Sutter County

Groundwater Management Plan

March 2012

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Sutter County Groundwater Management Plan

Certificate and Seals

This report and analysis was prepared by Wood Rodgers, Inc. with data and technical assistance provided by the Sutter County Public Works Department - Water Resources Division and the California Department of Water Resources - North Central Region.

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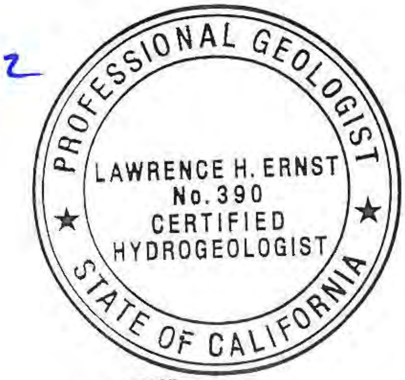

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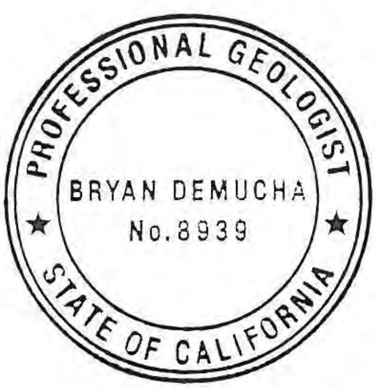

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1. INTRODUCTION

1.1. Purpose of Groundwater Management Plan

Sutter County (County) has prepared this Groundwater Management Plan (GMP) with input and direction from County stakeholders, and with financial and technical assistance from the California Department of Water Resources (DWR). Preparing this GMP is one step Sutter County is taking to promote and encourage groundwater users in the County to be responsible stewards of the water resources.

Sutter County's purposes for preparing this GMP are to:

- Summarize the current understanding of the groundwater underlying Sutter County and its role in the County's overall water supply, and make that information publicly available.
- Formulate goals and objectives that can be used as guidelines to help manage groundwater resources to meet current and future demands in Sutter County.
- Establish a plan for the County's involvement in ongoing monitoring and management of groundwater to promote those goals and objectives.
- Maintain eligibility for grant funding administered by the California Department of Water Resources to increase the understanding of the groundwater basins underlying Sutter County.

1.2. Sutter County's Role in Groundwater Management

Sutter County has the authority to adopt and implement this GMP under California Water Code §10750 et seq., which states that a local agency that overlies part of a groundwater basin can "by ordinance, or by resolution…adopt and implement a groundwater management plan…within all or part of its service area," so long as the area is:

- Not served by another local agency, a water corporation regulated by the Public Utilities Commission, or a mutual water company.
- Served by a local agency, when the majority of the agency's governing body declines to exercise its authority to manage groundwater and enters into an agreement with the local agency developing the GMP.

Sutter County's intended role in groundwater management, as discussed in this GMP, is to help coordinate the various groundwater users in the County, and encourage them to be responsible stewards of the water resources. The County does not have the budget or staff to act as an “enforcer” with regards to groundwater use, and does not intend to do so.

1.3. Plan Area

Sutter County intends this GMP to be relevant for the entire County. Sutter County overlies the south central part of the Sacramento Valley Groundwater Basin, and specifically the Sutter Subbasin and portions of the East Butte and North American Subbasins, as shown in Figure 1. The majority of the County is serviced by water and irrigation districts, reclamation districts, cities, and public utility districts (Figure 2), which have the authority to manage groundwater in their service areas. Unless those entities decline to manage groundwater on their own, and instead enter into agreements with the County, this GMP does not formally apply to those areas. If those entities choose not to adopt their own GMPs, they have the option of taking formal action to adopt the Sutter County GMP for their areas. By doing so, they will fulfill the requirements of the groundwater management provisions of the California Water Code.

Some of the water purveyors in the County have prepared groundwater management plans established under provisions of Sections 10750-10756 of the California Water Code (Assembly Bill 3030). Four of these plans have been submitted to DWR for final adoption.

1.4. Public Involvement in Plan Development

Throughout the development of this GMP, Sutter County solicited public input to help guide the direction and content. Aside from the required public notices and hearings related to the GMP development, Sutter County undertook an extensive public outreach program to encourage public involvement in the GMP development and to solicit public input for the GMP. To help guide the development of the GMP, a Plan Advisory Group (PAG) was formed that included representatives of water purveyors, cities, and the general public (attendance sheets provided in Appendix A)

The Sutter County Water Resource Department and the Board of Supervisors approved a Public Outreach Plan (Appendix B) for the GMP process. The Public Outreach Plan established the following objectives:

- Establish an open process to facilitate stakeholder input.
- Provide information to facilitate stakeholder education on material forming the basis of the GMP.

- Provide a framework by which stakeholders are kept informed of the process, issues, and potential solutions.
- Incorporate public comments throughout the decision-making process.

Various entities – including the Board of Supervisors, Plan Advisory Group, and the general public – were involved in the development, approval, and adoption of the GMP.

