



Groundwater Primer – Part 2 Santa Rosa Plain Characterization & Management Planning

Updated July 2013

GROUNDWATER CHARACTERIZATION

A significant study has been completed to characterize the surface water and groundwater resources of the Santa Rosa Plain Watershed (Figure 10). Groundwater in the Santa Rosa Plain is a critical resource for its residents, agriculture, businesses and ecosystems. The study

provides a wealth of information and valuable tools for local stakeholders to use in protecting and managing the region's groundwater resources. The seven-year study was conducted by U.S. Geological Survey (USGS) scientists as part of a cooperative program with the Sonoma County Water Agency to study the major groundwater basins of Sonoma County. Additional funding for the study was provided by the cities of Cotati, Rohnert Park, Santa Rosa, Sebastopol, town of Windsor, Cal-American Water Company, and County of Sonoma. The completion of the study by USGS scientists brings state-of-the-art tools and a rigorous scientific approach. This Groundwater Primer provides a summary of important findings from the study.

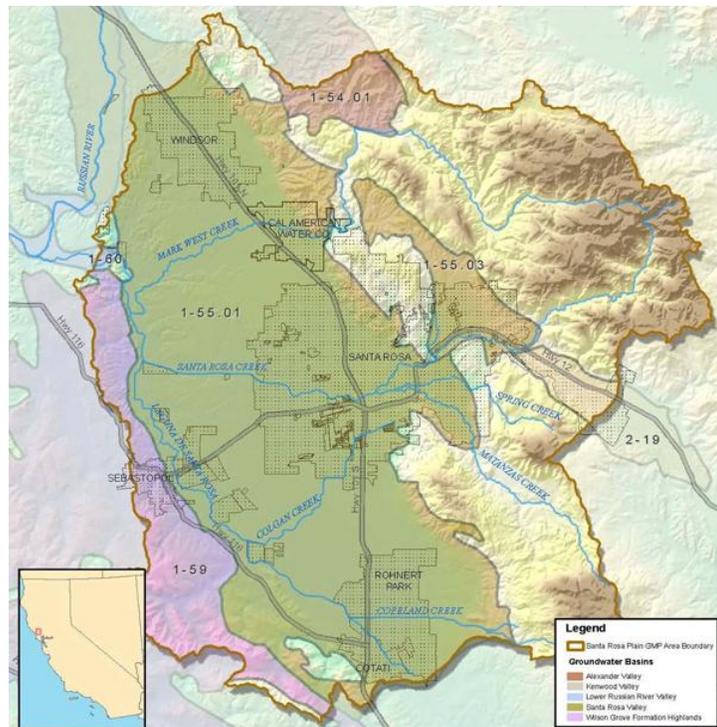


Figure 10: Map of Santa Rosa Plain Watershed and Groundwater Basins.

How to Stay Involved

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The Santa Rosa Plain Watershed study area covers approximately 167,000 acres (261 square miles) and is home to approximately half of the population of Sonoma County, including the Cities of Santa Rosa, Rohnert Park, Cotati, Sebastopol, Town of Windsor, and unincorporated areas of Sonoma County. The Santa Rosa Plain Watershed is the drainage area for the Santa Rosa Plain groundwater subbasin and also encompasses the Rincon Valley, north half of the Kenwood Valley and eastern portions of the Wilson Grove groundwater basins and subbasins, small portions of the Alexander Area and Lower Russian River subbasins, as well as upland areas.

Santa Rosa Creek, Mark West Creek, and the Laguna de Santa Rosa (Laguna) provide the main surface water drainage for the area. Santa Rosa and Mark West Creeks originate in the Mayacamas Mountains and generally flow from east to west. The Laguna runs primarily to the north along the western margin of the basin and is a swampy, intermittent drainage course that drains much of the groundwater basin and provides habitat for ecosystems. The groundwater system beneath the Santa Rosa Plain provides numerous benefits to the region, including rural residential and municipal water supplies, irrigation water for agriculture, and baseflow to streams, surface water bodies and associated ecosystems.

Stream flow within the Santa Rosa Plain Watershed is characterized as having a rapid response to precipitation events. Baseflow is a minor component of total mean streamflow, but it constitutes the only summer flow during the dry, summer months. The majority of the stream reaches within the Santa Rosa Plain Watershed are intermittent. In the Laguna de Santa Rosa floodplain, streamflow can be affected by backwater from the Russian River during heavy winter flows. Flow can reverse during periods of flooding on the Russian River.

