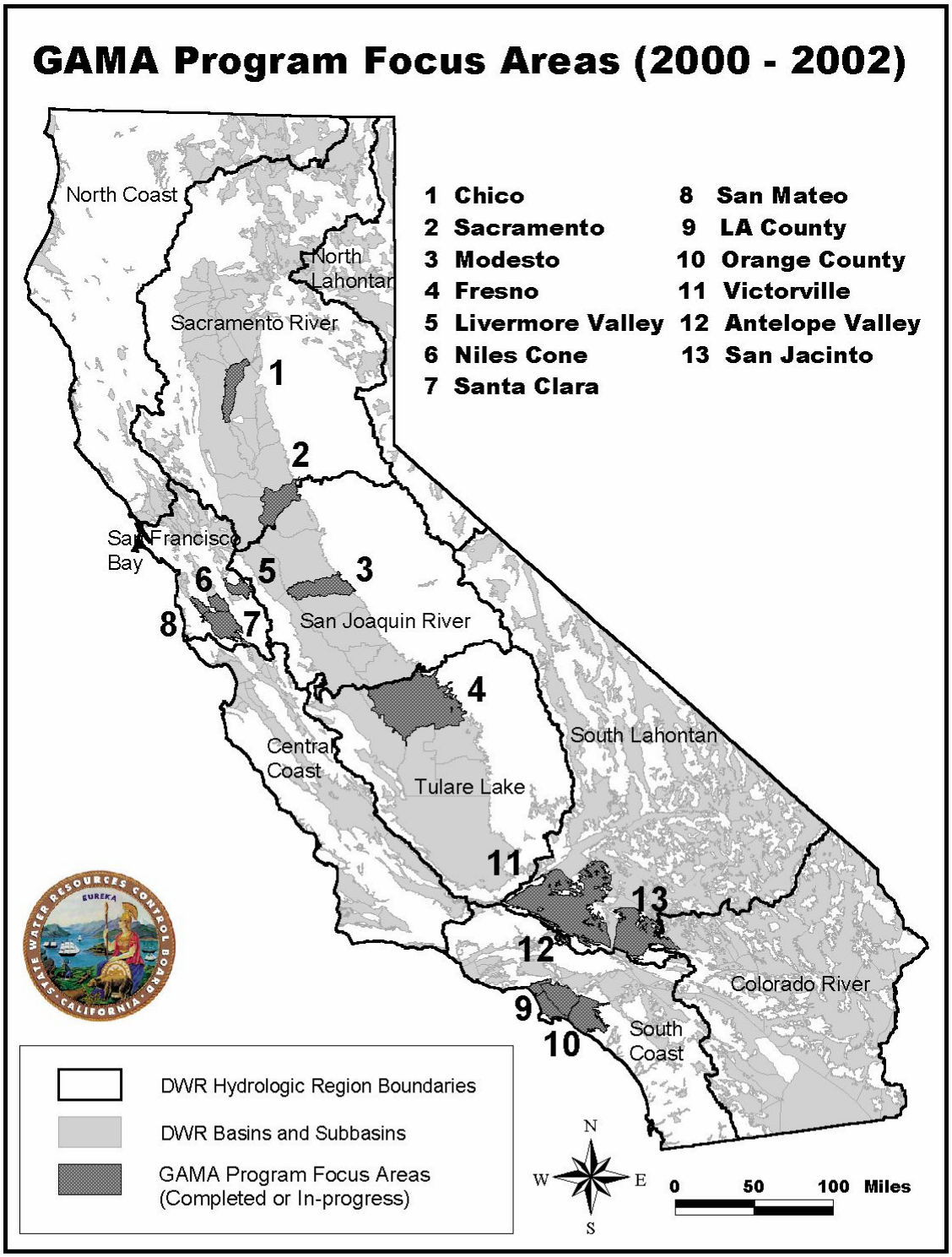



*Figure 6 – SWRCB GAMA Focus Areas*

**Monitoring Frequency Overview**

A ten-year overview of the Comprehensive Groundwater Quality Monitoring Program is shown on the following page. Monitoring and assessments for priority groundwater basins/subbasins (Categories 1- 4) are to be completed every ten years (see Table on following page). In the first three years, assessments for at least two groundwater areas outside basins (Category 5) will also be completed.

As previously described, selected wells will be sampled for Tier I, II, and III constituents. For basins that have already been assessed, three-year trend assessment will be performed on 10 percent of the selected wells. In addition, five-year assessment reviews of basins/subbasins analyzed to date will be conducted.

Category 6 (low groundwater-use basins) and remaining groundwater areas outside basins
(Category 5) will be monitored and assessed, as funding becomes available. Individual Category 6 basins/subbasins could move up in priority depending on future use and vulnerability.

| Ten-Year Overview: Comprehensive Groundwater Quality Monitoring Program | | | | |
|---|---|---|---|---|
| **Year** | **Groundwater Basins/Subbasins Priority[1]** | | **Constituents[2, 3]** | **Assessments/Reports[4]** |
| | Categories 1-4 | Categories 5-6 | | |
| **1** | ◆ | | ✓ Tier I, II, III | ✓ Data Summary |
| **2** | ◆ | | ✓ Tier I, II, III | ✓ Data Summary<br>✓ Biennial Groundwater Report |
| **3** | ◆ | ◆ | ✓ Tier I, II, III<br>✓ 3-Year Trend | ✓ Data Summary |
| **4** | ◆ | | ✓ Tier I, II, III | ✓ Data Summary<br>✓ Biennial Groundwater Report |
| **5** | ◆ | | ✓ Tier I, II, III | ✓ Data Summary<br>✓ 5-Year Assessment Review |
| **6** | ◆ | | ✓ Tier I, II, III<br>✓ 3-Year Trend | ✓ Data Summary<br>✓ Biennial Groundwater Report |
| **7** | ◆ | | ✓ Tier I, II, III | ✓ Data Summary |
| **8** | ◆ | | ✓ Tier I, II, III | ✓ Data Summary<br>✓ Biennial Groundwater Report |
| **9** | ◆ | | ✓ Tier I, II, III<br>✓ 3-Year Trend | ✓ Data Summary |
| **10** | ◆ | | ✓ Tier I, II, III | ✓ Data Summary<br>✓ 5-Year Assessment Review<br>✓ Biennial Groundwater Report |

1) Five to ten Category 1-4 groundwater basins will be monitored each year; at least two groundwater areas outside basins (Category 5) will be monitored in the first 3 years; and Categories 5 and 6 groundwater areas and basins/subbasins will be monitored as resources permit.
2) Each groundwater basin will be monitored for Tier I, II, and III constituents. Tier I or "Low Intensity" uses information from the existing DHS analytical database for the selected wells. Tier II or "Moderate Intensity" uses GAMA and pesticides analyses for a subset (approximately 75%) of the selected wells. The GAMA analytical suite consists of low-level VOC and age-dating analyses. Tier III or "High Intensity" uses the USGS NAWQA and emerging contaminant analyses for a subset (approximately 25%) of the selected wells.
3) 3-Year Trend Assessments will be based on monitoring approximately 10% of the selected wells (from previously monitored basins).
4) Finalized groundwater data will be posted to the Internet, in coordination with local groundwater agencies and water purveyors. Results will also be presented in the Biennial Groundwater Report. A 5-Year Assessment Review to be conducted for groundwater basins with completed assessments.

**Groundwater Resource Assessment**

In addition to water quality data, water use information is essential for making informed decisions in both protecting and optimizing the use of the groundwater resource. Despite California's reliance on groundwater, basic water use information is lacking for many of the state's groundwater basins. For example, how much groundwater is stored in the basin or what is known about the actual quantity of groundwater extracted from the basin? Developing this information on a statewide basis is the responsibility of DWR.

The Bulletin 118 report prepared by DWR evaluates the quantity of the groundwater resource statewide. *California's Ground Water – Bulletin 118* was originally published in 1975 and represented the first comprehensive attempt to summarize available resource information on California's groundwater basins. The Bulletin contains a summary of technical information for the majority of identified groundwater basins including maps showing their location and surface extent.

In the Budget Act of 1999, the California Legislature mandated that DWR prepare a statewide update of the Bulletin 118 inventory of groundwater basins. The information specified by the Legislature can complement the AB 599 water quality assessments including:

- review and summary of boundaries and hydrographic features
- well yield data
- well production characteristics
- water level monitoring
- development of a water budget for each groundwater basin
- recharge capability

The information on groundwater basins which will be presented in the forthcoming Bulletin 118 Update 2003 is mostly limited to the acquisition and compilation of existing data previously developed by federal, state, and local water agencies.

While the data provided by Bulletin 118 Update 2003 will serve as a useful starting point for understanding the "quantity" part of a basin assessment, there is still a significant amount of work needed for statewide basin assessments. For example, because of a lack of data, DWR was unable to compile a water budget for each groundwater basin or subbasin. Instead, DWR reported on the level of water budget information available by creating three categories: 1) basins with enough information to estimate most basin inflows and outflows; 2) basins where only groundwater extraction could be estimated based on overlying land-use information; and 3) basins where almost no water budget-related information was available.

Preliminary estimates indicate that only about 20 percent of the state's basins and subbasins have a high level of water budget information, about 20 percent have an estimate of groundwater extraction, and about 60 percent have little or no water budget information. The adequacy of the resource-related data from Bulletin 118 will need to be evaluated for each basin when the basin undergoes its water quality assessment.

In summary, water budget information is an essential component to understanding, protecting and optimizing the use of groundwater resources. Completion of water budgets should parallel completion of AB 599 groundwater quality assessments.

**Data Gaps and Additional Data Needs for a Comprehensive Groundwater Quality Assessment**

The Comprehensive Groundwater Quality Monitoring Program focuses on areas of groundwater use. Areas do exist in California where groundwater occurs but is not significantly used.

The approach described in this report aims to provide the most comprehensive groundwater quality assessment in a cost-effective manner. It is not feasible, nor possible, to detect every constituent everywhere. Thus, the Comprehensive Groundwater Quality Monitoring Program is limited by the constituents it samples for at specific detection limits. Additional constituents of concern are likely to occur and go undetected. Similarly, constituents may occur at concentrations below which they can be detected. It is important to recognize these as potential data gaps.

Furthermore, any groundwater quality assessment will be limited if no ancillary (additional) data are available. At a minimum, well characteristics are necessary for a basic groundwater assessment, including well depth, screened interval, and other related data. Some of these data have been added to the DHS database, as part of the DWSAP program. To raise the level of assessment, hydrogeologic and hydrologic information is necessary (i.e., depth to groundwater level measurements, aquifer characteristics, sources of recharge, and water use). Much of this information is available on well driller's logs and recent efforts by DWR to scan well logs are a helpful first step, which should be followed by a systematic digital representation of the scanned logs (database). This will be take a significant amount of time and should be prioritized to support the sequence of groundwater basin/subbasin assessments.

It may be possible to enlist the aid of geology graduate students from the University of California and California State University to digitize water well log information as part of the preparation of the hydrogeologic assessments. Digitized data could then be input into Geotracker. Funding higher education in this manner would benefit both the student and the citizens of the state.

In addition, information on the location of potential contaminant sources is essential. State regulatory programs currently collect data on the location of contaminant (point) sources, and these data should be digitally available. Spatial distribution of nonpoint sources has been difficult to quantify in the past. The exception to this is the outstanding database on pesticide application created by DPR that has proved to be of enormous value to investigators in a variety of environmental fields. The location of other nonpoint source contaminants is usually inferred from land use, and the current digital coverage of past land use created by DWR is invaluable in this regard. Because past land use practices may have had a lasting impact on groundwater quality it is recommended that DWR digitize historical land use information for use in future water quality assessments.

# CHAPTER 5
# FINDINGS AND RECOMMENDATIONS

As discussed in Chapter 1, AB 599 identifies specific tasks to be accomplished in preparation of a comprehensive groundwater monitoring program. As directed by AB 599, the SWRCB convened an Interagency Task Force and a Public Advisory Committee to address these tasks in greater detail. Based on the data and analyses presented in earlier chapters, in order to better understand – and thereby enable ourselves to better manage and protect – California's vital groundwater resources, the ITF and PAC make specific findings and recommendations discussed in detail at the end of this chapter. These specific findings and recommendations are captured in the following five integrated elements:

- **Accelerate the groundwater ambient monitoring and assessment (GAMA) program established by the SWRCB**. This program relies on enhancing the water quality information collected in existing public supply wells through age-dating and testing at a subset of those wells for very low levels of organic chemicals. The GAMA program methodology should be the basis for developing consistent hydrogeologic assessments for each basin/subbasin in accordance with the prioritization set forth in Chapter 4.

- **Conduct the monitoring and assessment program in accordance with the prioritization of basins/subbasins** set forth in Chapter 4 of this report. The prioritization is based on water use. Water use criterion places those basins most heavily used for drinking water in first priority.

- **Increase coordination among groundwater agencies.** To the extent that multiple agencies continue to monitor groundwater quality, efforts should be made to coordinate their roles and share data.

- **Maintain groundwater quality information for conducting monitoring and assessments in the SWRCB's Geotracker database** as described in Chapter 3. This Internet accessible database already stores all water quality information submitted to the Department of Health services by public water purveyors as well as groundwater contaminant information for over 40,000 cleanup sites.

- **Provide the public with useful access to groundwater monitoring and assessment information**, while maintaining appropriate security measures. Recommendations for public access are described in Chapter 5.

The specific findings and recommendations put forward by the PAC and ITF that support these elements are discussed in detail below.

## I. Integrate existing programs and design new elements to establish a program capable of assessing each groundwater basin through direct and other statistically reliable sampling approaches.

**Findings:**

1. There are several state agencies (DHS, DWR, DPR, SWRCB, and DTSC) that monitor or collect groundwater information as identified in Chapter 2.
2. Only SWRCB (GAMA Program) and DPR conduct ambient groundwater assessments.
3. The information from all these programs is valuable and in many instances is comprehensive within their scope.
4. A comprehensive groundwater quality monitoring and assessment program includes three elements: data management, monitoring (sampling and analyses of water wells), and groundwater basin assessment.
5. The Comprehensive Groundwater Quality Monitoring Program (as described in Chapter 4) is capable of assessing each groundwater basin in the state through integrating information from existing programs and adding new elements where necessary.

**Recommendations:**

1. Expand existing groundwater programs, by implementing the Comprehensive Groundwater Quality Monitoring Program, described in Chapter 4.
2. Fund collection of data from existing wells in the shallow groundwater zone (DPR, DTSC, SWRCB, and RWQCBs).
3. Fund and offer training to local agencies for interpretation and assessment of their local groundwater information.

## II. Determine the constituents to be included in the recommended program.

**Findings:**

1. DHS requires public supply wells to be sampled for a wide range of constituents in order to protect public health.
2. SWRCB's GAMA program has determined that age-dating and low-level VOC analyses provide good indicators for well vulnerability as well as a better understanding of hydrogeologic conditions.
3. Constituents of interest will vary based upon the water quality concerns of each groundwater basin.

**Recommendation:**
Rely primarily on the water quality constituents that are currently required and those that are proposed for analysis by DHS. Consistent with the GAMA Program, develop a monitoring regime for a subset of wells, to include age-dating, lower detection levels for VOCs, and a broader range of constituents based on the water quality concerns of a given groundwater basin.

## III. Incorporate existing data and assess if additional monitoring is necessary.

**Findings:**

1. The DHS database contains detailed water quality information for over 11,000 of the 16,000 public supply wells. Additional groundwater quality information is available from local agencies and other state agencies. Most of this information is in printed-paper format.
2. As part of SWRCB's Geotracker, electronic data are now available from tens of thousands of groundwater monitoring wells, linked to sites with contamination.
3. Public supply wells that have poor water quality, including exceeding MCLs, are usually taken out of service and placed on inactive status. In some cases, the wells are destroyed. This action results in a reduction of wells monitored for water quality and leads to an impression that the water quality in the basin is improving.
4. Additional monitoring wells may need to be installed, consistent with criteria identified in Chapter 4 and elsewhere in this report, as necessary to supplement monitoring in some areas of the state.

**Recommendations:**

1. Complement existing groundwater data with a broader range of constituents. Monitoring for a larger suite of analytes at lower detection limits and using innovative analyses, such as age-dating, will aid in the detection of emerging contaminants of concern.
2. Evaluate and incorporate historical groundwater data in an electronic format, as resources become available to perform this task. These data will complement the existing groundwater data already captured in Geotracker
3. Provide incentives or funding to water purveyors to maintain inactive wells for monitoring purposes.

## IV. Prioritize groundwater basins that supply drinking water.

**Findings:**

1. Of the more than 16,000 public supply wells, approximately 75 percent are located in 472 groundwater basins (and subbasins). The remaining wells are located outside groundwater basins, typically in mountainous areas.
2. The 472 groundwater basins/subbasins, as well as areas outside of these basins, can be prioritized using a variety of factors including: groundwater use, population served, number of wells per basin, and number of potentially contaminating activities (number of leaking USTs, and number of sections having pesticide application).
3. Regardless of the factor chosen, the resulting prioritization of basins, tended to remain the same (see discussion in Chapter 4).

**Recommendations:**

1. Conduct groundwater basin monitoring and assessment consistent with prioritization of basins described in Chapter 4.
2. Complete monitoring and assessments for priority basins (Categories 1-4, 116 basins), every 10 years, as described in Chapter 4. The recommended program assesses the groundwater basins that account for over 75 percent of all public supply wells in the state and over 90 percent of all groundwater use. In the first three years, complete assessments for at least two groundwater areas outside basins (Category 5). For basins that have been assessed, implement three-year trend assessment at 10 percent of selected wells and conduct five-year assessment reviews of basins.
3. Monitor and assess Category 6 (low groundwater-use basins) and remaining areas outside basins (Category 5), as funding becomes available. Individual Category 6 basins could move up in priority depending on future use and vulnerability.

## V. Identify measures to increase coordination among state and federal agencies and, as necessary, restructure existing groundwater monitoring programs.

**Findings:**

1. All state agencies with groundwater monitoring programs participate in the current Interagency Task Force. Each of the existing groundwater monitoring programs address specific legislative mandates. As part of a Comprehensive Groundwater Quality Monitoring Program, it is important to increase coordination efforts among the various groundwater agencies. Groundwater monitoring information is generated primarily through compliance and assessment monitoring. For example, water purveyors supply water quality data to DHS, while parties responsible for the clean up of contamination sites provide monitoring well data to regulatory agencies (DTSC, RWQCB).