While developing the GMP, eleven public meetings were held. The location and time for each of the PAG meetings were advertised in local media. Attendance at each PAG meeting was recorded and a mailing list was created to disseminate meeting times and important information regarding the GMP progress. Participation in the PAG was voluntary and the public was invited to attend and comment at public workshops held in Yuba City. At each of the public workshops, Wood Rodgers, Inc. presented a PowerPoint® presentation of the purpose, scope, and schedule for preparing the GMP, along with educational information related to groundwater, geology, wells, and information about the hydrogeology within the County. The PAG meetings were held in 2008 on June 10, August 14, October 17, and December 9; in 2009 on February 10; in 2010 on June 17, August 19, October 28, and December 15; and in 2011 on April 14[1] and October 20. The Sutter County Water Resources Department hosted a website for the GMP at:

http://www.co.sutter.ca.us/doc/government/depts/pw/wr/gmp/gmphome

All of the presentations and applicable meeting information were posted on the GMP website. Presentations, attendance sheets, and a summary of public comments from the workshops are included in Appendix B.

1.4.1. GMP Survey

The County circulated a voluntary Public Opinion Survey to obtain participation and feedback from stakeholders. The surveys were distributed to interested individuals at the PAG meetings and were also made available for download on the County's website. In order to differentiate between individual well owner concerns and water district concerns, two surveys were distributed. Unfortunately, due to the limited returns, the surveys were not beneficial in identifying countywide concerns related to groundwater.

[1] The reason the meetings extended over four years is that DWR issued a stop work order in 2009 due to uncertainties with the State of California budget. Consequently, the GMP process was temporarily delayed from February 2009 to May 2010. Resumption of the GMP process required approval of a new Notice of Intent and a contract amendment with DWR.

1.5. Issues of Concern

A variety of issues and/or concerns with regard to groundwater and groundwater management have been raised by residents of the County during the development of this GMP. These issues and concerns include the following.

1.5.1. Protect private groundwater rights.

The development of the GMP has raised concerns about how individual groundwater rights will be affected. California State Water Law gives property owners the right to make reasonable and beneficial use of the groundwater resource underlying their property. The GMP does not encroach upon or place any restrictions on groundwater rights. Furthermore, the County does not have the budget or staff to act as an "enforcer" with regards to groundwater use, and does not intend to do so.

1.5.2. Is there enough groundwater to sustain a drought?

Water districts within the County have been able to provide groundwater when surface water supplies were reduced during past droughts. Conversely, the use of groundwater when surface water is in short supply allows the aquifer(s) to recharge when surface water is available and is known as conjunctive use.

Increased use of groundwater in some areas is perceived to be taxing the available supply, and there is concern that wells will go dry during a drought. A related concern is that existing wells may be damaged by increased pumping. This concern is particularly widespread in the southeastern portion of the County, where groundwater is used extensively for irrigation. Additionally, changes in cropping trends to more permanent crops have raised concerns about the ability to reduce groundwater use during drought periods without sustaining substantial economic losses in areas that do not use groundwater conjunctively with surface water.

This concern is understandable given the history of significant groundwater level fluctuations in the southeastern portion of the County during past drought periods. Data also indicate that during wetter periods, or when pumping is reduced, groundwater levels have started to recover. The need for water supply reliability to support water users in the County can be addressed through the conjunctive use/management of available surface water, groundwater, and recycled water supplies. Together, these water sources comprise the irrigation water supply for the County, and can be used in fluctuating proportions to meet demands during different hydrologic (including climatic) and economic conditions. Successful management will also require better coordination among water users, and water users will need to work together to develop strategies for curtailing water use during drought periods. If intra-county water transfers (transfers from one party to another within Sutter County) are possible, they can become an important water management tool and consideration during these periods.

1.5.3. Are there plans to "export" water out of Sutter County?

There is general concern that projects related to groundwater studies and groundwater management (including this GMP) are somehow related to the desire to "export" water from the County. Those who express this concern feel that the State (and other parties within and outside of the County) cannot be trusted to protect the interests of the community within the County. Currently, under state law, groundwater substitution water transfers are allowed. A groundwater substitution water transfers occurs when an entity with surface water rights makes an agreement to transfer some or all of its surface water to downstream users (by not diverting it), and then pumps groundwater to make up for the "lost source supply" that results from the transfer.

This concern can be somewhat allayed by maintaining local water district control of water management decisions. Also, establishing an open process for discussing groundwater conditions and making management decisions will help the stakeholders within the County have a better understanding of the resources and issues and to voice their concerns and have them addressed.

1.5.3.1. Sutter County Conjunctive Water Use Success (Case Study)

The Department of Water Resources provided the following case study for inclusion in this GMP to demonstrate the effectiveness of conjunctive water use.