Communities within the Santa Rosa Plain Watershed rely on a combination of imported surface water from the Russian River and local groundwater to meet water supply demands. During drier years, when there is greater demand for water and less surface water is available, groundwater resources are relied on more. There are over 12,000 permitted water wells in the basin and these provide water for a variety of uses, including both urban and rural areas, agricultural irrigation, and commercial and industrial uses. Future growth in population and demand for water coupled with a changing climate and constraints on existing surface water sources are likely to increase stresses on the region's groundwater resources.

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Climate Change

Climate change is predicted to be a significant challenge to managing the surface water and groundwater system in the Santa Rosa Plain Watershed (Flint and Flint, 2012). Hydrologic models predict reduced early and late wet season runoff for the end of the century for both wetter and drier future climate projections, which could result in an extended dry season. In fact, summers are projected to be longer and drier in the future than in the past regardless of precipitation trends. While

water supply could be subject to increased variability (that is, reduced reliability) due to greater variability in precipitation, irrigation water demand is likely to steadily increase because of increased evapotranspiration rates and climatic water deficit during the extended summers. Extended dry season conditions and the potential for drought, combined with unprecedented increases in precipitation, could serve as additional stressors on water quality and habitat.

Santa Rosa Plain Geology

The study reveals a large geologically complex groundwater basin, with faulting, and multiple aquifers, that exhibits wide variations in well yields and groundwater quality in different areas. A large portion of Sonoma County is made up of bedrock that does not hold much groundwater. In the Santa Rosa Plain Watershed, however, thick sedimentary layers and volcanic rocks overlie this bedrock and are capable of storing and yielding large quantities of groundwater where they are sufficiently permeable.

The four main geologic units (groups of rocks with similar characteristics) which form the primary aquifers in the Santa Rosa Plain are sedimentary deposits of the Alluvium/Glen Ellen Formation, the Wilson Grove Formation, the Petaluma Formation, and the Sonoma Volcanics (Figure 11).

The basin's best water-producing units are stream channels filled with alluvial (water and air laid sand, silt, clay and gravel) sands and gravels; basin-fill alluvium and alluvial fan deposits that connect the Santa Rosa Plain with its bordering hills; and massive sandstone units of the Wilson Grove Formation extending beneath the basin from the low western hills. The Sonoma Volcanics, a thick sequence of lava flows present along the eastern boundary of the basin, and the Petaluma Formation, a shale and sandstone unit that extends beneath much of the deeper portions of the basin, produce variable amounts of water.

The recent studies conducted by the USGS have revealed the basin is divided by northwest trending faults, some of which serve as groundwater barriers, offsetting the geologic units and forming five hydrogeologic compartments: the Windsor, Cotati, Wilson Grove, Valley, and Uplands. The two primary compartments, Windsor in the north and Cotati in the south, which are separated by the Trenton fault, represent the deepest parts of the basin and range from 6,000 to 10,000 feet deep. The study does not conclude whether aquifers at these great depths are productive enough or contain sufficient water quality to be usable.