2. Statewide groundwater quality data are described in two reports: SWRCB's 305(b) report and DWR's Bulletin 118. Section 305(b) of the Clean Water Act does not require that states conduct or report on groundwater quality assessments. However, SWRCB's most recent 305(b) report describes groundwater quality for each basin showing drinking water standard exceedences in public supply wells. DWR's Bulletin 118 was published in 1975 and is being updated in 2002. Like the 305b report, the update includes a compilation of groundwater quality data by basin.

**Recommendations:**

1. The SWRCB, in consultation with the PAC and ITF, should implement the Comprehensive Groundwater Quality Monitoring Program (as described in this report). In coordination with Cal/EPA, the SWRCB should hold periodic program implementation reviews.
2. Permanently establish the Interagency Task Force of state agencies with groundwater responsibilities to ensure ongoing integration of existing programs.
3. Permanently establish the Public Advisory Committee to provide policy level recommendations to the SWRCB. The Legislature should consider that the PAC meet at least quarterly.
4. Replace and incorporate the elements of SWRCB's 305(b) and DWR's Bulletin 118 reports into a single document (California Groundwater Report). The report would be prepared biennially and jointly by DWR (groundwater use) and SWRCB (groundwater quality). The report would include both statewide and basin-specific descriptions and assessments.
5. The DWR should complete water budgets in conjunction with the AB 599 water quality assessments of groundwater basins.
6. As monitoring and assessments are completed, and after notifying the well owners, the information should be posted on the Internet with appropriate security measures in place.
7. The Comprehensive Groundwater Quality Monitoring Program should provide for the use of common groundwater terminology in California.
8. The monitoring program activities should be implemented in close coordination with local agencies.

## VI. Design a database compatible with Geotracker to support the program.

**Findings:**

1. Millions of dollars are spent annually by public and private organizations to collect and maintain groundwater data.
2. Government agencies and organizations that collect, maintain, and provide groundwater data independently adopt their own data collection standards and database structures. Uniform data collection, data management, and data transfer standards would bridge the gap between user and provider. Uniform

standards would greatly reduce the time required to transform and reformat, would reduce the possibility of misinterpretation of data, and maximize the utility of all these data in the future.

3. Efficient maintenance of a comprehensive groundwater quality database requires electronic submittal of data.
4. SWRCB's groundwater quality database (Geotracker) is capable, with appropriate modifications, of supporting the Comprehensive Groundwater Quality Monitoring Program.
5. SWRCB regulations require responsible parties of leaking underground storage tank cleanup sites to submit groundwater monitoring well data in a specific electronic data format.
6. State agencies provide grant funds to local agencies for groundwater management activities. Groundwater monitoring is often a component of these activities.
7. Groundwater basin assessments require a hydrogeologic understanding of the basin. Hydrogeologic understanding is based on interpretation of lithologic logs of the wells in the basin. DWR is currently making electronic scans of these logs. However, the information from the logs needs to be entered into a database and interpreted.
8. Many groundwater supply agencies lack the available resources to analyze and fully integrate their own monitoring programs.
9. Some local agency well data are not part of the DHS database. Local agencies should consider voluntarily providing groundwater monitoring data to the statewide database.
10. Data management and compatibility are the foundation to the program. This will lead to better assessments, increased knowledge, and better coordination with agencies.
11. The DHS water quality database (WQM/WQI) receives most of its data from water suppliers. All water suppliers are required to submit water analyses data electronically.
12. There are inefficiencies from the lack of coordination among agencies.

**Recommendations:**

1. Expand the SWRCB's Geotracker as the database for housing, managing, and assessing groundwater information for the Comprehensive Groundwater Quality Monitoring Program.
2. Require that groundwater data associated with state funding be submitted to the appropriate state agency.
3. Require that all groundwater data supplied to state agencies be submitted electronically in a consistent format.
4. Provide database query tools in Geotracker to groundwater supply agencies. Additionally, a data analysis "tool kit," which shall be public domain, should be written in commercially available software.
5. Modify Geotracker to be the Program's comprehensive database.

6. Populate Geotracker with data from multiple agencies and programs within one year of the inception of the Program. Update the database at least annually thereafter.
7. Input well construction and digitized lithologic information from the scanned well logs into a database compatible with Geotracker.
8. ITF should conduct a review of SWRCB's adopted data format for groundwater monitoring at sites with contamination for application to groundwater monitoring for basin assessment.
9. Develop a standard data format for electronic submittal of groundwater monitoring data by May 1, 2004, and begin a stakeholder process to find the best format to develop the implementation of the electronic format.
10. Develop and adopt data collection and transfer methods and formats. The methods should include tabular groundwater and geologic data, and spatial mapping. Spatial mapping includes groundwater level contours, aquifer yield, and contaminant plume maps usually stored in a GIS or computer aided drafting system (CAD).
11. The state should provide incentives or make funding available to the local agencies to cover costs associated with groundwater data submittal.

## VII. Identify the means to make monitoring information available to the public.

**Findings:**

1. All water supply agencies are required to annually prepare Consumer Confidence Reports that summarize water quality information on supplied water. All water supply agencies that serve 100,000 or more persons are required to post their Consumer Confidence Report on the Internet. In addition, several smaller agencies have voluntarily posted their report on the Internet. A link to the water supply agencies is provided on the DHS website.
2. While access to public supply well location and well log information is confidential, all water quality data are available to the public.
3. All water supply agencies are required to have a source water assessment done on each of their sources by May 2003. These assessments are required to be available to the public through the water system or the DHS (for smaller water suppliers). A brief description of the assessment for the water supply agency will be provided in the Consumer Confidence Report and will provide information on the major potential contaminating activities located in close proximity to the sources.

**Recommendations:**

1. Continue to make groundwater quality information from public supply wells available on the Internet through Geotracker.
2. Make water quality assessments of groundwater basins easily accessible to the public.
3. Create a groundwater quality information webpage with links to statewide documents such as the 305(b) report, Bulletin 118, and other published

documents. When available, provide a weblink to the California Groundwater Report.
4. Guide users to appropriate weblinks depending on public or domestic supply and use existing links to the water purveyor's consumer confidence reports.
5. Refer groundwater quality questions from the public back to the appropriate water purveyor or state or local agency.
6. Present groundwater data and information to the public in the proper context and in layperson language.

## VIII. Estimate funding necessary to implement the program and recommend an ongoing source of funds.

**Findings:**

1. The State Budget appropriates funding for state programs. Funding sources for water quality programs typically include fees levied on permittees, federal grants, storage fees (UST Cleanup Fund), reimbursements from responsible parties for regulatory cleanup oversight, bonds approved by the voters, and general funds from tax revenues.
2. The General Fund has supported ambient groundwater monitoring and assessment activities.
3. The Comprehensive Groundwater Quality Monitoring Program, described in Chapter 4, requires a stable funding source.
4. Proposition 50 of 2002 provides funding for groundwater monitoring.

**Recommendations:**

1. Use funds from Proposition 50 to support the Comprehensive Groundwater Quality Monitoring Program for the first 10 years. The minimum effort for the Comprehensive Groundwater Quality Monitoring Program should be the $50M program, as described in Chapter 4.
2. By Year 3, the PAC should recommend ongoing funding sources for program operation.

## IX. Develop a ranked list of actions to increase the effectiveness of monitoring.

**Findings:**

1. The current level of groundwater monitoring is not adequate to comprehensively assess the groundwater quality of California.
2. The Comprehensive Groundwater Quality Monitoring Program must be implemented over a number of years.
3. The SWRCB endorses the recommended Comprehensive Groundwater Quality Monitoring Program (Chapter 4).
4. The PAC and the ITF should annually review the Comprehensive Groundwater Quality Monitoring Program status and recommend appropriate revisions, if necessary, to the SWRCB.

**Recommendations: (See next page)**

## IX. Recommendations:

The SWRCB recommends the following monitoring program:

| STATUS | ACTIONS | LEAD AGENCIES | COSTS |
|---|---|---|---|
| **Proposed New** | **Monitor and Assess Basins in Categories 1 – 4 and at least two areas outside basins (Category 5) - Covers 75% of all public supply wells and 90% of groundwater use** (IV, Recommendation (Rec.) #1 and #2) | | |
| | **Data Collection and Management** | SWRCB | $3M |
| | **Monitoring** | | $28.1M ($240K/basin) |
| | **Groundwater Basin Assessment** | | $17.3M ($150K/basin) |
| | **Ongoing Monitoring & Trend Assessment** | | Monitoring $1M ($100K/yr)<br>Midterm Assessment $600K |
| | **Ten Year Costs for Recommended Program** | | **$50M** |
| | **Monitor & Assess Basins in Category 6 (low groundwater-use) and remaining Category 5 areas - Covers remaining groundwater-use areas** (IV, Rec. #3) | | |
| | **Data Collection and Management** | SWRCB | -- |
| | **Monitoring** | | $33.9M ($143K/basin) |
| | **Groundwater Basin Assessment** | | $1.7M ($160K/basin-province) |
| | **Ongoing Monitoring & Trend Assessment** | | Monitoring $6M ($600K/yr)<br>Midterm Assessment $800K |
| | **Ten Year Costs in addition to Recommended Program** (to be performed if funding becomes available to monitor low-groundwater-use basins) | | $42.4M |
| | **Total Cost for both the Recommended Program and remaining groundwater-use areas** | | $92.4M |
| **STATUS** | **ACTIONS** | **LEAD AGENCIES** | **COSTS** |
| **Current** | **Continue to maintain and fund the existing groundwater assessment programs.** (I, Rec. #1) | DPR, DWR, SWRCB | See Tables in Appendix |

| STATUS | ACTIONS | LEAD AGENCIES | COSTS |
|---|---|---|---|
| **Proposed New** | **Improve Groundwater Information Management** | | |
| | • Provide to water supply agencies database query tools in Geotracker. Additionally, a database analyses tool kit, which shall be public domain, should be written in commercially available software. Provide training (or FAQs) for laboratories and water suppliers. (VI, Rec. #9) | SWRCB | Existing Program |
| | • Continue to populate Geotracker data from multiple agencies and programs. (VI, Rec. #4) | SWRCB | Existing Program |
| | • Require that groundwater data associated with state funding be submitted to the appropriate state agency. (VI, Rec. #1) | DWR, SWRCB | -- |
| | • Require that all groundwater data supplied to state agencies be submitted electronically. (VI, Rec. #2) | DWR, SWRCB DTSC, DHS | -- |
| | • ITF should conduct a review of SWRCB's adopted data format for groundwater monitoring at sites with contamination for application to groundwater monitoring for basin assessment. ITF should recommend a standard data format for electronic submittal of groundwater monitoring data for basin assessment. (VI, Rec. #6,7) | DWR, DTSC, DHS | Costs to laboratories and water suppliers |
| | • Put into electronic format well log data (lithology and construction) for public supply wells. Populate Geotracker with these data in addition to monitoring well data from DTSC and RWQCB cleanup sites and local water agency data, where available. (VI, Rec. #5) | SWRCB, DWR (UC/CSU) | $4M |

| STATUS | ACTIONS | LEAD AGENCIES | COSTS |
|---|---|---|---|
| **Proposed New** | **Make Groundwater Information Available to Public** | | |
| | • Create a California Groundwater Quality information webpage with link to 305(b) report, and Bulletin 118, and other published documents. (VII, Rec. #1) | SWRCB | Existing Program Staff |
| | • Guide user to appropriate weblinks depending on public or private domestic supply. (VII, Rec. #2) | SWRCB | |
| | • Provide weblink to California Groundwater Report. (IX, Rec. #4) | SWRCB | |
| | **Increase Coordination among State and Federal Agencies** | | |
| | • Continue the Interagency Task Force to ensure ongoing integration of existing programs in accordance with the AB 599. (V, Rec. #3) | ITF Agencies | Existing Programs |
| | • Continue the Public Advisory Committee to provide input to the Interagency Task Force. (V, Rec. #4) | PAC Member Agencies | $10K |
| | • Replace and incorporate the elements of SWRCB's 305(b) and DWR's Bulletin 118 reports into a single document (California Groundwater Report). The report would be prepared jointly by DWR (groundwater use) and SWRCB (groundwater quality). The report would include both statewide and basin-specific descriptions and assessments. (V, Rec. #5) | DWR SWRCB | SWRCB: Existing Staff DWR: $1.2M/yr for 10 yrs* |

| STATUS | ACTIONS | LEAD AGENCIES | COSTS |
|---|---|---|---|
| **Proposed New** | **Pursue Ongoing Funding Mechanism** (VIII, Rec. #1 and #2)<br><br>• Use funds from Proposition 50 to support the Program for the first 10 years.<br><br>• Within the first three years of the recommended Program, the PAC will recommend ongoing funding sources for program operation beyond the tenth ($10^{th}$) year. | SWRCB | -- |

# LIST OF ABBREVIATIONS

AB .....Assembly Bill
Cal/EPA .....California Environmental Protection Agency
CAS.....California Aquifer Susceptibility Assessment
CDFA.....California Department of Food and Agriculture
DHS.....Department of Health Services
DLR .....Detection Limit for Reporting Purposes
DPR.....Department of Pesticide Regulation
DTSC .....Department of Toxic Substances Control
DWR .....Department of Water Resources
DWSAP.....Drinking Water Source Assessment and Protection (i.e., DHS SWAP)
FY .....Fiscal year
GAMA .....Groundwater Ambient Monitoring and Assessment Program
GIS .....Geographic information system
ITF.....Interagency Task Force
ITFM.....Intergovernmental Task Force on Monitoring
LLNL .....Lawrence Livermore National Laboratory
LRL.....Laboratory Reporting Level
LUFT.....Leaking Underground Fuel Tanks
MCL .....Maximum Contaminant Level
MRL .....Method Reporting Limit
MTBE .....Methyl tertiary-butyl ether
NAWQA .....National Water Quality Assessment Program
NPDES.....National Pollutant Discharge Elimination System
OEHHA.....Office of Environmental Health Hazard Assessment
PAC.....Public Advisory Committee
PHG.....Public Health Goal (set by OEHHA).
PY .....Personnel year
QA/QC .....Quality Assurance/Quality Control
RWQCB.....Regional Water Quality Control Board
SWRCB.....State Water Resources Control Board
UCRM.....Unregulated Chemicals Requiring Monitoring
USEPA.....U.S. Environmental Protection Agency
USGS .....U.S. Geological Survey
UST .....Underground Storage Tank
VOC .....Volatile Organic Compound
WDR .....Waste discharge requirements

# GLOSSARY

**ABANDONED WELL**: A groundwater well that is no longer used. (See destroyed well).

**ACRE-FEET**: A common unit of measure in hydrology that defines the amount of water required covering one acre one foot deep. Abbreviated as ac-ft.

**ACTION LEVEL (AL)**: Health-based advisory level established by DHS for chemicals in drinking water that lack a maximum contaminant level (MCL). Chemicals for which ALs are established may eventually be regulated by MCLs, depending on the extent of contamination, the levels observed, and the risk to human health.

**AMBIENT MONITORING**: Any activity in which information about the status of the physical, chemical, and biological characteristics of the environment is collected to answer specific questions about the status and trends in the characteristics.

**ASSESSMENT REPORT**: A comprehensive record of historical, existing and projected water quality conditions of a watershed.

**AQUIFER**: A saturated permeable geologic unit that yields usable quantities of water to wells or springs.

**BENEFICIAL USE OF WATER**: Regulatory definitions of the resources, services, and qualities of specific water bodies that are the ultimate goals of protecting and achieving high water quality. These include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

**COMPLIANCE MONITORING**: Monitoring to determine if a specific discharger is meeting the requirements established in Waste Discharge Requirements WDRs, NPDES permits, or water quality certifications.

**CONCENTRATION**: Amount of material dissolved in a solution; a common unit is mg/L (milligrams of dissolved material in a liter of solution).

**CONFINED GROUNDWATER**: A body of groundwater (aquifer) covered (overlain) by a confining layer of low permeability geologic material.

**CONTAMINATION**: An impairment of the quality of the waters of the state by waste that creates a hazard to the public health.

**DESTROYED WELL**: An abandoned well that has been destroyed in accordance with California State Well Standards in order to protect groundwater bodies.

**DETECTION LIMIT FOR REPORTING PURPOSES (DLR)**: For contaminants with MCLs are listed in 22 CCR §64432 and §64445.1. DLRs define the analytical detection of a

contaminant in drinking water supplies, identifying the level at which DHS is confident about the quantification of the chemical's presence.

**DRINKING WATER**: Water used for human consumption.

**GROUNDWATER HYDROLOGY**: The branch of hydrology that deals with groundwater; its occurrence and movements, its replenishment and depletion, the properties of geologic materials that control groundwater movement and storage, and the methods of investigation and utilization of groundwater.

**GROUNDWATER BASIN**: An aquifer or aquifer system in which groundwater is stored. The water may be placed in the aquifer by artificial or natural means.

**GROUNDWATER**: The supply of fresh water found beneath the Earth's surface (usually in aquifers) which is often used for supplying wells and springs. Groundwater is a major source (30 to 40 percent) of California's water supply.

**HYDROGEOLOGY**: See Groundwater Hydrology

**HYDROLOGIC CYCLE**: The process by which water travels in a sequence from the air (condensation) to the earth (precipitation) and returns to the atmosphere (evaporation).

**INDICATOR**: The tools used to assess and measure water quality. Indicators must be measurable with available technology, scientifically valid, and useful for providing information for management decision making. Environmental indicators include tools for assessment of chemical, physical, and biological conditions and processes.

**INFILTRATION**: The gradual downward flow of water from the surface into soil material.

**LANDFILL**: A disposal facility where waste is placed in or on land.

**LEAKING UNDERGROUND FUEL STORAGE TANK**: Those underground storage tanks that have been identified as a leaking (LUFT).

**MAXIMUM CONTAMINANT LEVELS (MCL)**: enforceable regulatory standards under the Safe Drinking Water Act and must be met by all public drinking water systems to which they apply.

**Mg/L**: Milligrams per liter.

**MONITORING**: Periodic or continuous collection of environmental information to assess the status or changes in the environment over time. It can be short or long term in duration and is typically driven by statutory, policy or other regulatory requirements.