"An example of a successful conjunctive use program was implemented by the South Sutter Water District (SSWD or District). The SSWD is located in southern Sutter and western Placer counties, with the Bear River as the northern boundary and stretching southwest between Highway 65 and Highway 70 to Pleasant Grove and Curry Creeks. The District was formed in 1954 to develop, store and distribute surface water supplies and to augment and replenish over-drafted groundwater supplies. Figures 3 and 4 are groundwater level hydrographs illustrating the recovery of groundwater levels after the implementation of the

Figure 3 - Hydrograph for Well 13N/5E-30A1M

conjunctive use program. Today SSWD encompasses a total gross area of nearly 64,000 acres, including 57,012 acres that are authorized to receive surface water. According to the District,41,946 acres have actually been irrigated in recent years using a combination of surface and groundwater supplies. By far the majority of those acres grow rice (roughly 34,834 acres, or 83%), while the balance is apportioned between orchards (2,881 acres, or 5%), irrigated pasture (2,088 acres, or 5%), row and field crops (1,742 acres, or 4%) and the remaining 3%, which is fallowed in certain years.

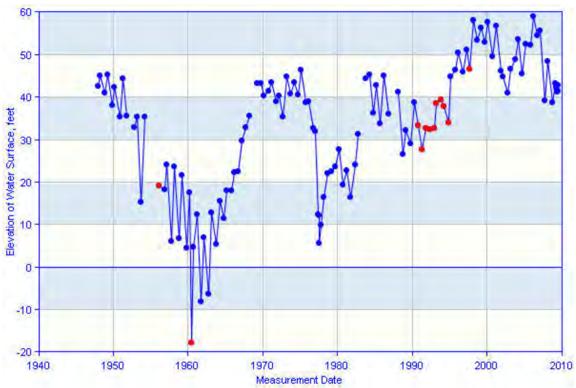

Figure 4 - Hydrograph for Well 13N/4E-13R1M

The enlarged New Camp Far West (NCFW) Reservoir was completed in 1964 with a storage capacity of 104,400 acre-feet (AF). SSWD and Camp Far West Irrigation District (CFWID), formed in 1924, holds the water rights for operating the reservoir. Surface supplies are managed conjunctively with groundwater supplies. The seven (7) megawatts of power generated by the NCFW powerhouse is wholesaled to Sacramento Municipal Utility District. The Federal Energy Commission (FERC) license for NCFW was issued on July 2, 1981.

One and a quarter miles downstream of NCFW Dam (and about 15 miles above the confluence with the Feather River), water is diverted by a diversion dam designed to move 30 cubic feet per second (cfs) north into the CFWID and 380 cfs south into the SSWD. In 1994, SSWD, CFWID, and the Department of Water Resources entered into a settlement agreement to meet the District's obligations under the State Water Resources Control Board's (SWRCB) Water Quality Control Plan for the Bay-Delta. Under the agreement, SSWD agreed to release up to 4,400 AF of water from NCFW, when requested by DWR, in all dry and critical year types. The present water rights require minimum in stream flows below the diversion works of 25 cfs from April 1 through June 30 and 10 cfs from July 1 through March 30. Under the new agreement, SSWD would increase the flow releases to the lower Bear up to 37 cfs in dry and critical years for up to sixty days in July through September.

SSWD receives anywhere from 5,000-20,000 AF of surplus water from Nevada Irrigation District (NID) annually. That water is currently conveyed to SSWD from Rollins Reservoir via the Bear River/Wise Canal system. When completed, SSWD's Canal Expansion project, including related conveyance system improvements, could *well provide previously-unforeseen opportunities for delivering a portion of surplus NID supplies to SSWD directly via the Bear River and NCFW Reservoir."*

1.5.4. Will there be taxes or fees for groundwater use?

Concerns have been expressed about the sources of funding for the GMP and other groundwater programs in the County. Funding would be necessary should staff be required to perform new monitoring and evaluation activities or to undertake groundwater investigations. Funding for the latter may be available from DWR and other grant programs, under which this GMP maintains eligibility for the County. Currently, the County assesses fees only for exploratory drilling, well construction, and well destructions, as shown in the following table (Table 1).

Table 1
***Current* Sutter County Fee Assessments (as of January 1, 2012)**

Well Permit	*Fee*
Well Construction	$470.00
Well Destruction	$376.00
Water Exploration and Test Holes	$376.00
Permit Extension (1 year)	$47.00

There is concern about the potential for taxes and fees on groundwater use, and metering of pumps. This GMP does not contain any recommendation to meter groundwater pumping or to enact use-based fees or taxes, although they are considerations and are used in other areas. State law affords property owners the right to make beneficial use of groundwater on their land.

1.5.5. How can we obtain good quality water?

Water quality problems are significant within the County and concerns have been expressed about water quality with regard to salinity, arsenic, and manganese. The hydrogeology of the County as it relates to water quality is not well-understood, and further study will be necessary to develop guidelines for how to obtain good-quality water in different areas of the County, and to determine how to manage groundwater without causing water quality deterioration in areas with otherwise good quality water. As discussed in Section 4.4, this GMP illustrates water quality in different areas of the

County, and shows the geographic areas (and depths) where poorer quality groundwater can be anticipated. As more data becomes available, the County will be able to incorporate it into the existing understanding of the groundwater subbasins.