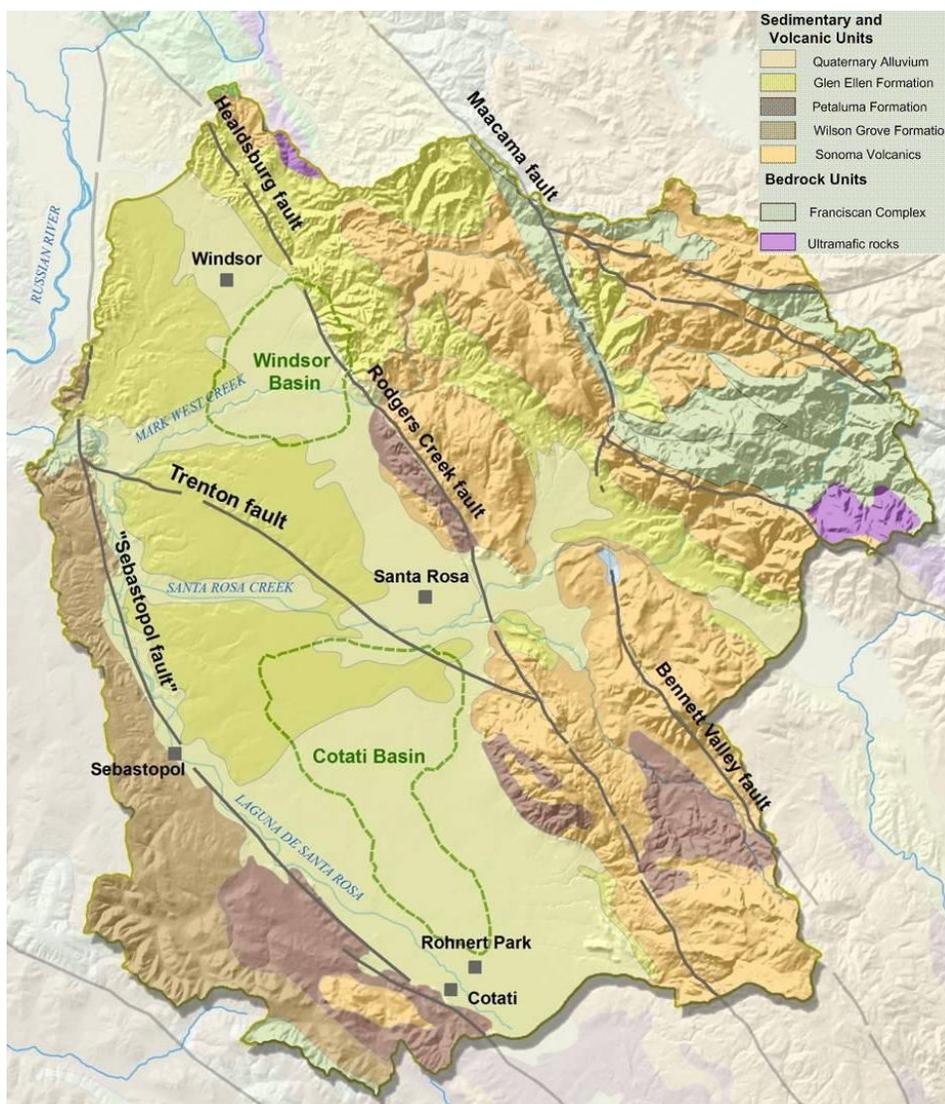


Figure 11: Generalized Geologic Map of the Santa Rosa Plain area showing the distribution of geologic units and faults.

Groundwater Recharge and Discharge in the Santa Rosa Plain Watershed

Groundwater generally flows from the recharge areas (e.g., highlands to the east and west of the basin) towards the Laguna de Santa Rosa on the west side of the Santa Rosa Plain groundwater subbasin (Figure 12). This general pattern can be disrupted locally due to exchanges with other surface water features within the basin, the presence of fault zones and the pumping of groundwater from water wells. Study results indicate that the Rodgers Creek Fault Zone forms a barrier to groundwater flow, and the Sebastopol Fault may also act as a partial barrier to groundwater flow. Groundwater within shallow aquifers is relatively young, often less than 50 years old, while groundwater within deeper aquifers commonly exceeds 4,000 years in age, with the oldest dated groundwater exceeding 30,000 years in age.