**PARTS PER BILLION (PPB)**: The number of parts by weight of a substance per billion parts of water – Often referred as micrograms per Liter (μg/L).

**PARTS PER MILLION (PPM)**: The number of parts by weight of a substance per million parts of water – Often referred as Milligrams per Liter (mg/L).

**PARTS PER TRILLION (PPT)**: The number of parts by weight of a substance per trillion parts of water – Often referred as nanograms per Liter (ng/L).

**PERMEABILITY**: The ability of a water bearing material to transmit water. It is measured by the quantity of water passing through a unit cross section, in a unit time, under 100% hydraulic gradient.

**pH**: A way of expressing both acidity and alkalinity on a scale of 0 to 14, with 7 representing neutrality; numbers less than 7 indicate increasing acidity and numbers greater than 7 indicate increasing alkalinity.

**POINT SOURCE POLLUTION**: This type of water pollution results from the discharges into receiving waters from easily identifiable point(s).

**POLLUTION**: An alteration of the quality of the waters of the State by waste that unreasonably affects the water for beneficial uses.

**RECHARGE, ARTIFICIAL**: The infusion of surface water into an aquifer by using recharge wells, basins and/or trenches.

**RECHARGE**: The addition of water into a groundwater system.

**SATURATED ZONE**: The subsurface zone below the water table where pores within the geologic unit are filled with water and fluid pressure is greater than atmospheric (groundwater).

**SURFACE WATER**: Lakes (fresh and saline), reservoirs, bays, harbors, rivers, streams, estuaries, and wetlands (fresh and tidal).

**UNREGULATED CHEMICALS REQUIRING MONITORING (UCRM)**: "unregulated" in that they lack drinking water maximum contaminant level (MCLs). These chemicals are included in a regulation —Title 22 of the California Code of Regulations §64450.

**UNCONFINED AQUIFER**: are the saturated portions of the upper soil profile located above a confining layer. Their upper surface is in direct contact with the atmosphere through porous materials. This upper surface is known as the water table.

**UNDERGROUND FUEL STORAGE TANK (UST)**: Any one or combination of underground tanks and any connecting underground pipes used to contain an accumulation of regulated substances, the volume of which, including the volume of the connecting underground pipes, is 10% or more beneath the surface of the ground.

**UNSATURATED ZONE**: see VADOSE ZONE.

**µg/L**: Micrograms per liter (parts per billion).

**VOLATILE ORGANIC COMPOUNDS (VOCs)**: VOCs include light alcohols, acetone, trichloroethylene, tetrachloroethylene, dichloroethylene, benzene, vinyl chloride, toluene, and methylene chloride. These chemicals are used as solvents, degreasers, paints, thinners, and fuels. They readily evaporate into the air and have low water solubility.

**VADOSE ZONE**: The subsurface zone above the water table and the capillary fringe in which pores within the geologic matrix are partially filled with air and partially filled with water, and fluid pressure is less than atmospheric (unsaturated zone).

**WATER**: A clear, colorless, odorless, and tasteless liquid ($H_2O$), essential for most plant and animal life, that is precipitated from clouds to form bodies of water (oceans, rivers, lakes) and aquifers.

**WATER FLOW**: The rate of flow of water measured in volume and time.

**WATER LEVEL**: The water surface elevation of a particular water body.

**WATER QUALITY**: A term used to describe the chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

**WATERSHED**: Lands that drain to a common place. As physical systems, watersheds consist of hill slopes, valleys, and drainage networks.

**WATER SUPPLY**: Any quantity of available water.

**WATER TABLE**: The upper surface of a zone of saturation; the upper surface of the groundwater.

**WATER TABLE AQUIFER**: See UNCONFINED AQUIFER.

**WATER BUDGET**: A water budget is an analysis of a hydrologic system's inflows and outflows (including uses) to determine a change in water storage. Water budgets are useful tools to help understand a groundwater basin, but necessary information is currently not available for most groundwater basins in California. Also known as water use budget, hydrologic budget, hydrologic balance, water balance, law of mass conservation, and hydrologic equation.

**WATER WELL (Driller's) REPORT**: A report which a water well contractor or landowner who is constructing his own well submits to the Department Water Resources. It includes the location and dimensions of the well, its flow, a record of geologic materials encountered in drilling, and other data.

**WELL DRILLERS**: Individuals who have the equipment and ability to drill or dig wells.

**WELL LOGS**: A record that is kept during well drilling of the various formations and rock materials and the depths at which they are encountered.

**WELL SCREEN INTERVAL**: A series of small openings (perforations) in water well casing which allow water to flow from the water bearing formation into the well.

**YIELD**: The quantity of water expressed either as a continuous rate of flow (cubic feet per second, etc.) or as a volume per unit of time. It can be collected for a given use, or uses, from surface or groundwater sources on a watershed.

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9) Groundwater Remediation Technologies Analysis Center (GWRTAC) http://www.gwrtac.org/html/glossary.html.

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# APPENDIX A

AB 599 Bill Text

BILL NUMBER: AB 599 CHAPTERED
BILL TEXT

CHAPTER 522
FILED WITH SECRETARY OF STATE OCTOBER 5, 2001
APPROVED BY GOVERNOR OCTOBER 4, 2001
PASSED THE SENATE SEPTEMBER 12, 2001
PASSED THE ASSEMBLY SEPTEMBER 12, 2001
AMENDED IN SENATE SEPTEMBER 6, 2001
AMENDED IN SENATE AUGUST 28, 2001
AMENDED IN SENATE AUGUST 20, 2001
AMENDED IN SENATE JULY 19, 2001
AMENDED IN SENATE JULY 5, 2001
AMENDED IN ASSEMBLY MAY 31, 2001
AMENDED IN ASSEMBLY APRIL 26, 2001

INTRODUCED BY Assembly Member Liu
(Coauthors: Assembly Members Calderon, Chavez, Robert Pacheco, and Strom-Martin)
(Coauthors: Senators Kuehl and Romero)

FEBRUARY 22, 2001

An act to add Part 2.76 (commencing with Section 10780) to Division 6 of the Water Code, relating to water.

LEGISLATIVE COUNSEL'S DIGEST

AB 599, Liu. Groundwater contamination: quality monitoring program.

Existing law declares that groundwater is a valuable natural resource in the state and should be managed to ensure its safe production and its quality. Existing law authorizes specified local agencies to adopt and implement groundwater management plans.

This bill would require the State Water Resources Control Board to integrate existing monitoring programs and design new program elements, as necessary, for the purpose of establishing a comprehensive monitoring program capable of assessing each groundwater basin in the state through direct and other statistically reliable sampling approaches, and to create an interagency task force to identify actions necessary to establish the monitoring program and to identify measures that would increase coordination among state and federal agencies that collect groundwater contamination information. The bill would require the state board to

convene a described advisory committee to the task force. The bill would require the state board, in consultation with other specified agencies, to submit to the Governor and the Legislature, on or before March 1, 2003, a report that includes a description of a comprehensive groundwater quality monitoring program for the state.

THE PEOPLE OF THE STATE OF CALIFORNIA DO ENACT AS FOLLOWS:

SECTION 1. The Legislature finds and declares the following:

(a) The importance of maintaining and monitoring a safe groundwater supply in this state for purposes of maintaining a healthy environment and a safe supply of drinking water cannot be minimized.

(b) The lack of information about groundwater contamination greatly impairs the ability of regulators and the public to protect and restore the state's groundwater basins.

(c) The Groundwater Quality Monitoring Act of 2001 enacted by this act is necessary to protect and restore groundwater as a valuable natural resource in California.

SEC. 2. Part 2.76 (commencing with Section 10780) is added to Division 6 of the Water Code, to read:

PART 2.76. GROUNDWATER QUALITY MONITORING

10780. This part shall be known and may be cited as the Groundwater Quality Monitoring Act of 2001.

10781. In order to improve comprehensive groundwater monitoring and increase the availability to the public of information about groundwater contamination, the state board, in consultation with other responsible agencies, as specified in this section, shall do all of the following:

(a) Integrate existing monitoring programs and design new program elements as necessary to establish a comprehensive monitoring program capable of assessing each groundwater basin in the state through direct and other statistically reliable sampling approaches. The interagency task force established pursuant to subdivision (b) shall determine the constituents to be included in the monitoring program. In designing the comprehensive monitoring program, the state board, among other things, shall integrate projects established in response to the Supplemental Report of the 1999 Budget Act, strive to take advantage of and incorporate existing data whenever possible, and

prioritize groundwater basins that supply drinking water.

(b) (1) Create an interagency task force for all of the following purposes:

(A) Identifying actions necessary to establish the monitoring program.

(B) Identifying measures to increase coordination among state and federal agencies that collect information regarding groundwater contamination in the state.

(C) Designing a database capable of supporting the monitoring program that is compatible with the state board's geotracker database.

(D) Assessing the scope and nature of necessary monitoring enhancements.

(E) Identifying the cost of any recommended measures.

(F) Identifying the means by which to make monitoring information available to the public.

(2) The interagency task force shall consist of a representative of each of the following entities:

(A) The state board.

(B) The department.

(C) The State Department of Health Services.

(D) The Department of Pesticide Regulation.

(E) The Department of Toxic Substances Control.

(F) The Department of Food and Agriculture.

(c) Convene an advisory committee to the interagency task force, with a membership that includes all of the following:

(1) Two representatives of appropriate federal agencies, if those agencies wish to participate.

(2) Two representatives of public water systems, one of which shall be a representative of a retail water supplier.

(3) Two representatives of environmental organizations.

(4) Two representatives of the business community.

(5) One representative of a local agency that is currently implementing a plan pursuant to Part 2.75 (commencing with Section 10750).

(6) Two representatives of agriculture.

(7) Two representatives from groundwater management entities.

(d) (1) The members of the advisory committee may receive a per diem allowance for each day's attendance at a meeting of the advisory committee.

(2) The members of the advisory committee may be reimbursed for actual and necessary travel expenses incurred in connection with their official duties.

10782. On or before March 1, 2003, the state board, in consultation with the other task force agencies specified in Section 10781, shall report to the Governor and the Legislature. The

multiagency report shall include all of the following:

(a) A detailed description of a comprehensive groundwater quality monitoring program for California that accomplishes the goals and objectives of the act adding this part.

(b) A description of how the program takes maximum advantage of existing information and an assessment of additional monitoring necessary to support the program.

(c) A specific set of recommendations for coordinating and, as necessary, restructuring existing monitoring programs to efficiently achieve the goals of this part.

(d) An estimate of funding necessary to implement the comprehensive program and the factual basis for the estimate.

(e) Recommendations with regard to an ongoing source of funds to pay for the program.

(f) A ranked list of actions that, if implemented independently, would increase the effectiveness of monitoring efforts.

10782.3. The state board shall use existing resources to carry out this part, and the operation of the program set forth in this part shall not supplant the operation of any other program required to be undertaken by the state board.

# APPENDIX B

## HISTORY OF THE SWRCB

**Why the SWRCB was chosen as the lead agency for AB 599**

The following text from the *History of the State Water Resources Control Board* (summarized on the SWRCB webpage at: http://www.swrcb.ca.gov/about/history.html provides some background on why the SWRCB is responsible for regulating water quality for the state.

In 1949, the Legislature found that existing laws were cumbersome and often unreasonable. To address this, the Legislature drafted the Dickey Water Pollution Act creating the State Water Pollution Control Board and the nine regional water pollution control boards.

The State Water Rights Board, created in 1956 as part of the same legislation that created the Department of Water Resources (DWR), recognized that the DWR would both hold water rights and operate water project facilities. The Legislature created an independent board to administer the water right functions of state government thus avoiding a potential conflict of interest by the DWR. When the State Water Project was planned and developed, the DWR recognized that water quality was important. The Water Pollution Control Board was subsequently strengthened by being charged with the broader scope of water quality and consequently was renamed the State Water Quality Control Board.

In 1965, the Little Hoover Commission examined the numerous boards and commissions within the Resources Agency. To streamline government and reduce costs, the Commission recommended that the water quality program be turned over to the DWR. During the next two years, legislative and executive branch staff discussed these recommendations and alternatives. Recognizing that there would be serious conflicts of interest if the DWR were mandated to protect water quality (as chief regulator) and develop its purvey simultaneously, it was instead proposed that the Water Quality Control and Water Rights Boards be merged. Because of these efforts, the two water boards were merged as one and as a result the SWRCB was created in 1967.

**Porter-Cologne: California's cornerstone of water protection law**

The Assembly then asked a panel of industrial, agricultural, and state and local government members to report on needed revisions to existing water quality laws. In 1969, the State Legislature enacted the Porter-Cologne Water Quality Control Act, the cornerstone of today's water protection efforts in California (California Water Code Division 7, Sections 13000 – 14598).

Porter-Cologne, named for Assemblyman Carly V. Porter and Senator Gordon Cologne, was recognized as one of the nation's strongest pieces of anti-pollution legislation. Through it, the SWRCB and the nine RWQCBs were entrusted with broad duties and powers to preserve and enhance all beneficial uses of the state's complex waterscape. This state law was so influential that the U.S. Congress used sections of Porter-Cologne as the basis of the Federal Water Pollution Control Act Amendments of 1972 (Clean Water Act).

Currently, the SWRCB allocates water rights, adjudicates water right disputes, develops statewide water protection plans, establishes water quality standards, and guides the nine RWQCBs located in the major watersheds of the state. The RWQCBs serve as the frontline for state and federal water pollution control efforts. A Basin Plan, or "Water Quality Control Plan", tailored to its unique watershed and providing scientific and regulatory basis for each RWQCB's water protection efforts guides each Board.

In summary, there is a historical and practical reason the agencies are set up as they are today. They have been created, in the case of the SWRCB, because of years of revisions and upgrades to address the needs of the public with respect to water issues.

# APPENDIX C

## TABLES

## TABLE 1: Existing Groundwater Data Summary

| | DTSC | SWRCB | DWR | DPR | DHS | USGS |
|---|---|---|---|---|---|---|
| **Chemical analyses** | | | | | | |
| *Field parameters: pH, electrical conductivity, dissolved oxygen, alkalinity* | ✓ Statewide (site-specific) | ✓ Statewide (site-specific) | ✓ Statewide (Northern/Central Districts) Bull. 118 | ✓ Statewide to Local | ✓ Statewide (Title 22 – Safe Drinking Water Act – CSDWA) | ✓ Statewide to Local (NAWQA) |
| *Major ions and total dissolved solids* | ✓ Statewide (site-specific) | ✓ Statewide (site-specific) | ✓ Statewide (Northern/Central Districts) Bull. 118 | ✓ Statewide to Local | ✓ Statewide-CSDWA | ✓ Statewide to Local (NAWQA) |
| *Volatile organic compounds* | ✓ Statewide (site-specific) | ✓ Statewide (focus areas) Low-level (GAMA) | | ✓ Statewide to Local | ✓ Statewide-CSDWA | ✓ Statewide to Local (NAWQA) |
| *Pesticides* | ✓ Statewide (site-specific) | ✓ Statewide (site-specific) | | ✓ Statewide to Local | ✓ Statewide-CSDWA | ✓ Statewide to Local (NAWQA) |
| *Trace elements* | ✓ Statewide (site-specific) | ✓ Statewide (site-specific) | Statewide (Northern/Central Districts) Bull. 118 | | ✓ Statewide - CDDWA | ✓ Statewide to Local (NAWQA) |
| *Stable isotopes (tracers of water sources)* | | ✓ Statewide (focus areas) (GAMA) | | | | ✓ Statewide to Local (NAWQA) |
| *Tritium and helium (tracers and age-dating)* | | ✓ Statewide (focus areas) (GAMA) | | | | ✓ Statewide to Local (NAWQA) |
| *Newly Identified Constituents: pathogens, pharmaceuticals, hormones, personal care products, waste-water indicators* | | | | | ✓ Statewide (Title 22) for some new constituents | |

| | DTSC | SWRCB | DWR | DPR | DHS | USGS |
|---|---|---|---|---|---|---|
| **Key interpretative results** | | | | | | |
| **New exceedences of drinking water standards are identified** | | ✓ GAMA | | ✓ | ✓ CSDWA | ✓ NAWQA |
| **New occurrences of compounds of concern are identified** | | ✓ GAMA | | ✓ | ✓ CSDWA | ✓ NAWQA |
| **Flow system is defined at the basin-scale to enable interpretation of data** | | ✓ GAMA | | | | ✓ NAWQA |
| **Hydrogeologic Data** | | | | | | |
| | | ✓ Hydrogeologic Vulnerability Areas | ✓ Bulletin 118 (Hardcopy) | ✓ California Vulnerability (CALVUL) | | ✓ NAWQA |
| **Databases** | | | | | | |
| | | ✓ GeoTracker **(electronic/ Oracle/ spatial data available)** | ✓ (Bulletin 118 – Water Quality Network) | ✓ Well Inventory Database<br>✓ Pesticide Use Report Database<br>✓ Pesticide Chemistry Database | ✓ PICME, WQMI (Public Supply Well Databases) | ✓ NAWQA |