1.5.6. Is this going to generate new regulations on groundwater?

Concern has been expressed about the potential for additional layers of bureaucracy and regulations on groundwater use. In general, stakeholders recognize a need to better understand and manage groundwater in the County, but have expressed a desire for a "balance" between achieving this objective and minimizing bureaucracy and regulations.

To implement the GMP, an institutional framework (not yet determined) will be needed; however, the intent of this GMP is to minimize the bureaucracy and regulations needed to achieve the goals and objectives of the GMP. The GMP provides a framework and a forum for studying, discussing, and managing groundwater within the County. Ideally, management will be accomplished cooperatively amongst the groundwater users in the County.

2. THE COUNTY

2.1. Physical Setting

Sutter County encompasses approximately 607 square miles (389,443 acres) in the central portion of the Sacramento Valley. As shown in Figure 5, Sutter County is bound by Butte County to the north, Colusa and Yolo Counties to the west, Yuba and Placer Counties to the east, and Sacramento County to the south. The County seat, Yuba City, is located approximately 50 miles north of Sacramento. The 2010 U.S. Census reported that the population of the County in 2010 was 94,737, with the majority of the population residing in Yuba City and Live Oak, and about 25 percent of the population in the rural communities. Land use within the County is principally agricultural, with approximately 318,701 acres in production (Sutter 2010a).

The two main population centers in the County are Yuba City, with 67 percent of the population, and the City of Live Oak, approximately 10 percent of the population (U.S. Census 2010). The remaining County residents live within the small communities of Tierra Buena, Meridian, Rio Oso, Trowbridge, Sutter, Pleasant Grove, Nicolaus, East Nicolaus, Riego, Robbins, or in the vast rural agricultural areas which make up Sutter County. Future major growth areas planned for Sutter County include Sutter Pointe (Measure M). The Sutter Pointe Specific Plan details a large-scale development project that is currently on file with and being processed by Sutter County. This plan area is located in the southern most portion of the County adjacent to the Sacramento County border and a portion of the Placer County border. The plan area includes the development of approximately 7,500 acres into mixed use and residential properties and has been structured to facilitate future incorporation as an independent city (Sutter 2010).

The main transportation routes connecting the County with the region are Highway 99, which runs north-south through the County, California State Route 20, which runs east-west through the County and Highway 113, which runs from the south-west portion of the County and terminates at Highway 99 (connecting Woodland with the County).

Land elevations range between 80 and 20 feet above sea level throughout the County with the exception of the Sutter Buttes, where elevations are more than 2,100 feet above sea level. The lowest land elevations are located towards the southern portion of the County.

Sutter County has abundant surface water, including the Sacramento, Feather, and Bear Rivers, as shown in Figure 5. A number of the water districts in the County (Figure 2) divert and transfer surface water.

2.2. Water Purveyors and Users

Water resources in the County are managed by water purveyors and individual water users who have "hands on" control of both surface water and groundwater for agricultural, urban, environmental, and domestic uses. These water managers represent a complex mix of organized water purveyors, non-organized areas, and areas within National Wildlife Refuges. A brief discussion of each category is presented below.

2.2.1. Water Purveyors

There are 48 water purveyors in Sutter County which provide water service to their customers (Figure 2). These water purveyors include water districts, irrigation districts, reclamation districts, mutual water companies, public utilities districts, and incorporated cities. Additionally, there are many private water users including community service districts (CSD's) and farming interests.

Six water purveyors provide water service not only in Sutter County, but in the counties that share borders with Sutter. They are:

- Reclamation District No. 1004 (Colusa County)
- Biggs-West Gridley Water District (Butte County)
- Butte Water District (Butte County)
- Dry Creek Mutual Water Company (Yuba County)
- South Sutter Water District (Placer County)
- Natomas Central Mutual Water Company (Sacramento County)

2.2.2. Non-Organized Areas

The non-organized areas within the County are not within the boundaries or service area of established water purveyors.

2.2.3. National Wildlife Refuges

The Sacramento National Wildlife Refuge Complex consists of five national wildlife refuges and three wildlife management areas. Portions of Sutter County have been dedicated, both through public and private efforts, as wildlife refuges. Exclusively in Sutter County, the Sutter National Wildlife Refuge has 2,591 total acres, with the majority (83%) located inside the Sutter Bypass. According to U.S. Fish and Wildlife

Service, the refuge "consists of approximately 1,881 acres of seasonal and summer wetlands and approximately 674 acres of unmanaged wetlands, grasslands, and riparian habitats" (USFW 2009).

The Natomas Basin Conservancy also owns nearly 1,000 acres of wildlife habitat/mitigation lands within the southern portion of the County.