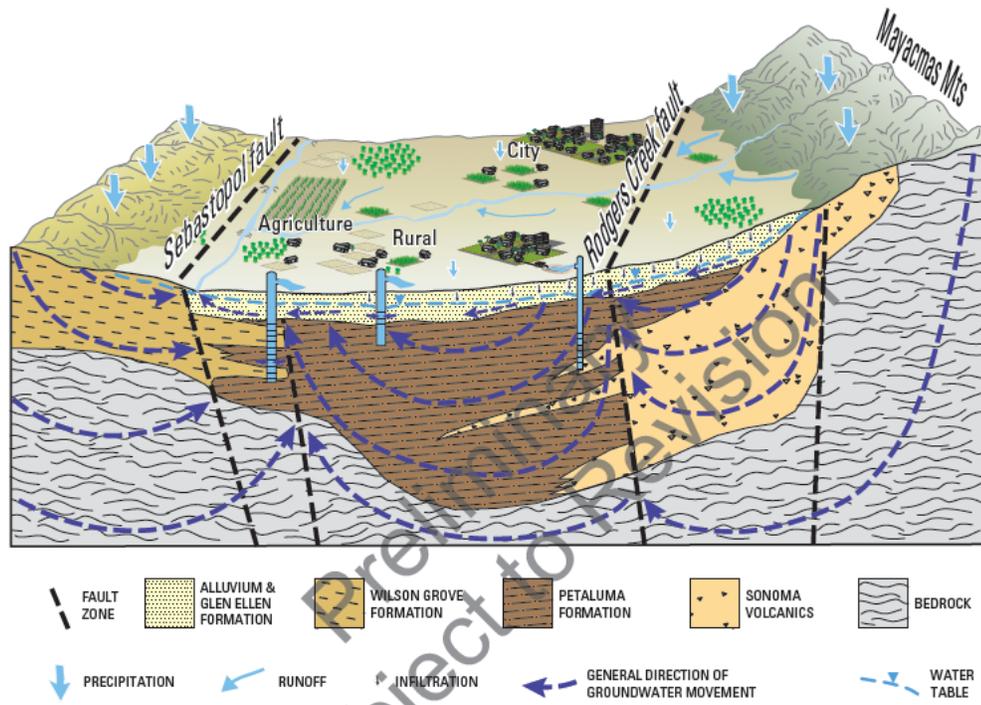


Figure 12: Conceptual Block Diagram of the Santa Rosa Plain showing how groundwater generally moves through the basin.

The primary sources of groundwater recharge in the Study area (Figure 12) are infiltration of precipitation on the ground surface and infiltration from streams, with secondary recharge from septic systems and irrigation return flows. In the Santa Rosa Plain, significant natural recharge occurs along stream channels in the eastern portions of the basin and outcrops of permeable sedimentary units along the southwestern margin of the basin. Clay-rich sediments cover portions of the central southern Santa Rosa Plain, and extend northward along the Laguna de Santa Rosa, impeding water infiltration.

Groundwater leaves the basin (discharges) from wells, springs, evapotranspiration from plants, and as subsurface outflow. Groundwater also discharges to streams and contributes to streamflows in some areas of the basin, including segments of Santa Rosa Creek and the Laguna de Santa Rosa. Groundwater pumping is the most significant groundwater basin discharge from the study area, and has been estimated to be as much as 53,000 acre-feet per year, with the largest significant proportions being agricultural and domestic pumpage, followed by public supply pumpage. The majority of pumping is not measured or reported and was estimated in the study using land use data and a numerical groundwater flow model. Pumping from municipal public supply wells is the only component which is required to be measured and reported and comprises up to approximately 15% of the total pumping.

Groundwater Movement and Level Trends

Routine measuring and monitoring of groundwater levels within wells has historically been relatively sparse within the Santa Rosa Plain. In general, groundwater levels in shallow aquifers fluctuate seasonally with rainfall and are largely stable over time (Figure 13). In contrast, groundwater level trends for deeper water wells show a combination of trends over time (Figure 14). Some wells show overall stability, some show overall declining trends and some show historical declining trends followed by recent increases in groundwater levels. The greater occurrence of declining groundwater level trends within the deeper zone wells is likely related to both the larger sized wells completed in deeper zones and the greater amount of time these deeper zones require to recharge.

Hydrographs of Select Shallow Wells

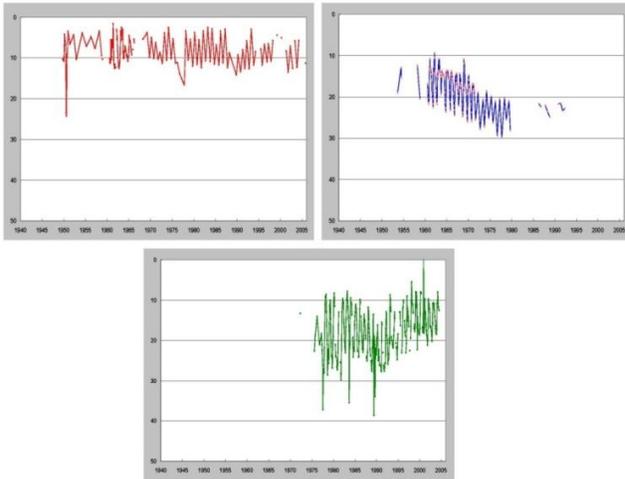


Figure 13: Groundwater-Level Hydrographs of Select Shallow Wells (less than 100 feet deep) within the Santa Rosa Plain. The Red and Blue graphs are from shallow wells located in the northern portions of the basin and the Green graph is from a well located in the southern portion of the basin. Shallow wells generally show fluctuations seasonally with rainfall and are largely stable over time.