## TABLE 2: Groundwater Monitoring/Assessment Data

| Types of Groundwater Data Collected | Spatial Coverage (Statewide/Regional/ Local) | Type of Sampling (Survey – one time effort, Monitoring – ongoing data collection but limited analysis, or Assessment – ongoing data collection and detailed analysis) | Data Format (Hard copy or Electronic; Application - Oracle, Access, Dbase, Excel, etc.) | Spatial Data (GIS) Availability |
|---|---|---|---|---|
| **Dept. of Health Services (DHS)** | | | | |
| Public Water Well Locations and Water Quality | Statewide | Monitoring, Assessment | Electronic (Access); Hardcopy | Yes |
| Source Water Assessment Program Data | Statewide | Survey, Assessment | Electronic (Access) | Yes |
| Well Data | Statewide | Monitoring | Electronic (Access); Hardcopy | Yes |
| Water System Water Quality Monitoring Plan | Statewide | Monitoring, Assessment | Hardcopy | No |
| Groundwater Recharge with Recycled Water Monitoring Programs | Local | Survey, Monitoring | Hardcopy | No |
| **Dept. of Pesticide Regulation (DPR)** | | | | |
| Well Inventory Database – Mandated by law that other state agencies report their pesticide well monitoring results to DPR. Other federal and local agencies are contacted for submission of data | Statewide | Collects survey and monitoring data | Electronic - Oracle | Yes. All databases are indexed according to the USGS Public Land Survey Coordinate System - Township/ Range/Section (TRS) |

| Types of Groundwater Data Collected | Spatial Coverage (Statewide/Regional/ Local) | Type of Sampling (Survey – one time effort, Monitoring – ongoing data collection but limited analysis, or Assessment – ongoing data collection and detailed analysis) | Data Format (Hard copy or Electronic; Application - Oracle, Access, Dbase, Excel, etc.) | Spatial Data (GIS) Availability |
|---|---|---|---|---|
| Well Sampling Investigations - Well sampling conducted to comply with Pesticide Contamination Prevention Act. Study objectives are to: 1. Identify pesticide active ingredients in groundwater; 2. Identify vulnerable areas; 3. Determine relationship of detections with agronomic and geographic variables; 4. Determine trends in concentration to measure effective of regulations | Local to Statewide | Surveys and monitoring | Electronic - Oracle (captured in the Well Inventory Database) | Yes. Indexed to TRS |
| Pesticide Use Report Database – Beginning in 1990, all agricultural uses of pesticides are reported to DPR by Township, Range, and Section via the County Agricultural Commissioner | Statewide | Assessment (used to identify potential sampling sites) | Electronic - Oracle | Yes. Indexed to TRS |
| California Vulnerability Model (CALVUL) – Identify soil, climatic, depth to groundwater and other geographic properties of vulnerable areas | Statewide | Assessment (used to identify potential sampling sites) | Electronic - Oracle or Access | Yes. Indexed to TRS |
| Pesticide Chemistry Database – Registrants of pesticide active ingredients are required to submit data on the physical and chemical properties of pesticides including water solubility, soil adsorption coefficient (KOC), hydrolysis half-life, aerobic and anaerobic soil metabolism and dissipation of pesticides | Not Applicable | Assessment (used to identify potential sampling sites) | Electronic - Oracle or Access | Not Applicable |
| **Dept. of Toxic Substances Control (DTSC)** | | | | |
| Hazardous Waste Management Program - Facility Permitting Division | Statewide (mostly urbanized areas) | Survey, Monitoring | Hard copy only | No. Spatial well information is not available |
| Site Mitigation Program - Statewide Cleanup Operations Division | Statewide (mostly urbanized areas) | Survey, Monitoring | Hard copy only | No. Spatial well information is not available |

| Types of Groundwater Data Collected | Spatial Coverage (Statewide/Regional/ Local) | Type of Sampling (Survey – one time effort, Monitoring – ongoing data collection but limited analysis, or Assessment – ongoing data collection and detailed analysis) | Data Format (Hard copy or Electronic; Application - Oracle, Access, Dbase, Excel, etc.) | Spatial Data (GIS) Availability |
|---|---|---|---|---|
| Site Mitigation Program - Emergency Response and Statewide Operations Division | Statewide (mostly urbanized areas) | Survey, Monitoring | Hard copy only except for Stringfellow site (data are currently in Access and will be moved to Equis in the near future) | Yes. for Stringfellow site. Otherwise, spatial well information is not available |
| Site Mitigation Program - Office of Military Facilities | Statewide (military bases) | Survey, Monitoring | Hard copy only | No. Spatial well information is not available |
| **Dept. of Water Resources (DWR)** | | | | |
| Bulletin 118 groundwater basin and subbasin boundaries and associated numbers based on basin and subbasin data (some data in GIS) | Statewide | NA | ArcView | limited |
| Groundwater levels, available in hydrograph and tabular format on DWR's web page | Statewide | Monitoring | Hardcopy, electronic, Oracle, Access | limited |
| Groundwater quality analyses, available in tabular format on DWR's web page | Regional, Local | Monitoring, Assessment | Oracle, Access | limited |
| Inelastic and elastic subsidence | Regional, Local | Monitoring | Access | none |
| AB 303 Data (WC §10750)—The statute requires that any data collected as a result of the grant must be submitted to DWR. | Local | Survey, Monitoring, Assessment | Hardcopy, Electronic: (various applications) | Yes, varies with project |
| Well Completion Reports, commonly called Well Logs (DWR 188) | Statewide | NA | Electronic: Access | Yes, limited |
| Watermaster data for Central and West Coast Basins (Southern District) | Local, Regional | Monitoring | Electronic: Excel | No |
| Prop 13 Groundwater Storage and conjunctive management project specific data | Local, Regional | Survey, Monitoring, Assessment | Hardcopy, Electronic: (various applications) | Yes, varies with project |

| Types of Groundwater Data Collected | Spatial Coverage (Statewide/Regional/ Local) | Type of Sampling (Survey – one time effort, Monitoring – ongoing data collection but limited analysis, or Assessment – ongoing data collection and detailed analysis) | Data Format (Hard copy or Electronic; Application - Oracle, Access, Dbase, Excel, etc.) | Spatial Data (GIS) Availability |
|---|---|---|---|---|
| **State and Regional Water Boards (SWRCB/RWQCBs)** | | | | |
| Groundwater Ambient Monitoring and Assessment (GAMA) Program, California Aquifer Susceptibility (CAS) Assessment - Low-level VOCs, groundwater age data | Statewide | Survey, Assessment | Oracle | Yes |
| GAMA Program, Voluntary Domestic Well Assessment Project - Private domestic drinking water well location and water quality data | Local | Assessment | Access | Yes |
| Location, release, water quality, and water level data for Leaking UST sites (Geotracker) | Leaking UST sites located statewide | Monitoring | Hard copy and Electronic: Oracle | Yes |
| Location, water quality, and water level data for Land Disposal Program sites | Land Disposal sites located statewide | Monitoring | **Location (hard copy, limited electronic: Excel);** Water quality (hard copy, limited electronic: Excel); Water level data (hard copy, limited electronic Excel) | Yes (Land Disposal site locations) |
| Location, water quality, and water level data for Dept. of Defense (DOD), Leaking Landfills, and Spills Leaks, Investigations, and Cleanup (SLIC) sites | DOD, landfills, and SLIC sites located statewide. | Monitoring | **Electronic UST data in Geotracker. In general, site location (hard copy, limited electronic: Excel);** Water quality (hard copy, limited electronic: Excel); Water level data (hard copy, limited electronic: Excel) | In progress |
| Hydrogeologic Vulnerability Areas (GIS) delineated based on published hydrogeologic data and information | Statewide | NA | Electronic: GIS | Yes |

| Types of Groundwater Data Collected | Spatial Coverage (Statewide/Regional/ Local) | Type of Sampling (Survey – one time effort, Monitoring – ongoing data collection but limited analysis, or Assessment – ongoing data collection and detailed analysis) | Data Format (Hard copy or Electronic; Application - Oracle, Access, Dbase, Excel, etc.) | Spatial Data (GIS) Availability |
|---|---|---|---|---|
| RWQCBs specific efforts:<br>San Francisco Bay Regional Water Quality Control Board – Electronic Solvent Plume Reporting Project.<br><br>Others – To be determined | Regional | Survey, Monitoring, Assessment | (San Francisco Bay Regional Water Quality Control Board, Electronic Solvent Plume Reporting Project - Excel) | Yes (San Francisco Bay Regional Water Quality Control Board, Electronic Solvent Plume Reporting Project) |

## TABLE 3: State Agencies Conducting Groundwater Quality Monitoring and Assessment Programs

| Agency | Number of PYs Budgeted to Groundwater Monitoring/Assessment | Budget allocated to Groundwater Monitoring/Assessment ($/Year) |
|---|---|---|
| Dept. of Pesticide Regulation (DPR) | 8.5 PYs | $925,000/Year |
| Dept. of Water Resources (DWR) | 3 PYs | $300,000/Year |
| State Water Board (SWRCB) | 5.5 PYs | $650,000/Year |
| Department of Health Services (DHS) | 5 PYs | $500,000/Year |

## TABLE 4: Existing Groundwater Programs

| Agency | Groundwater Programs | Groundwater Monitoring/ Assessment Objectives | Number of PYs Budgeted to Groundwater Monitoring/Assessment | Budget allocated to Groundwater Monitoring/Assessment ($/Year) |
|---|---|---|---|---|
| **Department of Health Services (DHS)** | California Safe Drinking Water Act | 1. Ascertain quality of all PWS sources for compliance with MCLs;<br>2. Complete source water assessments of all sources by May 2003;<br>3. A source water assessment is required for all new sources before receiving a DHS permit. | DWSAP – 10 (through 5/03);<br>LAB – 2;<br>FOB – Estimated to be 15;<br>MEU – 3.0; | Personnel*: $3,000,000 |
| | | **TOTAL (DHS)** | **28* PYs** | **$3,000,000/year; 2,000,000/year after May 2003** |
| **Department of Pesticide Regulation (DPR)** | Groundwater Contaminate Identification | 1. Determine potential for movement of pesticide residues to groundwater based on their physical/chemical properties.<br>2. Conduct well sampling to identify new pesticide active ingredients in groundwater.<br>3. Provide monitoring data to determine trends in pesticide concentrations in contaminated basins. | 1 SERS,<br>2 AERS | Personnel*: $300,000<br>Method Development Costs: 1 chemicals at $15,000 each = $15,000<br>Sample Analysis: 200 wells at $300 = $60,000<br><br>Subtotal: $375,000 |
| | Vulnerable Area Identification | 1. Determine the spatial extent of contamination for residues already detected in groundwater.<br>2. Use monitoring, soil, depth to groundwater, climate and other geographic or agronomic factors to identify areas vulnerable to pesticide contamination of groundwater. | 0.5 SERS,<br>1 AERS | Personnel*: $150,000 |
| | Mitigation Measure Development and Implementation | 1. Identify and test mitigation measures to prevent movement of residues to groundwater.<br>2. Implement mitigation measures to prevent continued movement of pesticides to groundwater. | 1.0 ERS | Personnel*: $100,000 |
| | Well Inventory Database | Input well monitoring data into a statewide database and prepare an annual report to the legislature on the detection of pesticides in groundwater. | 1.0 ERS | Personnel*: $100,000 |
| | Review of Registrant data | Determine potential for contamination | 0.5 SERS, 0.5 ERS | Personnel*: $100,000 |

| Agency | Groundwater Programs | Groundwater Monitoring/ Assessment Objectives | Number of PYs Budgeted to Groundwater Monitoring/Assessment | Budget allocated to Groundwater Monitoring/Assessment ($/Year) |
|---|---|---|---|---|
| | Backflow and Chemigation Education and Training Program | Prevent the backflow of residues into groundwater when they are applied through injection into irrigation water. | 1 ERS | Personnel*: $100,000 |
| | | **TOTAL (DPR)** | **8.5 PYs** | **$925,000/Year** |
| **Department of Toxic Substances Control (DTSC)** | Hazardous Waste Management Program - Facility Permitting Division | Evaluation of groundwater contamination at RCRA storage, treatment, and disposal facilities | 9 | Personnel: $900,000* |
| | Site Mitigation Program - Statewide Cleanup Operations Division | Evaluation of groundwater contamination at superfund, brownfield, and voluntary cleanup sites | 8 | Personnel: $800,000* |
| | Site Mitigation Program - Emergency Response and Statewide Operations Division | Evaluation of groundwater contamination at superfund, brownfield, and voluntary cleanup sites (technical support) | 2 | Personnel: $200,000*<br><br>Stringfellow groundwater monitoring: $125,000 per year (100 wells sampled twice a year) |
| | Site Mitigation Program - Office of Military Facilities | Evaluation of groundwater contamination at military sites | 5 | Personnel: $500,000* |
| | | **TOTAL (DTSC)** | **24* PYs** | **$2,525,000/Year** |

| Agency | Groundwater Programs | Groundwater Monitoring/ Assessment Objectives | Number of PYs Budgeted to Groundwater Monitoring/Assessment | Budget allocated to Groundwater Monitoring/Assessment ($/Year) |
|---|---|---|---|---|
| **Department of Water Resources (DWR)** | Bulletin 118 | Update of groundwater basin boundaries and basin characteristic | 10 PYs /3 years | $ 1 mil/year; Funds end after FY 01-02 |
| | Water Quality & Quantity (Water & Environmental Monitoring) | Long-term water quality and Well level data | 15 PYs | $2.3 mil |
| | Local and Regional Studies | Miscellaneous groundwater studies addressing local groundwater issues | Not Available | Cooperative funding within Rural Counties Assistance and Water Management Programs |
| | Groundwater Quantity for Updating the State Water Plan | State's water supply and demand budget | Not Available | Funded within the Water Plan Update |
| | State Water Project Conjunctive use program (OSWPP) | Basin monitoring associated with SWP conjunctive use projects | Not Available | Not Available |
| | Integrated Storage Investigations Conjunctive Use Program (DPLA), and Grants and Loans | Data collection, monitoring, & evaluation, feasibility studies for GW recharge and storage | 10 PYs<br>and consultants | Personnel: $1,000,000*<br><br>Contracts to external agencies (limited funding for groundwater monitoring and assessment):<br>Loans and Grants: (local agencies)<br>Water Bond $18.5 mil; AB303 $5 mil; ISI Partnerships $4 mil in 2001; Water Bond $100 mil, AB303 $4 mil, Partnerships $4 mil in 2002 |
| | Water Data Management Systems | Water Data Library: on-line access to hydrologic data | 1 PY current;<br>2 additional PYs planned | Personnel: $300,000*<br><br>Funding uncertain; limited |
| | Subsidence Monitoring | Monitoring along CA Aqueduct; special studies as needed | Not Available | SWP funded for Aqueduct; no direct funding for special studies |
| | | **TOTAL (DWR)** | **38* PYs** | **$4,600,000/Year** |

| Agency | Groundwater Programs | Groundwater Monitoring/ Assessment Objectives | Number of PYs Budgeted to Groundwater Monitoring/Assessment | Budget allocated to Groundwater Monitoring/Assessment ($/Year) |
|---|---|---|---|---|
| **State and Regional Water Boards (SWRCB/ RWQCBs)** | Groundwater Ambient Monitoring and Assessment (GAMA) Program | The primary objective of the GAMA Program is to assess statewide groundwater quality and aquifer susceptibility. | 5.5 PYs | Personnel*: $550,000<br>Contracts: $100,000 |
| | Underground Storage Tank (UST) Program | The primary objective of the UST Program is to preserve and enhance the quality of California's water resources by regulating USTs and providing cleanup oversight. | 12 PYs | Personnel*: $1,200,000 |
| | Land Disposal Program | The Land Disposal Program imposes statewide requirements for siting, operation, and closure of waste disposal sites through issuance of waste discharge requirements and compliance and enforcement efforts to ensure adequate protection of water quality. | 20 PYs | Personnel*: $2,000,000 |
| | Spills, Leaks, Investigations, and Cleanup (SLIC) Program (reimbursed cleanup program) | Oversees the investigation and remediation of sites associated with unauthorized releases that may impact water quality. | 4 PYs | Personnel*: $400,000 |
| | Department of Defense Program (DOD) | The SWRCB and RWQCBs partner with the US Dept. of Defense (DOD) through the Defense and State Memorandum of Agreement (DSMOA) to oversee the investigation and remediation of water quality issues at military facilities. The over 200 military facilities require environmental cleanups that range from a few UST cleanups to complex Superfund cleanups. | 5 PYs | Personnel*: $500,000 |
| | Regional Board specific efforts | A few Regional Water Boards have special projects to address groundwater monitoring outside the core regulatory programs described above.<br><br>Region 2 – Groundwater Basin Evaluations, Electronic Reporting of Solvent Plume Maps | Reg. 2 = .2 PYs | Reg. 2 Personnel*: $20,000 |

| Agency | Groundwater Programs | Groundwater Monitoring/ Assessment Objectives | Number of PYs Budgeted to Groundwater Monitoring/Assessment | Budget allocated to Groundwater Monitoring/Assessment ($/Year) |
|---|---|---|---|---|
| **Dept. of Food and Agriculture (CDFA)** | Not Applicable<br>TOTAL (CDFA) | The Food and Agriculture Code (Section 33515) provides that the water supply for the milk house and dairy barn to have a bacterial quality that conforms to the requirements of the State Board of Health for public supplies of drinking water. These requirements are that the water supply be free of total coliform (<1.1 MPN), fecal coliform, or E. coli.<br><br>The Department of Food and Agriculture (CDFA) enforces these provisions through the dairy sanitation inspection program. Water samples are collected from the dairy water distribution system and analyzed for most probable number (MPN) coliform count. Water supply for most dairies is groundwater.<br><br>The monitoring is also conducted to satisfy Federal Food and Drug Administration regulations, which require that dairy water supply be evaluated every three years. Nine counties, most of which have high concentrations of dairies are approved to conduct their own inspection program. These counties also conduct water monitoring and maintain their own records. | The Milk and Dairy Foods Branch of CDFA has 39 staff dedicated to inspecting dairies and milk processing plants. It is unknown how many are needed just for dairy inspections and just to conduct the water monitoring aspect of the inspection. | Funding for the dairy inspections and water monitoring is covered by an annual assessment to the dairy. The portion which is just for the monitoring is unknown. |
| | | **TOTAL (CDFA)** | **0.2 PYs** | **$20,000** |

* 1 PY estimated at $100,000.