2.3. Land Use

The predominant land use within the County is agriculture. The 2008 Sutter County General Plan Technical Background Report estimates that 322,240 acres (83%) of Sutter County is agricultural land. An estimated 44,581 acres (11%) is designated as open space. The remaining 6% of the County is designated as residential, public and vacant, commercial, industrial, and transportation and utilities. As stated above, agriculture dominates land uses within Sutter County. Figure 6 shows the distribution of land uses, with regard to crop type and water source, for the entire County. It is apparent that permanent crops dominate the eastern portion of the County, along the Feather River, while rice and other non-permanent crops dominate the central and western portion of the County.

2.4. Water Use

The amount of water applied for agricultural production and urban or community use has been estimated using information from DWR with respect to unit crop, consumptive use, and applied water, with corresponding losses included and accounted for. Water use within cities and communities was estimated using limited production data from some water purveyors from 2008 to 2010.

2.4.1. Agricultural Water Use

Water use during the 2009 growing season was calculated based on the Sutter County 2009 Crop Report. Estimates of applied water for irrigated agriculture are 1,122,018 AF.

Sutter County's agricultural water usage is approximately 60 percent surface water, 20 percent groundwater, and 20 percent that is irrigated by both surface water and groundwater. Figure 6 illustrates the source of water for crops grown in the County. The predominant source of water for permanent crops is groundwater.

2.4.2. Urban/Community Water Use

Water for urban and community use is from groundwater and surface water. From available DWR records, the minimum urban water use was 1,770 AF in 2010 (records for all urban water suppliers was not available). Yuba City provides mostly surface water (15,682 AF in 2008) while smaller communities rely exclusively on groundwater.

3. HYDROLOGY AND SURFACE WATER

3.1. Seasonal and Long-Term Hydrology

Annual fluctuations in northern California precipitation directly influence the volume of water flowing in the Sacramento River. Precipitation and climate data from the Western Regional Climate Center (WRCC) suggest the average annual precipitation for the west side of the County (Colusa Station) is 16.40 inches per year and on the east side of the County (Marysville Station), it is 20.96 inches per year. In Nicolaus, the average annual precipitation is 18.27 inches per year. Collectively, average annual precipitation is 18.54 inches per year. Snow-fall within Sutter County is rare, measuring on average 0.01 inches per year. Precipitation is highly variable throughout the State, from year to year. Precipitation usually takes place from October to May and on average no precipitation occurs from June to September. The water year, defined as starting on October 1 and ending September 30, is classified as one of five water year types: critical, dry, below normal, above normal, or wet[2]. Within the past ten years, only two water years were classified as wet and one year was classified above normal. The remaining years were either dry, critical, or below normal. The average annual temperature is approximately 62° F, with an average high of 95.7° F in July and an average low of 37.4° F in January.

Precipitation in the Sierra Nevada, Coast Range, Klamath, and Cascade Mountains contribute to surface water flow and groundwater recharge in the Sacramento River Basin. The general direction of surface water flow is toward the center of the valley, flowing south. Water diversions, evaporation, and groundwater recharge reduce flows as the Sacramento River approaches the Delta.

3.2. Surface Water

Sutter County is located in the Sacramento River Basin, with the Sacramento River on the west and the Feather River on the east. The Sacramento River is the largest river in northern California and drains the northern central part of California. The watershed for the Sacramento River includes tributaries originating in the Sierra Nevada, the Coast Range, and the Cascade Mountains. The main tributaries in Sutter County include the Feather River, Bear River, Dry Creek, Pleasant Grove Creek, Auburn Ravine, and Coon Creek.

During periods of heavy precipitation and runoff, a portion of the flow within the Sacramento River is diverted through the Sutter Bypass. The Sutter Bypass is a man-made feature in Sutter County and was designed to alleviate the flood control system along the Sacramento

[2] http://cdec.water.ca.gov/cgi-progs/iodir/wsihist

River. Aside from the major rivers and tributaries within Sutter County, there are no significant surface water storage reservoirs within Sutter County.

It is important to note that flows in all the major rivers in northern California are managed by dams, e.g. the Feather River by Lake Oroville and the Sacramento River by Lake Shasta. The reservoirs are managed to provide flood protection while collecting runoff from the watershed. Releases from the reservoirs occur from spring through summer to provide irrigation water for agriculture as well as to provide drinking water downstream.

The following discussion provides information on the location, ownership, infrastructure, and an overview of the operational practices of the major water bodies that relate to or are within Sutter County.

3.2.1. The Sacramento River

The Sacramento River is the major surface water feature in Sutter County. Running north-south along the western part of the County, the Sacramento River is the main drainage for the Sacramento Valley Basin on its way to the Delta and the San Francisco Bay. The Sacramento River supports many beneficial uses including recreational, agricultural, and wildlife. The river is currently not used for municipal or domestic water supplies in the County. There are, however, future plans to utilize the Sacramento River, in conjunction with groundwater, to provide municipal water supply to the Measure M Sutter Pointe development (Sutter 2011).