Hydrographs of Select Deeper Wells

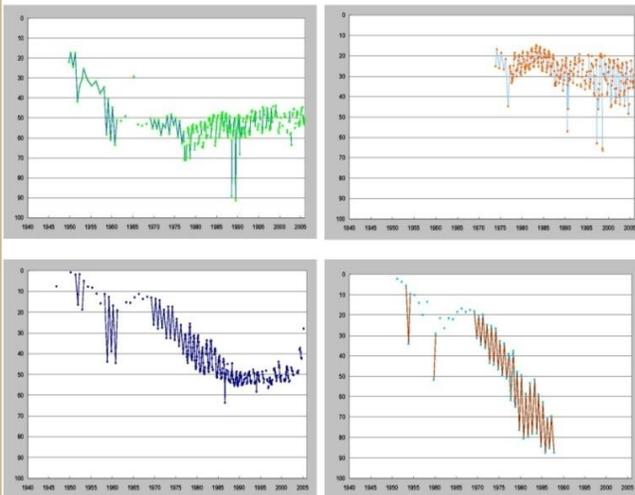


Figure 14: Groundwater-Level Hydrographs of Select Deeper Wells (greater than 200 feet deep) within the Santa Rosa Plain. The Green graph is from a well located in the northern portion of the basin, the Orange graph is from a well located in the central portion of the basin and the Blue and Burgundy graphs are from wells located in the southern portions of the basin. A greater occurrence of declining groundwater levels is observed within deeper zone wells.

This series of groundwater level contour maps for the Santa Rosa Plain Watershed shows a progression of groundwater level depressions, dominantly in the deeper aquifers, as groundwater demands increased over time. Replacement of groundwater with surface water helped recover the groundwater reduce the depressions.

The groundwater level contour map for 1951 (Figure 15) shows the general pattern of groundwater movement from the highlands towards the axis of the basin to the location of the Laguna de Santa Rosa, which was the main location of natural groundwater discharge. In addition, groundwater moved toward and discharged into stream channels, sustaining stream baseflow in many parts of the basin.

As more wells were added to the basin and agricultural, domestic and urban pumpage increased over time, groundwater levels dropped, less groundwater discharge occurred in the Laguna De Santa Rosa and more discharge resulted from well pumpage. As pumping increased, two pumping depressions formed, and are evident in the groundwater level contour map for 1990 (Figure 16).

Increased urban pumping was considered largely responsible for the depression in the Rohnert Park-Cotati area of the basin. Since the early 2000s, increases in imported surface water from the Russian River and water conservation have greatly reduced groundwater demand. The groundwater level contour map for 2007 (Figure 17) shows significant groundwater recovery in the Rohnert Park-Cotati area of the basin, with the depression largely recovered.