# APPENDIX D

## GROUNDWATER BASIN PRIORITIZATION TABLES

## CATEGORY 1

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| **Basins with more than 260 wells** | | | | | | | | | |
| 8-2 | UPPER SANTA ANA VALLEY | Transverse and Selected Peninsular Range | 1,932 | 788 | 883,891 | 0 | 972 | 270 | 0.79 |
| 5-22.01 | SAN JOAQUIN VALLEY | Central Valley | 2,862 | 750 | 224,431 | 581.59 | 745 | 813 | 0.52 |
| 5-22.08 | SAN JOAQUIN VALLEY | Central Valley | 3,949 | 692 | 695,806 | 895.22 | 660 | 1419 | 1.00 |
| 5-22.14 | SAN JOAQUIN VALLEY | Central Valley | 7,872 | 552 | 369,175 | 3303.19 | 708 | 1878 | 0.84 |
| 3-4 | SALINAS VALLEY | Southern Coast Ranges | 4,025 | 511 | 129,158 | 0 | 297 | 777 | 1.00 |
| 4-11 | COASTAL PLAIN OF LOS ANGELES | Transverse and Selected Peninsular Range | 1,274 | 478 | 3,578,031 | 0 | 3223 | 112 | 0.66 |
| 5-22.02 | SAN JOAQUIN VALLEY | Central Valley | 998 | 353 | 135,552 | 154.02 | 222 | 257 | 0.61 |
| 2-9 | SANTA CLARA VALLEY | Southern Coast Ranges | 1,470 | 351 | 588,085 | 0 | 4663 | 113 | 0.33 |
| 5-22.11 | SAN JOAQUIN VALLEY | Central Valley | 1,803 | 327 | 213,101 | 514.23 | 257 | 679 | 0.98 |
| 5-21.64 | SACRAMENTO VALLEY | Central Valley | 1,377 | 326 | 25,482 | 313.04 | 524 | 289 | 0.11 |
| 7-21 | COACHELLA VALLEY | Desert Mountains | 1,964 | 324 | 46,097 | 0 | 306 | 231 | 0.55 |
| 6-44 | ANTELOPE VALLEY | Desert Mountains | 4,488 | 313 | 100,243 | 86.34 | 282 | 169 | 0.46 |
| 8-1 | COASTAL PLAIN OF ORANGE COUNTY | Transverse and Selected Peninsular Range | 899 | 269 | 839,857 | 29.51 | 2242 | 182 | 0.66 |
| **Grouped basins with more than 260 wells in group** | | | | | | | | | |
| 4-13 | SAN GABRIEL VALLEY | Transverse and Selected Peninsular Range | 513 | 365 | 474,266 | 2.7 | 795 | 59 | 0.72 |
| 4-23 | RAYMOND | Transverse and Selected Peninsular Range | 106 | 79 | 78,180 | 0 | 65 | 8 | 0.44 |
| | **group totals** | | **619** | **444** | **552,446** | **2.7** | **860** | **67** | |
| 1-55 | SANTA ROSA VALLEY | Northern Coast Ranges | 409 | 200 | 227,480 | 0 | 535 | 107 | 1.00 |
| 1-59 | WILSON GROVE FORMATION HIGHLANDS | Northern Coast Ranges | 350 | 56 | 10,274 | 1.71 | 89 | 75 | 1.00 |
| 2-1 | PETALUMA VALLEY | Northern Coast Ranges | 186 | 25 | 49,957 | 0.26 | 129 | 28 | 1.00 |
| | **group totals** | | **946** | **281** | **287,711** | **1.97** | **753** | **210** | |
| 6-42 | UPPER MOJAVE RIVER VALLEY | Desert Mountains | 1,671 | 193 | 91,090 | 10.54 | 118 | 30 | 0.57 |
| 6-40 | LOWER MOJAVE RIVER VALLEY | Desert Mountains | 1,155 | 55 | 850 | 7.69 | 111 | 49 | 1.00 |
| 6-41 | MIDDLE MOJAVE RIVER VALLEY | Desert Mountains | 855 | 16 | 3,988 | 12.84 | 21 | 13 | 1.00 |
| | **group totals** | | **3,681** | **264** | **95,928** | **31.07** | **250** | **92** | |
| 4-4 | SANTA CLARA RIVER VALLEY | Transverse and Selected Peninsular Range | 775 | 216 | 64,006 | 0 | 702 | 200 | 0.27 |
| 4-6 | PLEASANT VALLEY | Transverse and Selected Peninsular Range | 87 | 14 | 25,986 | 7.65 | 85 | 29 | 0.40 |
| 4-8 | LAS POSAS VALLEY | Transverse and Selected Peninsular Range | 171 | 30 | 8,790 | 14.97 | 46 | 63 | 0.27 |
| | **group totals** | | **1,034** | **260** | **98,782** | **22.62** | **833** | **292** | |
| **Basins with less than 260 wells but in category 1 because of Province representation** | | | | | | | | | |
| 6-12 | OWENS VALLEY | Basin and Range | 2,675 | 115 | 6,052 | 66.15 | 85 | 63 | 1.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 5-25 | KERN RIVER VALLEY | Sierras | 321 | 110 | 0 | 1.98 | 14 | 12 | 0.00 |
| 6-5 | TAHOE VALLEY | Sierras | 93 | 80 | 32,240 | 0 | 87 | 1 | 0.73 |
| 9-5 | TEMECULA VALLEY | San Diego | 355 | 68 | 49,160 | 3.08 | 27 | 69 | 0.57 |
| 1-4 | SHASTA VALLEY | Northern California Volcanics and Q Sed | 793 | 43 | 1,363 | 0 | 42 | 79 | 0.12 |

## CATEGORY 2

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| **Basins with more than 100 wells** | | | | | | | | | |
| 5-22.03 | SAN JOAQUIN VALLEY | Central Valley | 1,405 | 251 | 109,398 | 199.77 | 173 | 458 | 1.00 |
| 5-21.65 | SACRAMENTO VALLEY | Central Valley | 1,003 | 211 | 107,720 | 122.36 | 664 | 168 | 0.25 |
| 5-22.15 | SAN JOAQUIN VALLEY | Central Valley | 1,396 | 209 | 35,408 | 232.07 | 223 | 413 | 0.21 |
| 3-3 | GILROY-HOLLISTER VALLEY | Southern Coast Ranges | 745 | 187 | 113,714 | 0 | 179 | 199 | 1.00 |
| 5-22.13 | SAN JOAQUIN VALLEY | Central Valley | 1,898 | 184 | 57,698 | 404.95 | 123 | 657 | 1.00 |
| 4-12 | SAN FERNANDO VALLEY | Transverse and Selected Peninsular Range | 586 | 180 | 123,352 | 0 | 704 | 28 | 0.35 |
| 5-22.04 | SAN JOAQUIN VALLEY | Central Valley | 1,987 | 172 | 110,738 | 265.49 | 240 | 536 | 1.00 |
| 3-12 | SANTA MARIA | Southern Coast Ranges | 745 | 142 | 14,643 | 190.76 | 105 | 197 | 0.17 |
| 5-21.67 | SACRAMENTO VALLEY | Central Valley | 914 | 140 | 99,823 | 87.27 | 224 | 320 | 0.77 |
| 5-21.66 | SACRAMENTO VALLEY | Central Valley | 1,720 | 125 | 34,245 | 156.8 | 166 | 584 | 0.34 |
| 5-22.07 | SAN JOAQUIN VALLEY | Central Valley | 3,021 | 123 | 29,559 | 1264.65 | 188 | 931 | 1.00 |
| 5-6 | REDDING AREA | Central Valley | 1,579 | 123 | 41,794 | 0 | 212 | 95 | 0.41 |
| 5-22.06 | SAN JOAQUIN VALLEY | Central Valley | 1,591 | 110 | 45,986 | 226.94 | 127 | 498 | 0.99 |
| 5-21.52 | SACRAMENTO VALLEY | Central Valley | 3,717 | 108 | 25,717 | 1904.73 | 88 | 1216 | 1.00 |
| 5-22.12 | SAN JOAQUIN VALLEY | Central Valley | 2,120 | 100 | 82,728 | 448.99 | 136 | 701 | 0.89 |
| **Grouped basins with more than 100 wells in group** | | | | | | | | | |
| 3-2 | PAJARO VALLEY | Southern Coast Ranges | 357 | 146 | 49,310 | 92.75 | 148 | 119 | 0.87 |
| 3-21 | SANTA CRUZ PURISIMA FORMATION | Southern Coast Ranges | 163 | 23 | 0 | 26.62 | 6 | 29 | 0.00 |
| 3-1 | SOQUEL VALLEY | Southern Coast Ranges | 10 | 13 | 45,000 | 0 | 27 | 1 | 1.00 |
| 3-26 | WEST SANTA CRUZ TERRACE | Southern Coast Ranges | 32 | 10 | 1,988 | 1.4 | 109 | 4 | 0.02 |
| | **group totals** | | **561** | **192** | **96,298** | **120.77** | **290** | **153** | |
| 2-23 | NAPA-SONOMA VOLCANIC HIGHLANDS | Northern Coast Ranges | 1,010 | 76 | 0 | 38.45 | 57 | 224 | 0.00 |
| 2-2 | NAPA-SONOMA VALLEY | Northern Coast Ranges | 530 | 52 | 9,860 | 0 | 441 | 140 | 0.10 |
| 2-3 | SUISUN-FAIRFIELD VALLEY | Northern Coast Ranges | 541 | 15 | 0 | 3.18 | 127 | 56 | 0.00 |
| 2-19 | KENWOOD VALLEY | Northern Coast Ranges | 21 | 9 | 0 | 0.13 | 6 | 7 | 0.00 |
| | **group totals** | | **2,101** | **152** | **9,860** | **42** | **631** | **427** | |
| 1-10 | EEL RIVER VALLEY | Northern Coast Ranges | 298 | 30 | 14,075 | 6.08 | 88 | 30 | 0.93 |
| 1-1 | SMITH RIVER PLAIN | Northern Coast Ranges | 164 | 22 | 15,316 | 7.89 | 80 | 12 | 1.00 |
| 1-14 | LOWER KLAMATH RIVER VALLEY | Northern Coast Ranges | 28 | 20 | 0 | 8.94 | 9 | 3 | 0.00 |
| 1-9 | EUREKA PLAIN | Northern Coast Ranges | 151 | 13 | 28,234 | 0.02 | 188 | 13 | 1.00 |
| 1-27 | BIG LAGOON AREA | Northern Coast Ranges | 54 | 12 | 0 | 0 | 12 | 2 | 0.00 |
| 1-8 | MAD RIVER VALLEY | Northern Coast Ranges | 160 | 10 | 42,500 | 0 | 107 | 8 | 0.18 |
| | **group totals** | | | **107** | | | | **107** | |
| **Basins with less than 100 wells but in category 2 because of province representation** | | | | | | | | | |
| 6-54 | INDIAN WELLS VALLEY | Basin and Range | 1,545 | 81 | 36,319 | 3.92 | 59 | 7 | 1.00 |

## CATEGORY 3

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| **Basins with more than 24 wells (+ 2 or more other significant factors)** | | | | | | | | | |
| 3-15 | SANTA YNEZ RIVER VALLEY | Southern Coast Ranges | 828 | 95 | 46938 | 147.39 | 280 | 146 | 1.00 |
| 5-22.16 | SAN JOAQUIN VALLEY | Central Valley | 1,135 | 69 | 8500 | 251.35 | 52 | 236 | 0.73 |
| 5-21.61 | SACRAMENTO VALLEY | Central Valley | 423 | 53 | 11513 | 79.71 | 141 | 115 | 1.00 |
| 5-21.59 | SACRAMENTO VALLEY | Central Valley | 1,074 | 44 | 8007 | 305.03 | 71 | 307 | 0.32 |
| 5-21.60 | SACRAMENTO VALLEY | Central Valley | 418 | 36 | 12320 | 49.65 | 69 | 124 | 1.00 |
| 5-21.50 | SACRAMENTO VALLEY | Central Valley | 1,079 | 35 | 14347 | 101.41 | 59 | 106 | 1.00 |
| 5-21.58 | SACRAMENTO VALLEY | Central Valley | 735 | 32 | 81515 | 110.52 | 46 | 237 | 1.00 |
| 2-10 | LIVERMORE VALLEY | Southern Coast Ranges | 282 | 31 | 43628 | 0.1 | 162 | 65 | 0.31 |
| **Grouped basins with more than 24 wells (+ 2 or more other significant factors) in group** | | | | | | | | | |
| 8-5 | SAN JACINTO | Transverse and Selected Peninsular Range | 758 | 70 | 4200 | 156.82 | 138 | 192 | 0.14 |
| 8-4 | ELSINORE | Transverse and Selected Peninsular Range | 104 | 27 | 0 | 9.88 | 15 | 7 | 0.00 |
| | **group totals** | | **862** | **97** | **4,200** | **167** | **153** | **199** | |
| 3-16 | GOLETA | Transverse and Selected Peninsular Range | 37 | 47 | 0 | 6.85 | 73 | 9 | 0.00 |
| 3-49 | MONTECITO | Transverse and Selected Peninsular Range | 25 | 19 | 2658 | 0 | 15 | 11 | 0.19 |
| 3-53 | FOOTHILL | Transverse and Selected Peninsular Range | 13 | 13 | 0 | 2.32 | 25 | 2 | 0.00 |
| 3-17 | SANTA BARBARA | Transverse and Selected Peninsular Range | 25 | 11 | 1901 | 0 | 120 | 5 | 0.02 |
| 3-18 | CARPINTERIA | Transverse and Selected Peninsular Range | 33 | 5 | 14600 | 0.08 | 17 | 14 | 1.00 |
| | **group totals** | | **133** | **95** | **19,159** | **9** | **250** | **41** | |
| 7-38 | PALO VERDE VALLEY | Desert Mountains | 295 | 25 | 0 | 0 | 27 | 117 | 0.00 |
| 7-39 | PALO VERDE MESA | Desert Mountains | 910 | 14 | 0 | 4.37 | 134 | 94 | 0.00 |
| | **group totals** | | | **39** | **0** | **4.37** | **161** | **211** | |
| **Basins in category 3 because of province representation** | | | | | | | | | |
| 8-9 | BEAR VALLEY | Transverse and Selected Peninsular Range | 79 | 52 | 7000 | 2.01 | 31 | 1 | 1.00 |
| 6-4 | HONEY LAKE VALLEY | Northern California Volcanics and Q Sed | 1,261 | 38 | 2741 | 29.87 | 16 | 51 | 0.30 |
| 5-34 | MOUNT SHASTA VOLCANIC AREA | Northern California Volcanics and Q Sed | 85 | 31 | 3680 | 0.1 | 26 | 1 | 1.00 |
| 9-8 | WARNER VALLEY | San Diego | 97 | 29 | 0 | 7.61 | 4 | 0 | 0.00 |
| 5-67 | CLEAR LAKE PLEISTOCENE VOL. AREA | Northern Coast Ranges | 280 | 27 | 2000 | 74.87 | 8 | 16 | 0.69 |
| 1-52 | UKIAH VALLEY | Northern Coast Ranges | 152 | 22 | 12289 | 2.31 | 115 | 52 | 0.48 |
| 1-5 | SCOTT RIVER VALLEY | Klamath | 258 | 12 | 0 | 28.1 | 19 | 56 | 0.00 |
| 7-36 | YUMA VALLEY | Desert Mountains | 502 | 12 | 0 | 1.31 | 11 | 37 | 0.00 |
| 7-44 | NEEDLES VALLEY | Desert Mountains | 356 | 9 | 6000 | 0 | 26 | 9 | 1.00 |
| 9-17 | SWEETWATER VALLEY | San Diego | 24 | 9 | 0 | 0.49 | 152 | 2 | 0.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| **Grouped basins in category 3 because of province representation** | | | | | | | | | |
| 3-9 | SAN LUIS OBISPO VALLEY | Southern Coast Ranges | 51 | 39 | 1018 | 29.47 | 46 | 17 | 0.02 |
| 3-8 | LOS OSOS VALLEY | Southern Coast Ranges | 28 | 18 | 0 | 0 | 1 | 9 | 0.00 |
| | **group totals** | | **80** | **57** | **1,018** | **29** | **47** | **26** | |
| 9-7 | SAN LUIS REY VALLEY | San Diego | 120 | 17 | 0 | 18.84 | 18 | 38 | 0.00 |
| 9-4 | SANTA MARGARITA VALLEY | San Diego | 32 | 15 | 0 | 0.59 | 0 | 4 | 0.00 |
| | **group totals** | | **152** | **32** | **0** | **19** | **18** | **42** | |

## CATEGORY 4

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| **Basins with more than 24 wells (+ 1 other significant factor)** | | | | | | | | | |
| 5-21.62 | SACRAMENTO VALLEY | Central Valley | 532 | 63 | 135 | 66.11 | 60 | 193 | 0.00 |
| 5-21.57 | SACRAMENTO VALLEY | Central Valley | 504 | 61 | 0 | 46.86 | 51 | 114 | 0.00 |
| 1-21 | FORT BRAGG TERRACE AREA | Northern Coast Ranges | 98 | 31 | 0 | 27.14 | 69 | 13 | 0.00 |
| 5-55 | SACRAMENTO VALLEY EASTSIDE | Northern California Volcanics and Q Sed | 2,052 | 27 | 0 | 68.02 | 44 | 58 | 0.00 |
| **Grouped basins with more than 24 wells (+ 1 other significant factor) in group** | | | | | | | | | |
| 7-12 | WARREN VALLEY | Desert Mountains | 96 | 18 | 0 | 0.25 | 9 | 0 | 0.00 |
| 7-62 | JOSHUA TREE | Desert Mountains | 110 | 18 | 0 | 0.22 | 0 | 1 | 0.00 |
| 7-20 | MORONGO VALLEY | Desert Mountains | 29 | 6 | 0 | 0.34 | 1 | 0 | 0.00 |
| | **group totals** | | **235** | **42** | **0** | **1** | **10** | **1** | |
| 3-13 | CUYAMA VALLEY | Southern Coast Ranges | 978 | 14 | 0 | 56.92 | 5 | 56 | 0.00 |
| 5-82 | CUDDY CANYON VALLEY | Southern Coast Ranges | 13 | 8 | 2,365 | 0.07 | 1 | 0 | 1.00 |
| 5-84 | CUDDY VALLEY | Southern Coast Ranges | 14 | 8 | 0 | 0.08 | 7 | 1 | 0.00 |
| 5-29 | CASTAC LAKE VALLEY | Southern Coast Ranges | 14 | 6 | 624 | 0.08 | 20 | 0 | 1.00 |
| 5-83 | CUDDY RANCH AREA | Southern Coast Ranges | 17 | 6 | 0 | 0.09 | 0 | 0 | 0.00 |
| | **group totals** | | **1,037** | **42** | **2,989** | **57** | **33** | **57** | |
| **Basins with more than 24 wells (+ no other significant factors)** | | | | | | | | | |
| 1-60 | LOWER RUSSIAN RIVER VALLEY | Northern Coast Ranges | 27 | 31 | 0 | 0.41 | 20 | 5 | 0.00 |
| 1-54 | ALEXANDER VALLEY | Northern Coast Ranges | 126 | 29 | 7,750 | 0 | 53 | 38 | 1.00 |
| 7-24 | BORREGO VALLEY | Desert Mountains | 617 | 27 | 0 | 7.23 | 9 | 11 | 0.00 |
| 5-21.54 | SACRAMENTO VALLEY | Central Valley | 76 | 26 | 0 | 7.13 | 17 | 23 | 0.00 |
| 6-67 | MARTIS VALLEY | Sierras | 147 | 25 | 12,800 | 0 | 40 | 0 | 1.00 |
| **Grouped basins with more than 24 wells (+ no other significant factors) in group** | | | | | | | | | |
| 5-28 | TEHACHAPI VALLEY WEST | Sierras | 73 | 33 | 10,337 | 0.39 | 9 | 10 | 1.00 |
| 5-27 | CUMMINGS VALLEY | Sierras | 41 | 18 | 0 | 0.22 | 0 | 9 | 0.00 |
| 6-45 | TEHACHAPI VALLEY EAST | Sierras | 97 | 11 | 0 | 0.72 | 0 | 4 | 0.00 |
| | **group totals** | | **210** | **62** | **10,337** | **1** | **9** | **23** | |
| **Basins with more than 12 wells (+ 2 or more other significant factors)** | | | | | | | | | |
| 5-22.05 | SAN JOAQUIN VALLEY | Central Valley | 644 | 22 | 6,800 | 86.85 | 28 | 234 | 1.00 |
| 5-22.09 | SAN JOAQUIN VALLEY | Central Valley | 2,590 | 18 | 8,000 | 556.03 | 30 | 935 | 0.58 |
| **Basins with more than 12 wells (+ 1 other significant factor)** | | | | | | | | | |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 4-3 | VENTURA RIVER VALLEY | Transverse and Selected Peninsular Range | 51 | 22 | 0 | 0 | 84 | 13 | 0.00 |
| 5-21.51 | SACRAMENTO VALLEY | Central Valley | 832 | 21 | 6,272 | 69.5 | 36 | 162 | 1.00 |
| 2-35 | WESTSIDE | Southern Coast Ranges | 103 | 19 | 14,820 | 0.15 | 473 | 4 | 0.17 |
| **Basins with priority lowered due to low density of wells** | | | | | | | | | |
| 5-33 | MODOC PLATEAU PLEISTOCENE VOL. AREA | Northern California Volcanics and Q Sed | 5,010 | 27 | 3,040 | 351.79 | 9 | 94 | 1.00 |