Many tributary streams flow from the mountains on both sides of the valley into the Sacramento River. According to a 2005 report by the Glenn County Department of Agriculture (GCDA), flows in the Sacramento River near Grimes in Southern Colusa County range from 6,500 cfs to 16,900 cfs for the period of record of 1946-2003 (GCDA 2005).

3.2.2. The Feather River

The Feather River is a major tributary of the Sacramento River and outlines a major portion of Sutter County's eastern boundary. The river trends north-south along the northern and central portions of the County to the convergence with the Bear River, where it changes course and flows southwest through the south-central portion of the County until it intersects the Sutter Bypass and the Sacramento River. Like the Sacramento River, the Feather River provides beneficial uses including recreation, agricultural, and wildlife. Yuba City obtains a large portion of its annual water supplies for municipal and domestic use from the Feather River.

3.2.3. The Bear River

The Bear River is a tributary of the Feather River and enters Sutter County from Placer County near the City of Wheatland in Yuba County. It forms the boundary between Sutter and Yuba Counties up to the convergence with the Feather River. The Bear River generally flows west until it converges with the Feather River, approximately one mile upstream from the rural community of Nicolaus. Although smaller than the Sacramento and Feather Rivers, the Bear River also provides beneficial uses that include recreation, agricultural, and wildlife. Discharges within the river are partially controlled by several upstream reservoirs. The Camp Far West Reservoir (located in the counties of Yuba, Placer and Nevada) is the last downstream reservoir on the river and subsequently regulates surface water discharges to downstream users, which has been the source of surface water for a very successful conjunctive water use program for the South Sutter Water District.

3.2.4. The Sutter Bypass

The Sutter Bypass (Bypass) is an artificial flood corridor constructed in the 1930's. As described by the Army Corp of Engineers, "the Sutter Bypass, which began operation in the 1930's, is a leveed portion of the natural floodway in the Sutter Basin. The bypass is south of the Sutter Buttes from Colusa to Verona between the Sacramento and Feather rivers. Flows enter the Sutter Bypass from the Butte Basin at its upper end near Colusa at the Butte Slough. Other flows enter from Wadsworth Canal, interior drainage from pumping plants, and the Sacramento River by way of the Tisdale Weir and Bypass. Flows exit the Sutter Bypass and combine with the Sacramento River, Feather River, Natomas Cross Canal, and Yolo Bypass upstream from the Fremont Weir near the town of Verona"(USACE).

3.3. Seasonal and Long-Term Water Quality

Under the USGS National Water Quality Assessment (NAWQA) Program, the USGS conducted an intensive study of the Sacramento River Basin and collected data between 1995 and 1998. Through the sampling process, the USGS selected indicator streams that were based upon the characterization that "they drain small to intermediate sized watersheds with relatively homogeneous land use and geology" (USGS 1998). The Colusa Basin Drain is located entirely in the Sacramento Valley and was chosen as an indicator stream to determine the impacts of agriculture on stream-water quality (USGS 1998). At the indicator water quality station, Colusa Basin Drain at Road 99E near Knights Landing, it was determined that pH levels were generally on the higher end, with declining suspended sediment concentrations over the two-year sampling period. The higher concentrations of mercury correlate with suspended sediment because much of the load of total mercury is transported with the suspended material.

The findings of the USGS study also indicated that the water of the Sacramento River and its major tributaries is generally of good quality. As stated in the U.S. Geological Survey Circular 1215:

> "the amount of dissolved solids in the Sacramento River and its major tributaries (Yuba, Feather, and American rivers) was low at all of the sampled locations. Higher median concentrations of dissolved solids occurred at agricultural sites such as the Sacramento Slough and Colusa Basin Drain, but those are diluted upon mixing with Sacramento River water. Nutrient concentrations such as nitrate also were low throughout the Sacramento River Basin, and drinking-water standards for nitrate were not exceeded during the course of this study. The concentrations of Molinate and other pesticides (used in rice farming) measured during this study in the Colusa Basin Drain or in the Sacramento River, represent a significant improvement over concentrations measured in previous years".

3.4. Surface Water Supply Contracts

3.4.1. Settlement Contracts

USBR currently contracts with approximately 145 water districts, water purveyors, or private users for water rights to the Sacramento River. The total amount of water under the settlement contracts is approximately 2.2 million acre-feet and cover a total of almost 440,000 acres of land bordering the Sacramento River and its tributaries between Redding and Sacramento. The Settlement Contracts were originally executed in 1964 with a term not to exceed 40 years. New contracts have been executed with approximately 145 existing Sacramento River Settlement Contracts.

The Settlement Contracts include a Base Supply and Project Water. The Base Supply is the amount that reflects the agreed-upon water right of the respective entity. This is generally regarded as pre-1914 water rights and also water rights perfected after 1914 and reflect water that would be available to the respective entities under "natural" conditions. Project Water represents the amount of water the Bureau of Reclamation agrees to provide from its Central Valley Project (CVP) yield. Under the provisions of the Settlement Contracts both the Base Supply and Project Supply could be reduced by 25 percent of the total contract amount, but only in certain water year types.