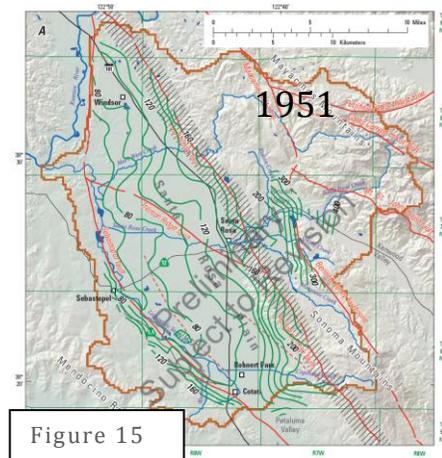


Figure 15

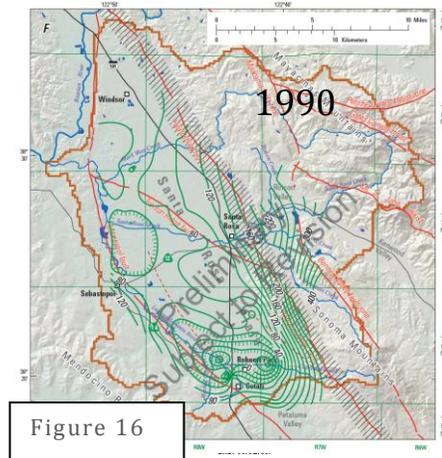


Figure 16

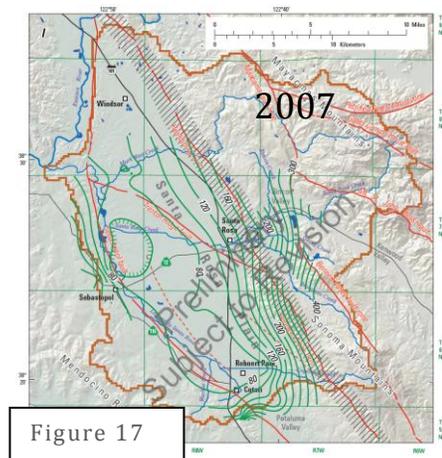


Figure 17

Groundwater Quality

Groundwater quality was characterized in the USGS study using analyses for selected wells from previous investigations, from databases maintained by the California Department of Public Health, California Department of Water Resources, and public supply purveyors from 1974-2010. Additionally, groundwater sample data collected by the USGS in 2004 (under the State Water Resources Control Board GAMA program) and 2006-2010 was evaluated. Results indicate that the groundwater quality is highly variable throughout the study area and generally acceptable. Manganese, iron, boron, and arsenic are potential constituents of concern that occur naturally in groundwater and exceeded secondary or health-based standards for drinking water. Manganese and iron exceeded aesthetic standards in approximately three-quarters, and less than one-half of the samples analyzed, respectively. Boron and arsenic exceeded health-based standards in approximately 10 percent of the samples analyzed. All samples represent native groundwater prior to being treated to achieve drinking water standards. While concentrations of chloride and specific conductance are predominantly well below secondary drinking water standards, increases have occurred in two-thirds and three-quarters of the wells evaluated for the study, respectively. The reason for the increases is unclear – some of the possible sources include groundwater inflow of older, more mineral-rich water, wastewater inputs through septic systems, and/or historical irrigation return flow. Improved understanding of the spatial distribution and trends of groundwater quality constituents of potential concern will assist in developing recommended actions, activities and possible projects as appropriate in the groundwater management plan.

Data Gaps

The study provides an improved and updated understanding of the Santa Rosa Plain groundwater subbasin. And like many studies, a number of data gaps were identified that will need to be addressed in the future:

- Improved estimates of unreported agricultural and domestic pumpage
 - Needed to refine the surface water-groundwater flow model being developed
- Depth dependent water level and water quality data needed
 - Required to improve the understanding of the hydrogeology and relationships between the shallow deeper aquifer system and flowpaths
 - Necessary to define the extent of usable groundwater resources
- Well location, lithology and construction information
 - Needed to better understand the hydrogeology and improve the groundwater model
- Long-term groundwater quality monitoring
 - Essential to better identify and understand significant water quality trends
- Long-term stream gage monitoring
 - Needed to understand the relationship between the drainages, precipitation events and climate change

GROUNDWATER MANAGEMENT PLANNING

A Basin Advisory Panel, made up of 30 members from throughout the Santa Rosa Plain, concluded current and future constraints on surface water imports and climate change present challenges in addressing the uncertainty and reliability in future water supplies and demonstrate the need for a plan to address these challenges. The Panel agreed to continue to meet to help develop a comprehensive plan to manage, protect and sustain groundwater resources in the SRP in order to provide a safe, reliable water supply for future generations. Scheduled for release in late 2013 or early 2014, the plan will set goals and identify ways to protect the Santa Rosa Plain groundwater basin into the future.

Panel members represent economic and environmental interests, groundwater users (agriculture and homeowners), water suppliers, and Tribal, county and city government. The Panel is a collaborative effort: community representatives and agencies with jurisdiction within the Santa Rosa Plain are working together to develop the groundwater management plan. Members work with an independent facilitator to ensure that all key interests from the Santa Rosa Plain are represented.