## CATEGORY 6

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| **Basins with more than 11 wells, no other significant factors** | | | | | | | | | |
| 6-43 | EL MIRAGE VALLEY | Desert Mountains | 307 | 22 | 0 | 2 | 11 | 4 | 0.00 |
| 7-19 | LUCERNE VALLEY | Desert Mountains | 597 | 21 | 0 | 1.2 | 4 | 13 | 0.00 |
| 5-2 | ALTURAS AREA | Northern California Volcanics and Q Sed | 737 | 18 | 2,982 | 0 | 6 | 31 | 1.03 |
| 6-7 | ANTELOPE VALLEY | Basin and Range | 81 | 18 | 0 | 10.06 | 2 | 6 | 0.00 |
| 6-47 | HARPER VALLEY | Desert Mountains | 1,657 | 16 | 0 | 26.04 | 7 | 13 | 0.00 |
| 4-5 | ACTON VALLEY | Desert Mountains | 33 | 15 | 0 | 2.11 | 1 | 1 | 0.00 |
| 5-12 | SIERRA VALLEY | Sierras | 515 | 14 | 0 | 0 | 2 | 11 | 0.00 |
| 6-46 | FREMONT VALLEY | Desert Mountains | 957 | 14 | 0 | 7.08 | 3 | 1 | 0.00 |
| 5-10 | AMERICAN VALLEY | Sierras | 28 | 13 | 6,228 | 0.75 | 17 | 3 | 1.00 |
| 6-20 | MIDDLE AMARGOSA VALLEY | Basin and Range | 1,577 | 13 | 0 | 0.01 | 2 | 1 | 0.00 |
| 7-5 | CHUCKWALLA VALLEY | Desert Mountains | 2,434 | 13 | 0 | 5.23 | 2 | 2 | 0.00 |
| 3-27 | SCOTTS VALLEY | Southern Coast Ranges | 3 | 12 | 0 | 0.24 | 13 | 0 | 0.00 |
| **Basins with 1 to 11 wells and 1 or more other significant factors** | | | | | | | | | |
| 1-2 | KLAMATH RIVER VALLEY | Northern California Volcanics and Q Sed | 653 | 10 | 1,500 | 0 | 8 | 154 | 1.00 |
| 1-3 | BUTTE VALLEY | Northern California Volcanics and Q Sed | 323 | 10 | 886 | 5.47 | 2 | 59 | 1.00 |
| 5-21.63 | SACRAMENTO VALLEY | Central Valley | 417 | 6 | 0 | 83.42 | 13 | 160 | 0.00 |
| 1-24 | MODOC PLATEAU PLEISTOCENE VOL. AREA | Northern California Volcanics and Q Sed | 2,107 | 5 | 0 | 384.99 | 1 | 38 | 0.00 |
| 2-33 | ISLAIS VALLEY | Southern Coast Ranges | 24 | 4 | 45,616 | 0.01 | 162 | 0 | 0.44 |
| 4-10 | CONEJO | Transverse and Selected Peninsular Range | 76 | 4 | 0 | 6.64 | 69 | 4 | 0.00 |
| 4-9 | SIMI VALLEY | Transverse and Selected Peninsular Range | 49 | 4 | 2,612 | 4.31 | 93 | 7 | 0.03 |
| 1-23 | MODOC PLATEAU RECENT VOLCANIC AREA | Northern California Volcanics and Q Sed | 1,194 | 3 | 0 | 98.74 | 0 | 29 | 0.00 |
| 6-103 | MODOC PLATEAU PLEISTOCENE VOL. AREA | Northern California Volcanics and Q Sed | 1,505 | 3 | 0 | 199.33 | 6 | 7 | 0.00 |
| 7-30 | IMPERIAL VALLEY | Desert Mountains | 3,876 | 3 | 0 | 0 | 164 | 831 | 0.00 |
| 5-32 | MODOC PLATEAU RECENT VOLCANIC AREA | Northern California Volcanics and Q Sed | 1,376 | 2 | 0 | 147.46 | 1 | 7 | 0.00 |
| 5-22.10 | SAN JOAQUIN VALLEY | Central Valley | 589 | 1 | 15,400 | 248.48 | 38 | 151 | 0.55 |
| **Basins with 1 to 11 wells, no other significant factors, but with a nonzero entry for one or more other factors** | | | | | | | | | |
| 1-19 | ANDERSON VALLEY | Northern Coast Ranges | 20 | 11 | 0 | 0.18 | 13 | 8 | 0.00 |
| 3-14 | SAN ANTONIO CREEK VALLEY | Southern Coast Ranges | 331 | 11 | 0 | 43.66 | 7 | 35 | 0.00 |
| 3-7 | CARMEL VALLEY | Southern Coast Ranges | 21 | 11 | 0 | 0 | 8 | 3 | 0.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 7-16 | AMES VALLEY | Desert Mountains | 439 | 11 | 0 | 0.88 | 0 | 0 | 0.00 |
| 2-22 | HALF MOON BAY TERRACE | Southern Coast Ranges | 37 | 10 | 0 | 0 | 40 | 9 | 0.00 |
| 5-14 | SCOTTS VALLEY | Northern Coast Ranges | 30 | 10 | 4,486 | 1.97 | 22 | 9 | 0.98 |
| 5-15 | BIG VALLEY | Northern Coast Ranges | 98 | 10 | 2,588 | 6.51 | 8 | 28 | 0.45 |
| 5-21.56 | SACRAMENTO VALLEY | Central Valley | 134 | 10 | 0 | 12.47 | 0 | 21 | 0.00 |
| 5-4 | BIG VALLEY | Northern California Volcanics and Q Sed | 373 | 9 | 442 | 9.46 | 5 | 30 | 1.00 |
| 7-13 | DEADMAN VALLEY | Desert Mountains | 479 | 9 | 0 | 0 | 0 | 0 | 0.00 |
| 7-41 | CALZONA VALLEY | Desert Mountains | 326 | 9 | 0 | 0 | 0 | 0 | 0.00 |
| 2-26 | PESCADERO VALLEY | Southern Coast Ranges | 12 | 8 | 0 | 0 | 6 | 4 | 0.00 |
| 3-6 | LOCKWOOD VALLEY | Southern Coast Ranges | 243 | 8 | 0 | 34.37 | 7 | 11 | 0.00 |
| 4-2 | OJAI VALLEY | Transverse and Selected Peninsular Range | 28 | 8 | 5,690 | 2.54 | 32 | 10 | 1.00 |
| 5-60 | HUMBUG VALLEY | Sierras | 40 | 8 | 2,200 | 1.3 | 12 | 0 | 1.00 |
| 5-9 | INDIAN VALLEY | Sierras | 119 | 8 | 0 | 9.72 | 9 | 1 | 0.00 |
| 6-8 | BRIDGEPORT VALLEY | Basin and Range | 131 | 8 | 600 | 12.44 | 0 | 5 | 1.00 |
| 9-11 | SANTA MARIA VALLEY | San Diego | 50 | 8 | 0 | 1.04 | 25 | 4 | 0.00 |
| 9-15 | SAN DIEGO RIVER VALLEY | San Diego | 40 | 8 | 0 | 0.83 | 54 | 3 | 0.00 |
| 1-57 | BODEGA BAY AREA | Northern Coast Ranges | 11 | 7 | 0 | 0 | 0 | 0 | 0.00 |
| 3-42 | CHORRO VALLEY | Southern Coast Ranges | 6 | 7 | 0 | 0 | 0 | 2 | 0.00 |
| 6-11 | LONG VALLEY | Basin and Range | 291 | 7 | 0 | 11.97 | 30 | 0 | 0.00 |
| 7-29 | COYOTE WELLS VALLEY | Desert Mountains | 589 | 7 | 0 | 6.9 | 2 | 1 | 0.00 |
| 1-53 | SANEL VALLEY | Northern Coast Ranges | 23 | 6 | 0 | 0.34 | 11 | 10 | 0.00 |
| 2-27 | SAND POINT AREA | Northern Coast Ranges | 6 | 6 | 0 | 0 | 0 | 0 | 0.00 |
| 2-4 | PITTSBURG PLAIN | Southern Coast Ranges | 47 | 6 | 6,660 | 0.2 | 53 | 1 | 0.12 |
| 2-5 | CLAYTON VALLEY | Southern Coast Ranges | 72 | 6 | 0 | 0.31 | 37 | 3 | 0.00 |
| 4-7 | ARROYO SANTA ROSA VALLEY | Transverse and Selected Peninsular Range | 15 | 6 | 0 | 1.32 | 2 | 6 | 0.00 |
| 5-11 | MOHAWK VALLEY | Sierras | 77 | 6 | 0 | 2.48 | 0 | 1 | 0.00 |
| 5-85 | MIL POTRERO AREA | Southern Coast Ranges | 9 | 6 | 0 | 0.05 | 1 | 0 | 0.00 |
| 6-18 | DEATH VALLEY | Basin and Range | 3,725 | 6 | 0 | 0 | 0 | 0 | 0.00 |
| 6-25 | BICYCLE VALLEY | Desert Mountains | 362 | 6 | 0 | 2.19 | 0 | 0 | 0.00 |
| 6-30 | IVANPAH VALLEY | Desert Mountains | 801 | 6 | 0 | 5.08 | 3 | 0 | 0.00 |
| 6-36 | LANGFORD VALLEY | Desert Mountains | 121 | 6 | 0 | 0 | 0 | 0 | 0.00 |
| 9-1 | SAN JUAN VALLEY | San Diego | 68 | 6 | 3,250 | 0 | 49 | 8 | 0.10 |
| 1-11 | COVELO ROUND VALLEY | Northern Coast Ranges | 66 | 5 | 0 | 8.97 | 8 | 5 | 0.00 |
| 1-61 | FORT ROSS TERRACE DEPOSITS | Northern Coast Ranges | 34 | 5 | 0 | 0.28 | 23 | 0 | 0.00 |
| 5-63 | STONYFORD TOWN AREA | Northern Coast Ranges | 26 | 5 | 0 | 0 | 0 | 2 | 0.00 |
| 6-38 | CAVES CANYON VALLEY | Desert Mountains | 295 | 5 | 0 | 1.86 | 0 | 0 | 0.00 |
| 8-6 | HEMET LAKE VALLEY | T not Desert Mountains | 68 | 5 | 0 | 9.19 | 2 | 1 | 0.00 |
| 9-2 | SAN MATEO VALLEY | San Diego | 12 | 5 | 0 | 0.15 | 0 | 1 | 0.00 |
| 1-16 | SEIAD VALLEY | Klamath | 9 | 4 | 0 | 0 | 1 | 0 | 0.00 |
| 1-26 | REDWOOD CREEK AREA | Northern Coast Ranges | 8 | 4 | 650 | 2.04 | 0 | 0 | 1.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 1-7 | HOOPA VALLEY | Klamath | 16 | 4 | 0 | 0 | 0 | 1 | 0.00 |
| 3-25 | TRES PINOS VALLEY | Southern Coast Ranges | 14 | 4 | 0 | 2.67 | 0 | 5 | 0.00 |
| 3-41 | MORRO VALLEY | Southern Coast Ranges | 3 | 4 | 0 | 1.49 | 3 | 1 | 0.00 |
| 4-21 | CONEJO-TIERRA REJADA VOLCANIC | Transverse and Selected Peninsular Range | 232 | 4 | 0 | 33.66 | 11 | 16 | 0.00 |
| 5-21.55 | SACRAMENTO VALLEY | Central Valley | 112 | 4 | 0 | 10.25 | 5 | 13 | 0.00 |
| 6-2 | MADELINE PLAINS | Northern California Volcanics and Q Sed | 632 | 4 | 0 | 4.11 | 1 | 16 | 0.00 |
| 6-33 | SODA LAKE VALLEY | Desert Mountains | 1,538 | 4 | 0 | 9.69 | 8 | 0 | 0.00 |
| 7-11 | COPPER MOUNTAIN VALLEY | Desert Mountains | 123 | 4 | 0 | 0.25 | 0 | 0 | 0.00 |
| 9-3 | SAN ONOFRE VALLEY | San Diego | 5 | 4 | 0 | 0.06 | 0 | 0 | 0.00 |
| 1-31 | WEOTT TOWN AREA | Northern Coast Ranges | 15 | 3 | 0 | 2.13 | 0 | 1 | 0.00 |
| 2-7 | SAN RAMON VALLEY | Southern Coast Ranges | 29 | 3 | 0 | 0.12 | 35 | 1 | 0.00 |
| 3-28 | SAN BENITO RIVER VALLEY | Southern Coast Ranges | 98 | 3 | 0 | 15.6 | 0 | 10 | 0.00 |
| 5-18 | COYOTE VALLEY | Northern Coast Ranges | 26 | 3 | 0 | 1.35 | 2 | 4 | 0.00 |
| 5-21.68 | SACRAMENTO VALLEY | Central Valley | 101 | 3 | 0 | 20.7 | 0 | 31 | 0.00 |
| 5-30 | LOWER LAKE VALLEY | Northern Coast Ranges | 10 | 3 | 0 | 0.65 | 2 | 1 | 0.00 |
| 5-69 | YOSEMITE VALLEY | Sierras | 30 | 3 | 0 | 0 | 0 | 1 | 0.00 |
| 6-1 | SURPRISE VALLEY | Northern California Volcanics and Q Sed | 924 | 3 | 650 | 75.33 | 0 | 37 | 1.00 |
| 7-2 | FENNER VALLEY | Desert Mountains | 1,831 | 3 | 0 | 3.68 | 2 | 0 | 0.00 |
| 7-35 | OGILBY VALLEY | Desert Mountains | 539 | 3 | 0 | 14.18 | 0 | 1 | 0.00 |
| 7-40 | QUIEN SABE POINT VALLEY | Desert Mountains | 102 | 3 | 0 | 0 | 0 | 2 | 0.00 |
| 7-47 | JACUMBA VALLEY | Desert Mountains | 10 | 3 | 0 | 0.12 | 4 | 0 | 0.00 |
| 7-9 | DALE VALLEY | Desert Mountains | 860 | 3 | 0 | 1.73 | 0 | 1 | 0.00 |
| 9-10 | SAN PASQUAL VALLEY | San Diego | 18 | 3 | 0 | 0.38 | 0 | 4 | 0.00 |
| 1-28 | MATTOLE RIVER VALLEY | Northern Coast Ranges | 13 | 2 | 0 | 0 | 0 | 0 | 0.00 |
| 1-32 | GARBERVILLE TOWN AREA | Northern Coast Ranges | 9 | 2 | 0 | 0 | 7 | 0 | 0.00 |
| 1-35 | HYAMPOM VALLEY | Klamath | 5 | 2 | 0 | 0 | 0 | 0 | 0.00 |
| 1-49 | ANAPOLIS OHLSON RANCH FM HIGHLANDS | Northern Coast Ranges | 35 | 2 | 0 | 0 | 9 | 2 | 0.00 |
| 1-51 | POTTER VALLEY | Northern Coast Ranges | 33 | 2 | 0 | 0.51 | 9 | 10 | 0.00 |
| 3-19 | CARRIZO PLAIN | Southern Coast Ranges | 852 | 2 | 0 | 1.33 | 0 | 27 | 0.00 |
| 3-20 | ANO NUEVO AREA | Southern Coast Ranges | 8 | 2 | 0 | 0.17 | 0 | 2 | 0.00 |
| 4-16 | HIDDEN VALLEY | Transverse and Selected Peninsular Range | 9 | 2 | 0 | 0.06 | 4 | 1 | 0.00 |
| 4-17 | LOCKWOOD VALLEY | Southern Coast Ranges | 88 | 2 | 0 | 10.11 | 0 | 0 | 0.00 |
| 5-13 | UPPER LAKE VALLEY | Northern Coast Ranges | 29 | 2 | 0 | 1.95 | 4 | 6 | 0.00 |
| 5-19 | COLLAYOMI VALLEY | Northern Coast Ranges | 26 | 2 | 5,766 | 1.34 | 5 | 3 | 1.00 |
| 5-35 | MCCLOUD AREA | Northern California Volcanics and Q Sed | 86 | 2 | 0 | 0 | 6 | 1 | 0.00 |
| 5-48 | BURNEY CREEK VALLEY | Northern California Volcanics and Q Sed | 10 | 2 | 5,240 | 0.07 | 9 | 0 | 1.00 |
| 5-5 | FALL RIVER VALLEY | Northern California Volcanics and Q Sed | 219 | 2 | 0 | 1.54 | 6 | 51 | 0.00 |
| 5-7 | LAKE ALMANOR VALLEY | Northern California Volcanics and Q Sed | 29 | 2 | 2,600 | 0.47 | 4 | 1 | 1.00 |
| 5-87 | MIDDLE FORK FEATHER RIVER | Sierras | 18 | 2 | 0 | 1.11 | 0 | 0 | 0.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 6-16 | EUREKA VALLEY | Basin and Range | 521 | 2 | 0 | 0 | 0 | 0 | 0.00 |
| 6-51 | PILOT KNOB VALLEY | Desert Mountains | 561 | 2 | 0 | 0 | 0 | 0 | 0.00 |
| 6-56 | ROSE VALLEY | Basin and Range | 172 | 2 | 0 | 0.02 | 0 | 0 | 0.00 |
| 6-6 | CARSON VALLEY | Sierras | 43 | 2 | 0 | 18.94 | 4 | 0 | 0.00 |
| 7-10 | TWENTYNINE PALMS VALLEY | Desert Mountains | 252 | 2 | 0 | 0.51 | 6 | 0 | 0.00 |
| 7-28 | VALLECITO-CARRIZO VALLEY | Desert Mountains | 493 | 2 | 0 | 5.77 | 0 | 0 | 0.00 |
| 7-42 | VIDAL VALLEY | Desert Mountains | 557 | 2 | 0 | 5.22 | 0 | 0 | 0.00 |
| 1-12 | LAYTONVILLE VALLEY | Northern Coast Ranges | 20 | 1 | 1,000 | 0 | 5 | 0 | 1.00 |
| 1-25 | PRAIRIE CREEK AREA | Northern Coast Ranges | 81 | 1 | 0 | 0 | 0 | 0 | 0.00 |
| 1-30 | PEPPERWOOD TOWN AREA | Northern Coast Ranges | 25 | 1 | 0 | 7.44 | 5 | 8 | 0.00 |
| 1-34 | DINSMORES TOWN AREA | Northern Coast Ranges | 9 | 1 | 0 | 2.69 | 0 | 1 | 0.00 |
| 1-37 | COTTONEVA CREEK VALLEY | Northern Coast Ranges | 3 | 1 | 0 | 0.03 | 2 | 0 | 0.00 |
| 1-50 | KNIGHTS VALLEY | Northern Coast Ranges | 17 | 1 | 0 | 0.25 | 0 | 4 | 0.00 |
| 2-11 | SUNOL VALLEY | Southern Coast Ranges | 67 | 1 | 0 | 0.02 | 6 | 15 | 0.00 |
| 2-30 | NOVATO VALLEY | Northern Coast Ranges | 83 | 1 | 43,450 | 0.1 | 56 | 2 | 0.79 |
| 3-29 | DRY LAKE VALLEY | Southern Coast Ranges | 6 | 1 | 0 | 1.12 | 1 | 1 | 0.00 |
| 3-30 | BITTER WATER VALLEY | Southern Coast Ranges | 130 | 1 | 0 | 18.9 | 0 | 14 | 0.00 |
| 3-32 | PEACH TREE VALLEY | Southern Coast Ranges | 40 | 1 | 0 | 5.61 | 0 | 5 | 0.00 |
| 3-5 | CHOLAME VALLEY | Southern Coast Ranges | 161 | 1 | 0 | 1.65 | 0 | 4 | 0.00 |
| 4-1 | UPPER OJAI VALLEY | Transverse and Selected Peninsular Range | 15 | 1 | 0 | 1.24 | 1 | 3 | 0.00 |
| 4-15 | TIERRA REJADA | Transverse and Selected Peninsular Range | 19 | 1 | 0 | 6.52 | 4 | 2 | 0.00 |
| 5-1 | GOOSE LAKE | Northern California Volcanics and Q Sed | 220 | 1 | 0 | 0 | 0 | 4 | 0.00 |
| 5-23 | PANOCHE VALLEY | Southern Coast Ranges | 134 | 1 | 0 | 2.32 | 0 | 1 | 0.00 |
| 5-50 | NORTH FORK BATTLE CREEK | Northern California Volcanics and Q Sed | 52 | 1 | 0 | 0.09 | 0 | 1 | 0.00 |
| 5-66 | CLEAR LAKE CACHE FORMATION | Northern Coast Ranges | 120 | 1 | 0 | 8 | 4 | 0 | 0.00 |
| 5-95 | MEADOW VALLEY | Sierras | 23 | 1 | 0 | 0.63 | 0 | 0 | 0.00 |
| 6-15 | DEEP SPRINGS VALLEY | Basin and Range | 121 | 1 | 0 | 0 | 0 | 0 | 0.00 |
| 6-22 | UPPER KINGSTON VALLEY | Desert Mountains | 715 | 1 | 0 | 1.44 | 1 | 0 | 0.00 |
| 6-32 | BROADWELL VALLEY | Desert Mountains | 372 | 1 | 0 | 2.43 | 0 | 0 | 0.00 |
| 6-74 | HARRISBURG FLATS | Basin and Range | 101 | 1 | 0 | 0 | 0 | 0 | 0.00 |
| 6-75 | WILDROSE CANYON | Basin and Range | 21 | 1 | 0 | 0 | 0 | 0 | 0.00 |
| 6-9 | MONO VALLEY | Basin and Range | 700 | 1 | 0 | 0 | 3 | 0 | 0.00 |
| 7-18 | JOHNSON VALLEY | Desert Mountains | 453 | 1 | 0 | 0 | 0 | 0 | 0.00 |
| 7-26 | TERWILLIGER VALLEY | Desert Mountains | 32 | 1 | 0 | 0.38 | 0 | 5 | 0.00 |
| 7-31 | OROCOPIA VALLEY | Desert Mountains | 389 | 1 | 0 | 4.28 | 0 | 0 | 0.00 |
| 7-33 | EAST SALTON SEA | Desert Mountains | 789 | 1 | 0 | 9.23 | 3 | 31 | 0.00 |
| 7-43 | CHEMEHUEVI VALLEY | Desert Mountains | 1,101 | 1 | 0 | 0.06 | 0 | 0 | 0.00 |
| 7-51 | LOST HORSE VALLEY | Desert Mountains | 70 | 1 | 0 | 0.14 | 0 | 0 | 0.00 |
| 7-59 | MASON VALLEY | Desert Mountains | 22 | 1 | 0 | 0.26 | 0 | 0 | 0.00 |
| 7-6 | PINTO VALLEY | Desert Mountains | 738 | 1 | 0 | 1.77 | 0 | 0 | 0.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 8-7 | BIG MEADOWS VALLEY | Transverse and Selected Peninsular Range | 57 | 1 | 0 | 1.5 | 3 | 0 | 0.00 |
| 9-22 | BATIQUITOS LAGOON VALLEY | San Diego | 3 | 1 | 0 | 0.24 | 4 | 1 | 0.00 |
| 9-28 | CAMPO VALLEY | San Diego | 14 | 1 | 0 | 0.25 | 4 | 0 | 0.00 |
| 9-29 | POTRERO VALLEY | San Diego | 8 | 1 | 0 | 0.14 | 0 | 0 | 0.00 |
| 9-6 | CAHUILLA VALLEY | Desert Mountains | 74 | 1 | 0 | 0.61 | 1 | 12 | 0.00 |
| **Basins with 0 wells, but 1 or more other significant factors** | | | | | | | | | |
| 2-39 | MARINA | Southern Coast Ranges | 9 | 0 | 0 | 0.01 | 190 | 0 | 0.00 |
| 2-40 | DOWNTOWN | Southern Coast Ranges | 31 | 0 | 0 | 0.01 | 780 | 0 | 0.00 |
| 2-6 | YGNACIO VALLEY | Southern Coast Ranges | 63 | 0 | 0 | 0.27 | 148 | 1 | 0.00 |
| 9-14 | MISSION VALLEY | San Diego | 30 | 0 | 0 | 0 | 208 | 0 | 0.00 |
| 9-16 | EL CAJON VALLEY | San Diego | 29 | 0 | 0 | 0.6 | 167 | 1 | 0.00 |
| **Basins with 0 wells, but non-zero entries for either lufts or pests** | | | | | | | | | |
| 1-13 | LITTLE LAKE VALLEY | Northern Coast Ranges | 41 | 0 | 0 | 0 | 28 | 1 | 0.00 |
| 1-15 | HAPPY CAMP TOWN AREA | Klamath | 11 | 0 | 0 | 0 | 2 | 0 | 0.00 |
| 1-18 | RED ROCK VALLEY | Northern California Volcanics and Q Sed | 36 | 0 | 0 | 0.62 | 1 | 7 | 0.00 |
| 1-20 | GARCIA RIVER VALLEY | Northern Coast Ranges | 9 | 0 | 0 | 0.08 | 0 | 1 | 0.00 |
| 1-38 | LOWER LAYTONVILLE VALLEY | Northern Coast Ranges | 9 | 0 | 0 | 0 | 6 | 1 | 0.00 |
| 1-41 | LITTLE VALLEY | Northern Coast Ranges | 3 | 0 | 0 | 0.03 | 0 | 1 | 0.00 |
| 1-43 | WILLIAMS VALLEY | Northern Coast Ranges | 7 | 0 | 0 | 0.9 | 0 | 1 | 0.00 |
| 1-46 | NAVARRO RIVER VALLEY | Northern Coast Ranges | 3 | 0 | 0 | 0.03 | 4 | 0 | 0.00 |
| 1-56 | McDOWELL VALLEY | Northern Coast Ranges | 6 | 0 | 0 | 0.09 | 0 | 3 | 0.00 |
| 1-6 | HAYFORK VALLEY | Klamath | 13 | 0 | 0 | 0 | 1 | 0 | 0.00 |
| 2-28 | ROSS VALLEY | Northern Coast Ranges | 7 | 0 | 0 | 0.01 | 22 | 0 | 0.00 |
| 2-29 | SAN RAFAEL VALLEY | Northern Coast Ranges | 4 | 0 | 0 | 0 | 37 | 0 | 0.00 |