3.4.2. Long-Term Renewal Contracts

In accordance with the CVP Improvement Act (CVPIA), the USBR negotiated long-term water service contracts in 2007. According to Section 3404c of the CVPIA, Renewal of Existing Long-Term Contracts requires the USBR to renew any existing long-term repayment or water service contract for the delivery of water from the CVP for a period of 25 years and may renew such contracts for successive periods of up to 25 years each. The USBR anticipates that, "as many as 113 CVP water service contracts, located within the Central Valley of California, may be renewed during this negotiation process" (USBR 2007a).

The long-term renewal contracts, unlike the Settlement Contracts, have no specified reduction in delivery; during critically dry or water-short years, the water supply available from the Project will be allocated among the contractors.

Also, the long-term renewal contracts contain a tiered pricing provision. The Base Supply is 80 percent of the total contract amount, and Tier 1 and Tier 2 supplies represent 10 percent each of the remaining contract amount. Each tier has an incrementally higher water cost. The Tier 1 and Tier 2 water, which is available in most years, is not used due to the incremental higher cost of water.

4. GROUNDWATER

4.1. Groundwater Basins and Subbasins

Sutter County is underlain by the Sacramento Valley Groundwater Basin. The Sacramento Valley Groundwater Basin covers a vast area and encompasses the alluvial deposits under the valley floor from the Sierra Nevada Mountains to the east, the Coast Range mountains to the west, the Sacramento-San Joaquin Delta to the south, and the Klamath and Cascade Ranges to the north. The Sacramento Valley Groundwater Basin covers over 5,900 square miles and 10 counties, and has been divided into 18 subbasins. The GMP area is underlain by three groundwater subbasins (Figure 1) as defined by the California Department of Water Resources (DWR) in "California's Groundwater, Bulletin 118 – Update 2003". These subbasins are: the East Butte Subbasin, the Sutter Subbasin, and the North American Subbasin. According to DWR,

"A groundwater basin is defined as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined […] features that significantly impede groundwater flow such as rock or sediments with very low permeability or a geologic structure such as a fault. […]

"A subbasin is created by dividing a groundwater basin into smaller units using geologic and hydrologic barriers or, more commonly, institutional boundaries […]. These subbasins are created for the purpose of collecting and analyzing data, managing water resources, and managing adjudicated basins."

4.2. Hydrogeology

4.2.1. Overview of Groundwater and Geology

Groundwater is water that is underground and below the water table (saturated zone), as opposed to surface water, which flows across the ground surface. There are three main types of subsurface geology where groundwater can exist:

- Hard Rock – Groundwater can be present in cracks or fractures in the rocks.
- Underground Caverns – Groundwater can fill these underground voids.
- Porous Sediments – Groundwater can fill the pore spaces between grains of sand and gravel.

In Sutter County, groundwater exists in porous sediments, alluvial aquifers, or fractured volcanic rock such as in the vicinity of the Sutter Buttes. Figure 7 shows a simplified surface geologic map with the major faults in the County. Sutter County is situated along the axial portion of the Sacramento Valley Groundwater Basin. The subsurface aquifers consist generally of layers of gravel, sand, clay, and in some cases volcanic ash. The characteristics of different aquifers, and zones within each aquifer, are related to the aquifer materials (sands, gravels, clays, etc.). Within a single aquifer zone, nearby wells with similar construction can have very similar well yields and water quality. It should be noted that many of the geologic formations that make up the alluvial aquifers are continuous units that are also present in other counties as discussed.

In the northern portion of Sutter County, the geologic setting changes rapidly from the stratigraphic succession observed in the rest of the County. A thick sequence of volcaniclastic sediments derived from the Sutter Buttes volcanic epoch form a volcanic fan apron of alluvial deposits around its perimeter. These deposits have been characterized recently by DWR as consisting largely of gravel, sand, silt, and clay. These deposits are observed at ground surface around the Buttes, and may extend up to a 15 mile radius in the subsurface (Springhorn 2008). Sediments deposited under marine sedimentary processes are also observed at ground surface and at shallow depths in the subsurface around the Buttes. These deposits were elevated from depth to their current position during the emplacement of the volcanic intrusion which formed the Sutter Buttes. Water quality in these sediments is generally poor and deteriorates with depth.

There is a large amount of hydrogeologic data available in the Sacramento Valley which has been widely studied, and groundwater is continuous within specific aquifer zones (although discontinuous between different aquifer zones) over large areas within the Sacramento Valley.

4.2.2. Status of Understanding of Regional and Local Geology

The geology of the Sacramento Valley has been studied for at least 95 years, and much has been learned over this time. However, there are still many areas of active study and debate. In Sutter County, areas that are not well-understood and/or are actively being studied include:

- The connection between the Coast Range-sourced Tehama Formation and the analogous Sierra Nevada-sourced deposits, and where this interaction occurs.
- The possible existence of subsurface barriers to groundwater flow within the County.
- The source of poor water quality in parts of the County.