Cooperative funders sponsor the planning effort. The Sonoma County Water Agency has formed a partnership with the Cities of Santa Rosa, Cotati, Rohnert Park and Sebastopol, the Town of Windsor, Cal American Water Company, and the County of Sonoma. After approval, the Panel will recommend that the boards of the cooperating funders and other implementing organizations adopt the plan.

Groundwater Management Plan Elements and Timeline

The voluntary, non-regulatory Groundwater Management Plan will consist of the following elements, developed during this timeframe.

Basin Management Goals & Objectives
Developed - *Summer 2012*

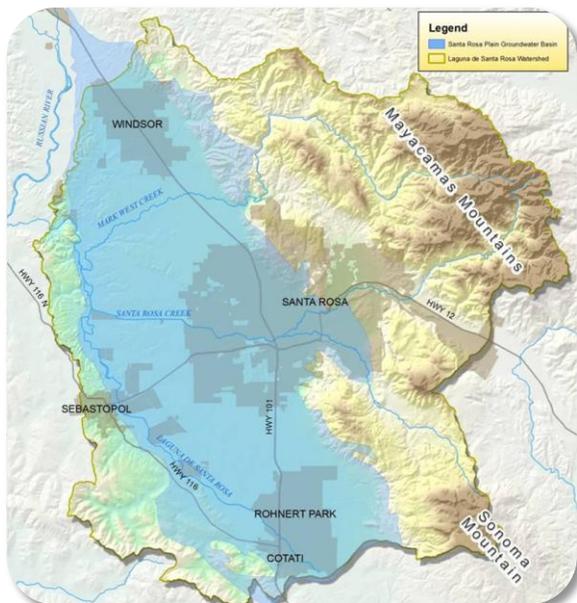
Management Components -
Spring 2013

Monitoring Program & Data Protocols -
2012 - 2013

Implementation Approach -
Summer-Fall 2013

Plan Release: Late 2013-Early 2014

How to Contribute



Participate in a Panel Meeting

The Panel meets the second Thursday of most (not all) months, from 9:00-12:00. All meetings are open to the public. Check the web site for dates and locations.

Talk to Your Organizational Representative

Learn about groundwater management planning and share your perspective with a panel member.

Visit the Web Site

The web site is updated regularly. Read documents and check the calendar for events.
www.scwa.ca.gov/srgroundwater

Schedule a Briefing

Panel members or staff are able to conduct briefings for interested organizations. Please contact Marcus Trotta at mtrotta@scwa.ca.gov or a Panel Member to schedule.

Contact Information

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Basin Advisory Panel

Jennifer Burke, *City of Santa Rosa*
 Michael Burns, *Santa Rosa Resident*
 Mark Calhoun, *Fircrest Mutual Water Company*
 Elizabeth Cargay, *Foothills of Windsor Homeowners Association*
 Ezra Chaaban, *North Bay Association of Realtors*
 Rue Furch, *Sebastopol Water Information Group (SWIG) and the Sierra Club*
 Joe Gaffney, *Sonoma County Alliance*
 Dawna Gallagher, *Rohnert Park Resident*
 Maureen Geary, *Federated Indians of Graton Rancheria*
 Edward Grossi, *Sweet Lane Wholesale Nursery*
 John Guardino, *Laguna de Santa Rosa Foundation*
 Kara Heckert, *Sonoma Resource Conservation District*
 Len Holt, *Santa Rosa Resident*
 Lloyd Iverson, *Local Well Owner*
 Keith Abels, *Community Alliance of Family Farmers*
 Jay Jasperse, *Sonoma County Water Agency*
 Darrin Jenkins, *City of Rohnert Park*
 Bill Keene, *Sonoma County Ag Preservation & Open Space District*
 Sue Kelly, *City of Sebastopol*
 Melissa Lema, *Western United Dairymen's Association*
 Gary Mickelson, *California Groundwater Association*
 Mike Mortenson, *California Groundwater Association*
 Curt Nichols, *Construction Coalition*
 Jane Nielson, *Sonoma County Water Coalition & O.W.L. Foundation*
 Damien O'Bid, *City of Cotati*
 Pete Parkinson, *Sonoma County Permit and Resource Management Department*
 Walter Ryan, *Sonoma County Farm Bureau*
 Andrew Soule, *Cal American Water Company*
 Rocky Vogler, *Town of Windsor*
 Robert Weinstock, *Representing Sonoma County Winegrape Commission*