| 2-31 | ARROYO DEL HAMBRE VALLEY | Southern Coast Ranges | 3 | 0 | 0 | 0.01 | 11 | 0 | 0.00 |
| 2-32 | VISITACION VALLEY | Southern Coast Ranges | 24 | 0 | 0 | 0.01 | 52 | 3 | 0.00 |
| 2-36 | SAN PEDRO VALLEY | Southern Coast Ranges | 3 | 0 | 0 | 0 | 9 | 0 | 0.00 |
| 2-37 | SOUTH SAN FRANCISCO | Southern Coast Ranges | 9 | 0 | 0 | 0 | 60 | 0 | 0.00 |
| 2-38 | LOBOS | Southern Coast Ranges | 10 | 0 | 0 | 0.01 | 68 | 0 | 0.00 |
| 2-8 | CASTRO VALLEY | Southern Coast Ranges | 7 | 0 | 0 | 0 | 58 | 0 | 0.00 |
| 3-22 | SANTA ANA VALLEY | Southern Coast Ranges | 11 | 0 | 0 | 2.15 | 0 | 4 | 0.00 |
| 3-24 | QUIEN SABE VALLEY | Southern Coast Ranges | 19 | 0 | 0 | 3.71 | 0 | 3 | 0.00 |
| 3-34 | ARROYO DE LA CRUZ VALLEY | Southern Coast Ranges | 4 | 0 | 0 | 0 | 0 | 1 | 0.00 |
| 3-36 | SANTA ROSA VALLEY | Southern Coast Ranges | 14 | 0 | 6,100 | 8.15 | 5 | 3 | 1.00 |
| 3-39 | OLD VALLEY | Southern Coast Ranges | 5 | 0 | 0 | 2.73 | 3 | 2 | 0.00 |
| 3-43 | RINCONADA VALLEY | Southern Coast Ranges | 10 | 0 | 0 | 1.48 | 0 | 3 | 0.00 |
| 3-44 | POZO VALLEY | Southern Coast Ranges | 28 | 0 | 0 | 3.93 | 0 | 3 | 0.00 |
| 3-45 | HUASNA VALLEY | Southern Coast Ranges | 19 | 0 | 0 | 1.12 | 0 | 5 | 0.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 3-47 | BIG SPRING AREA | Southern Coast Ranges | 30 | 0 | 0 | 0.3 | 0 | 1 | 0.00 |
| 3-50 | FELTON AREA | Southern Coast Ranges | 5 | 0 | 2,222 | 0.36 | 9 | 0 | 0.34 |
| 3-51 | MAJORS CREEK | Southern Coast Ranges | 1 | 0 | 0 | 0.01 | 0 | 1 | 0.00 |
| 3-52 | NEEDLE ROCK POINT | Southern Coast Ranges | 2 | 0 | 0 | 0.04 | 1 | 1 | 0.00 |
| 4-19 | THOUSAND OAKS AREA | Transverse and Selected Peninsular Range | 13 | 0 | 0 | 0.58 | 58 | 2 | 0.00 |
| 4-20 | RUSSELL VALLEY | Transverse and Selected Peninsular Range | 12 | 0 | 0 | 0.08 | 12 | 1 | 0.00 |
| 4-22 | MALIBU VALLEY | Transverse and Selected Peninsular Range | 2 | 0 | 0 | 0.02 | 7 | 0 | 0.00 |
| 5-17 | BURNS VALLEY | Northern Coast Ranges | 12 | 0 | 0 | 0.77 | 9 | 0 | 0.00 |
| 5-21.53 | SACRAMENTO VALLEY | Central Valley | 84 | 0 | 0 | 4.29 | 1 | 5 | 0.00 |
| 5-26 | WALKER BASIN CREEK VALLEY | Sierras | 31 | 0 | 0 | 0.17 | 0 | 1 | 0.00 |
| 5-36 | ROUND VALLEY | Northern California Volcanics and Q Sed | 29 | 0 | 0 | 0.75 | 0 | 1 | 0.00 |
| 5-40 | HOT SPRINGS VALLEY | Northern California Volcanics and Q Sed | 10 | 0 | 0 | 0.07 | 0 | 1 | 0.00 |
| 5-45 | CAYTON VALLEY | Northern California Volcanics and Q Sed | 5 | 0 | 0 | 0.04 | 0 | 1 | 0.00 |
| 5-47 | GOOSE VALLEY | Northern California Volcanics and Q Sed | 17 | 0 | 0 | 0.12 | 0 | 6 | 0.00 |
| 5-62 | ELK CREEK AREA | Northern Coast Ranges | 6 | 0 | 0 | 0 | 0 | 2 | 0.00 |
| 5-64 | BEAR VALLEY | Northern Coast Ranges | 37 | 0 | 0 | 2.45 | 1 | 0 | 0.00 |
| 5-68 | POPE VALLEY | Northern Coast Ranges | 29 | 0 | 0 | 1.48 | 2 | 6 | 0.00 |
| 5-86 | JOSEPH CREEK | Northern California Volcanics and Q Sed | 18 | 0 | 0 | 0.46 | 0 | 1 | 0.00 |
| 5-91 | ANTELOPE CREEK | Northern Coast Ranges | 8 | 0 | 0 | 1.45 | 0 | 1 | 0.00 |
| 5-92 | BLANCHARD VALLEY | Northern Coast Ranges | 9 | 0 | 0 | 3.16 | 0 | 1 | 0.00 |
| 6-104 | LONG VALLEY | Sierras | 189 | 0 | 0 | 4.49 | 0 | 1 | 0.00 |
| 6-14 | FISH LAKE VALLEY | Basin and Range | 195 | 0 | 0 | 0 | 0 | 16 | 0.00 |
| 6-24 | RED PASS VALLEY | Desert Mountains | 390 | 0 | 0 | 0.08 | 13 | 0 | 0.00 |
| 6-28 | PAHRUMP VALLEY | Desert Mountains | 376 | 0 | 0 | 2.34 | 2 | 0 | 0.00 |
| 6-29 | MESQUITE VALLEY | Desert Mountains | 357 | 0 | 0 | 2.22 | 0 | 8 | 0.00 |
| 6-3 | WILLOW CREEK VALLEY | Northern California Volcanics and Q Sed | 47 | 0 | 0 | 1.12 | 0 | 3 | 0.00 |
| 6-52 | SEARLES VALLEY | Basin and Range | 797 | 0 | 4,000 | 0.04 | 7 | 0 | 1.00 |
| 6-95 | DRY VALLEY | Northern California Volcanics and Q Sed | 26 | 0 | 0 | 0.17 | 0 | 1 | 0.00 |
| 7-22 | WEST SALTON SEA | Desert Mountains | 426 | 0 | 0 | 4.99 | 1 | 1 | 0.00 |
| 7-25 | OCOTILLO-CLARK VALLEY | Desert Mountains | 899 | 0 | 0 | 10.53 | 0 | 28 | 0.00 |
| 7-27 | SAN FELIPE VALLEY | Desert Mountains | 95 | 0 | 0 | 1.11 | 1 | 2 | 0.00 |
| 7-34 | AMOS VALLEY | Desert Mountains | 526 | 0 | 0 | 6.15 | 4 | 2 | 0.00 |
| 7-8 | BRISTOL VALLEY | Desert Mountains | 2,011 | 0 | 0 | 8.74 | 3 | 3 | 0.00 |
| 9-12 | SAN DIEGUITO CREEK | San Diego | 14 | 0 | 0 | 0.3 | 7 | 3 | 0.00 |
| 9-13 | POWAY VALLEY | San Diego | 10 | 0 | 0 | 0.21 | 25 | 0 | 0.00 |
| 9-18 | OTAY VALLEY | San Diego | 28 | 0 | 0 | 0.6 | 46 | 3 | 0.00 |
| 9-19 | TIA JUANA | San Diego | 30 | 0 | 0 | 0.53 | 14 | 1 | 0.00 |
| 9-23 | SAN ELIJO VALLEY | San Diego | 4 | 0 | 0 | 0.28 | 0 | 2 | 0.00 |
| 9-25 | RANCHITA TOWN AREA | Desert Mountains | 13 | 0 | 0 | 0.85 | 1 | 0 | 0.00 |
| 9-32 | SAN MARCOS AREA | San Diego | 9 | 0 | 0 | 0.68 | 56 | 0 | 0.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 9-9 | ESCONDIDO VALLEY | San Diego | 12 | 0 | 0 | 0.92 | 64 | 0 | 0.00 |
| **Basins with 0 wells, 0 lufts and 0 pests, but non-zero entry for ag_pumping** | | | | | | | | | |
| 1-17 | BRAY TOWN AREA | Northern California Volcanics and Q Sed | 33 | 0 | 0 | 0.55 | 0 | 0 | 0.00 |
| 1-22 | FAIRCHILD SWAMP VALLEY | Northern California Volcanics and Q Sed | 13 | 0 | 0 | 0.28 | 0 | 0 | 0.00 |
| 1-33 | LARABEE VALLEY | Northern Coast Ranges | 4 | 0 | 0 | 1.14 | 0 | 0 | 0.00 |
| 1-36 | HETTENSHAW VALLEY | Northern Coast Ranges | 3 | 0 | 0 | 1 | 0 | 0 | 0.00 |
| 1-44 | EDEN VALLEY | Northern Coast Ranges | 6 | 0 | 0 | 0.75 | 0 | 0 | 0.00 |
| 1-45 | BIG RIVER VALLEY | Northern Coast Ranges | 7 | 0 | 0 | 0.12 | 0 | 0 | 0.00 |
| 3-23 | UPPER SANTA ANA VALLEY | Southern Coast Ranges | 6 | 0 | 0 | 1.13 | 0 | 0 | 0.00 |
| 3-31 | HERNANDEZ VALLEY | Southern Coast Ranges | 12 | 0 | 0 | 2.26 | 0 | 0 | 0.00 |
| 3-33 | SAN CARPOFORO VALLEY | Southern Coast Ranges | 4 | 0 | 0 | 2.44 | 0 | 0 | 0.00 |
| 3-35 | SAN SIMEON VALLEY | Southern Coast Ranges | 2 | 0 | 0 | 1.28 | 0 | 0 | 0.00 |
| 3-37 | VILLA VALLEY | Southern Coast Ranges | 5 | 0 | 0 | 3.14 | 0 | 0 | 0.00 |
| 3-38 | CAYUCOS VALLEY | Southern Coast Ranges | 1 | 0 | 0 | 0.76 | 0 | 0 | 0.00 |
| 3-40 | TORO VALLEY | Southern Coast Ranges | 3 | 0 | 0 | 1.67 | 0 | 0 | 0.00 |
| 3-46 | RAFAEL VALLEY | Southern Coast Ranges | 12 | 0 | 0 | 0.12 | 0 | 0 | 0.00 |
| 4-18 | HUNGRY VALLEY | Transverse and Selected Peninsular Range | 21 | 0 | 0 | 1.35 | 0 | 0 | 0.00 |
| 5-16 | HIGH VALLEY | Northern Coast Ranges | 10 | 0 | 0 | 0.63 | 0 | 0 | 0.00 |
| 5-20 | BERRYESSA VALLEY | Northern Coast Ranges | 6 | 0 | 0 | 0.56 | 0 | 0 | 0.00 |
| 5-3 | JESS VALLEY | Northern California Volcanics and Q Sed | 27 | 0 | 0 | 0.69 | 0 | 0 | 0.00 |
| 5-31 | LONG VALLEY | Northern Coast Ranges | 11 | 0 | 0 | 0.75 | 0 | 0 | 0.00 |
| 5-37 | TOAD WELL AREA | Northern California Volcanics and Q Sed | 14 | 0 | 0 | 0.1 | 0 | 0 | 0.00 |
| 5-38 | PONDOSA TOWN AREA | Northern California Volcanics and Q Sed | 8 | 0 | 0 | 0.06 | 0 | 0 | 0.00 |
| 5-41 | EGG LAKE VALLEY | Northern California Volcanics and Q Sed | 17 | 0 | 0 | 0.42 | 0 | 0 | 0.00 |
| 5-43 | ROCK PRAIRIE VALLEY | Northern California Volcanics and Q Sed | 23 | 0 | 0 | 0.59 | 0 | 0 | 0.00 |
| 5-44 | LONG VALLEY | Northern California Volcanics and Q Sed | 4 | 0 | 0 | 0.11 | 0 | 0 | 0.00 |
| 5-46 | LAKE BRITTON AREA | Northern California Volcanics and Q Sed | 57 | 0 | 0 | 0.4 | 0 | 0 | 0.00 |
| 5-49 | DRY BURNEY CREEK VALLEY | Northern California Volcanics and Q Sed | 12 | 0 | 0 | 0.09 | 0 | 0 | 0.00 |
| 5-51 | BUTTE CREEK VALLEY | Northern California Volcanics and Q Sed | 13 | 0 | 0 | 0.09 | 0 | 0 | 0.00 |
| 5-52 | GRAYS VALLEY | Northern California Volcanics and Q Sed | 22 | 0 | 0 | 0.16 | 0 | 0 | 0.00 |
| 5-53 | DIXIE VALLEY | Northern California Volcanics and Q Sed | 20 | 0 | 0 | 0.14 | 0 | 0 | 0.00 |
| 5-54 | ASH VALLEY | Northern California Volcanics and Q Sed | 24 | 0 | 0 | 0.62 | 0 | 0 | 0.00 |
| 5-56 | YELLOW CREEK VALLEY | Sierras | 9 | 0 | 0 | 0.15 | 0 | 0 | 0.00 |
| 5-57 | LAST CHANCE CREEK VALLEY | Sierras | 19 | 0 | 0 | 0.51 | 0 | 0 | 0.00 |
| 5-58 | CLOVER VALLEY | Sierras | 68 | 0 | 0 | 1.85 | 0 | 0 | 0.00 |
| 5-59 | GRIZZLY VALLEY | Sierras | 54 | 0 | 0 | 1.73 | 0 | 0 | 0.00 |
| 5-70 | LOS BANOS CREEK VALLEY | Southern Coast Ranges | 20 | 0 | 0 | 0.33 | 0 | 0 | 0.00 |
| 5-71 | VALLECITOS CREEK VALLEY | Southern Coast Ranges | 61 | 0 | 0 | 1.04 | 0 | 0 | 0.00 |
| 5-8 | MOUNTAIN MEADOWS VALLEY | Northern California Volcanics and Q Sed | 33 | 0 | 0 | 1.06 | 0 | 0 | 0.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 5-89 | SQUAW FLAT | Northern Coast Ranges | 5 | 0 | 0 | 0.92 | 0 | 0 | 0.00 |
| 5-90 | FUNKS CREEK | Northern Coast Ranges | 12 | 0 | 0 | 2.14 | 0 | 0 | 0.00 |
| 5-93 | NORTH FORK CACHE CREEK | Northern Coast Ranges | 14 | 0 | 0 | 0.93 | 0 | 0 | 0.00 |
| 5-94 | MIDDLE CREEK | Northern Coast Ranges | 3 | 0 | 0 | 0.19 | 0 | 0 | 0.00 |
| 6-100 | SECRET VALLEY | Northern California Volcanics and Q Sed | 136 | 0 | 0 | 3.23 | 0 | 0 | 0.00 |
| 6-101 | BULL FLAT | Northern California Volcanics and Q Sed | 73 | 0 | 0 | 0.66 | 0 | 0 | 0.00 |
| 6-102 | MODOC PLATEAU REC. Volcanics | Northern California Volcanics and Q Sed | 8 | 0 | 0 | 0.19 | 0 | 0 | 0.00 |
| 6-105 | SLINKARD VALLEY | Basin and Range | 18 | 0 | 0 | 2.26 | 0 | 0 | 0.00 |
| 6-106 | LITTLE ANTELOPE VALLEY | Basin and Range | 10 | 0 | 0 | 1.25 | 0 | 0 | 0.00 |
| 6-107 | SWEETWATER FLAT | Basin and Range | 19 | 0 | 0 | 1.8 | 0 | 0 | 0.00 |
| 6-13 | BLACK SPRINGS VALLEY | Basin and Range | 125 | 0 | 0 | 1.58 | 0 | 0 | 0.00 |
| 6-23 | RIGGS VALLEY | Desert Mountains | 354 | 0 | 0 | 0.18 | 0 | 0 | 0.00 |
| 6-31 | KELSO VALLEY | Desert Mountains | 1,031 | 0 | 0 | 6.5 | 0 | 0 | 0.00 |
| 6-34 | SILVER LAKE VALLEY | Desert Mountains | 142 | 0 | 0 | 0.89 | 0 | 0 | 0.00 |
| 6-35 | CRONISE VALLEY | Desert Mountains | 511 | 0 | 0 | 3.22 | 0 | 0 | 0.00 |
| 6-37 | COYOTE LAKE VALLEY | Desert Mountains | 357 | 0 | 0 | 2.48 | 0 | 0 | 0.00 |
| 6-48 | GOLDSTONE VALLEY | Desert Mountains | 114 | 0 | 0 | 0.77 | 0 | 0 | 0.00 |
| 6-49 | SUPERIOR VALLEY | Desert Mountains | 487 | 0 | 0 | 3.29 | 0 | 0 | 0.00 |
| 6-50 | CUDDEBACK VALLEY | Desert Mountains | 384 | 0 | 0 | 2.41 | 0 | 0 | 0.00 |
| 6-68 | SANTA ROSA FLAT | Basin and Range | 68 | 0 | 0 | 0.18 | 0 | 0 | 0.00 |
| 6-69 | KELSO LANDER VALLEY | Sierras | 45 | 0 | 0 | 0.33 | 0 | 0 | 0.00 |
| 6-70 | CACTUS FLAT | Basin and Range | 28 | 0 | 0 | 0.37 | 0 | 0 | 0.00 |
| 6-79 | CALIFORNIA VALLEY | Desert Mountains | 235 | 0 | 0 | 0.45 | 0 | 0 | 0.00 |
| 6-89 | KANE WASH AREA | Desert Mountains | 24 | 0 | 0 | 0.15 | 0 | 0 | 0.00 |
| 6-90 | CADY FAULT AREA | Desert Mountains | 32 | 0 | 0 | 0.2 | 0 | 0 | 0.00 |
| 6-91 | COW HEAD LAKE VALLEY | Northern California Volcanics and Q Sed | 23 | 0 | 0 | 3.17 | 0 | 0 | 0.00 |
| 6-92 | PINE CREEK VALLEY | Northern California Volcanics and Q Sed | 39 | 0 | 0 | 0.91 | 0 | 0 | 0.00 |
| 6-93 | HARVEY VALLEY | Northern California Volcanics and Q Sed | 18 | 0 | 0 | 0.43 | 0 | 0 | 0.00 |
| 6-94 | GRASSHOPPER VALLEY | Northern California Volcanics and Q Sed | 71 | 0 | 0 | 0.46 | 0 | 0 | 0.00 |
| 6-96 | EAGLE LAKE AREA | Northern California Volcanics and Q Sed | 51 | 0 | 0 | 1.22 | 0 | 0 | 0.00 |
| 6-97 | HORSE LAKE VALLEY | Northern California Volcanics and Q Sed | 15 | 0 | 0 | 1.11 | 0 | 0 | 0.00 |
| 6-99 | PAINTERS FLAT | Northern California Volcanics and Q Sed | 26 | 0 | 0 | 0.17 | 0 | 0 | 0.00 |
| 7-1 | LANFAIR VALLEY | Desert Mountains | 633 | 0 | 0 | 0.66 | 0 | 0 | 0.00 |
| 7-14 | LAVIC VALLEY | Desert Mountains | 414 | 0 | 0 | 5.94 | 0 | 0 | 0.00 |
| 7-15 | BESSEMER VALLEY | Desert Mountains | 158 | 0 | 0 | 0.64 | 0 | 0 | 0.00 |
| 7-17 | MEANS VALLEY | Desert Mountains | 60 | 0 | 0 | 0.12 | 0 | 0 | 0.00 |
| 7-3 | WARD VALLEY | Desert Mountains | 2,256 | 0 | 0 | 4.54 | 0 | 0 | 0.00 |
| 7-32 | CHOCOLATE VALLEY | Desert Mountains | 522 | 0 | 0 | 6.07 | 0 | 0 | 0.00 |
| 7-37 | ARROYO SECO VALLEY | Desert Mountains | 1,038 | 0 | 0 | 13.68 | 0 | 0 | 0.00 |
| 7-4 | RICE VALLEY | Desert Mountains | 761 | 0 | 0 | 1.41 | 0 | 0 | 0.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 7-46 | CANEBRAKE VALLEY | Desert Mountains | 22 | 0 | 0 | 0.26 | 0 | 0 | 0.00 |
| 7-48 | HELENDALE FAULT VALLEY | | 11 | 0 | 0 | 0.02 | 0 | 0 | 0.00 |
| 7-49 | PIPES CANYON FAULT VALLEY | | 14 | 0 | 0 | 0.03 | 0 | 0 | 0.00 |
| 7-50 | IRON RIDGE AREA | Desert Mountains | 21 | 0 | 0 | 0.04 | 0 | 0 | 0.00 |
| 7-52 | PLEASANT VALLEY | Desert Mountains | 39 | 0 | 0 | 0.08 | 0 | 0 | 0.00 |
| 7-53 | HEXIE MOUNTAIN AREA | Desert Mountains | 45 | 0 | 0 | 0.09 | 0 | 0 | 0.00 |
| 7-54 | BUCK RIDGE FAULT VALLEY | Desert Mountains | 28 | 0 | 0 | 0.33 | 0 | 0 | 0.00 |
| 7-55 | COLLINS VALLEY | Desert Mountains | 29 | 0 | 0 | 0.33 | 0 | 0 | 0.00 |
| 7-56 | YAQUI WELL AREA | Desert Mountains | 61 | 0 | 0 | 0.71 | 0 | 0 | 0.00 |
| 7-61 | DAVIES VALLEY | Desert Mountains | 14 | 0 | 0 | 0.17 | 0 | 0 | 0.00 |
| 7-63 | VANDEVENTER FLAT | Desert Mountains | 27 | 0 | 0 | 0.32 | 0 | 0 | 0.00 |
| 7-7 | CADIZ VALLEY | Desert Mountains | 1,092 | 0 | 0 | 2.2 | 0 | 0 | 0.00 |
| 8-8 | SEVEN OAKS VALLEY | Transverse and Selected Peninsular Range | 16 | 0 | 0 | 0.43 | 0 | 0 | 0.00 |
| 9-24 | PAMO VALLEY | San Diego | 6 | 0 | 0 | 0.13 | 0 | 0 | 0.00 |
| 9-27 | COTTONWOOD VALLEY | San Diego | 16 | 0 | 0 | 0.27 | 0 | 0 | 0.00 |
| **Basins with no entries** | | | | | | | | | |
| 1-29 | HONEYDEW TOWN AREA | Northern Coast Ranges | 10 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 1-39 | BRANSCOMB TOWN AREA | Northern Coast Ranges | 6 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 1-40 | TEN MILE RIVER VALLEY | Northern Coast Ranges | 6 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 1-42 | SHERWOOD VALLEY | Northern Coast Ranges | 5 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 1-48 | GRAVELLY VALLEY | Northern Coast Ranges | 12 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 1-62 | WILSON POINT AREA | Klamath | 3 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 2-24 | SAN GREGORIO VALLEY | Southern Coast Ranges | 4 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 5-61 | CHROME TOWN AREA | Northern Coast Ranges | 6 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 5-65 | LITTLE INDIAN VALLEY | Northern Coast Ranges | 5 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 5-88 | STONY GORGE RESERVOIR | Northern Coast Ranges | 4 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-10 | ADOBE LAKE VALLEY | Basin and Range | 161 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-17 | SALINE VALLEY | Basin and Range | 592 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-19 | WINGATE VALLEY | Basin and Range | 288 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-21 | LOWER KINGSTON VALLEY | Desert Mountains | 970 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-26 | AVAWATZ VALLEY | Desert Mountains | 112 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-27 | LEACH VALLEY | Desert Mountains | 248 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-53 | SALT WELLS VALLEY | Basin and Range | 119 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-55 | COSO VALLEY | Basin and Range | 103 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-57 | DARWIN VALLEY | Basin and Range | 179 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-58 | PANAMINT VALLEY | Basin and Range | 1,049 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-61 | CAMEO AREA | Basin and Range | 38 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-62 | RACE TRACK VALLEY | Basin and Range | 57 | 0 | 0 | 0 | 0 | 0 | 0.00 |

| GW ID | Groundwater Basin | Province | Area (km2) | No. of Public Wells | Municipal Pop'n | Ag pumping Wells (10Mgpd) | No. Of LUFTs | No. of Pesticide (sq. miles) | Proportion of Drink Water from GW |
|---|---|---|---|---|---|---|---|---|---|
| 6-63 | HIDDEN VALLEY | Basin and Range | 73 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-64 | MARBLE CANYON AREA | Basin and Range | 42 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-65 | COTTONWOOD SPRING AREA | Basin and Range | 16 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-66 | LEE FLAT | Basin and Range | 82 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-71 | LOST LAKE VALLEY | Basin and Range | 94 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-72 | COLES FLAT | Basin and Range | 12 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-73 | WILD HORSE MESA AREA | Basin and Range | 13 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-76 | BROWN MOUNTAIN VALLEY | Basin and Range | 88 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-77 | GRASS VALLEY | Desert Mountains | 40 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-78 | DENNING SPRING VALLEY | Desert Mountains | 29 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-80 | MIDDLE PARK CANYON | Basin and Range | 7 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-81 | BUTTE VALLEY | Basin and Range | 36 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-82 | SPRING CANYON VALLEY | Basin and Range | 19 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-84 | GREENWATER VALLEY | Basin and Range | 242 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-85 | GOLD VALLEY | Basin and Range | 13 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-86 | RHODES HILL AREA | Basin and Range | 63 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-88 | OWL LAKE VALLEY | Basin and Range | 90 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 6-98 | TULEDAD CANYON VALLEY | Northern California Volcanics and Q Sed | 21 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 7-45 | PIUTE VALLEY | Desert Mountains | 709 | 0 | 0 | 0 | 0 | 0 | 0.00 |

# APPENDIX E

# FRAMEWORK FOR A GROUND-WATER QUALITY MONITORING AND ASSESSMENT PROGRAM FOR CALIFORNIA (USGS)