4.2.3. Regional Geology and Structure

The Sacramento Valley Groundwater Basin is a north-south trending structural trough which is filled with layers of sediments. The stratigraphic succession of the basin deposits, from oldest to youngest (deep to shallow), depict a regional change in depositional environment from one dominated by marine sedimentary processes to that of continental (alluvial) processes. The deepest portions of the basin generally consist of marine sedimentary rocks, ranging in age from Late Jurassic to early Miocene (160 million years ago to 24 million years ago). These marine deposits are overlain by younger alluvial and locally prominent volcanic rocks of early Miocene to Holocene age (Harwood and Helley 1987). Within the Basin, these deposits are disrupted by deformational stresses derived from east-west compressional forces associated with regional uplift along the western margin of the valley and extensional forces to the east, within the Basin and Range Provenance (Harwood and Helley 1987). Over time, these forces have applied great stresses and strain on valley deposits, creating complex and diversely-oriented fold and fault structures.

The prominent fault system that occurs in Sutter County is the Willows Fault. The Willows Fault is an active northwest-trending fault that dips steeply to the east and shows reverse displacement, meaning the ground east of the fault has moved up relative to the west side. The Willows Fault enters into the County from Colusa County southwest of the Sutter Buttes and extends to the southeast portion of the County towards Sacramento.

The most prominent and recognizable geologic feature in Sutter County are the Sutter Buttes. The Sutter Buttes are composed of late Cenozoic volcanic rocks that rise over 2,000 feet above the Sacramento Valley floor. The Sutter Buttes formed between 2.4 and 1.4 million years ago as magma at depth was injected into the overlying Cretaceous and Tertiary rocks, causing deformation in the form of faulting, folding, and uparching (Harwood and Helley 1987).

4.2.4. Regional Stratigraphy

The prominent non-marine, fresh water-bearing stratigraphic units found within the East Butte, Sutter, and North American Subbasins include (from youngest to oldest):

- Recent Alluvial Deposits (stream channel, basin, and flood plain);
- the Modesto Formation;
- the Riverbank Formation;

- the Sutter Buttes Rampart;
- the Victor Formation;
- the contiguous Laguna, Tuscan, and the Tehama Formations;
- the Mehrten Formation; and
- the informally named Sutter Formation (Springhorn 2008).

Except for the Sutter Formation, the stratigraphic descriptions presented herein are based upon the California Department of Water Resources "Bulletin 118 – California's Groundwater" and are shown in the geologic cross-sections (Figure 8). The location of the cross-section is shown in Figure 7.

Locally, the stratigraphic succession observed in each subbasin differs slightly; therefore, each subbasin and its associated geologic setting are described separately with regard to their relative positions and occurrences in the specific subbasin.

4.2.4.1. East Butte Subbasin (Basin Number 5-21.59)

The northern section of Sutter County is underlain by the East Butte Subbasin. The East Butte Subbasin is bounded by the Sutter Buttes to the south, Butte Creek to the west and northwest, the Cascade Mountain range to the northeast, and the Feather River to the southeast. The East Butte Subbasin aquifer system consists of late Tertiary to Quaternary aged deposits comprised of Sierra and Cascade sourced material, and in the southern portion of the subbasin around the Sutter Buttes, by volcanic and volcaniclastic rocks. The geologic formations that comprise the East Butte Subbasin are (from youngest to oldest):

- Recent Alluvial Deposits;
- the Pleistocene aged Modesto and Riverbank Formations;
- the Sutter Buttes Rampart; and
- the Tertiary aged Laguna and Tuscan Formations.

Recent Alluvial Deposits

Stream channel deposits are Holocene in age and were deposited between 11,000 years ago and present day. The stream channel deposits occur along the current and ancestral paths of streams and rivers in Sutter County. Where present, the stream channel deposits extend from ground surface up to a depth of 80 feet below ground surface (Helley and Harwood 1985). The stream channel deposits consist of unconsolidated gravels, sand, silt, and clay, derived from the erosion and reworking of the Modesto and Riverbank Formations (described below). This unit is moderately to highly permeable, but because of its shallow depth and limited thickness, it possesses limited water-bearing capacity.

Basin deposits are Holocene in age and, like the stream channel deposits, were deposited between 11,000 years ago and present day. Basin deposits occur where sediment-laden floodwaters breached natural stream and river levees and spread across lower-lying topography. Where present, the basin deposits extend from ground surface up to a depth of 150 feet. The basin deposits consist mainly of silt and clay. These units have low permeability and generally yield small quantities of water to wells.

The Modesto Formation

The Modesto Formation is Pleistocene in age and is a stream terrace deposit that was deposited between 12,000 to 50,000 years ago (Helley and Harwood, 1985). Within this subbasin, the Modesto Formation consists of poorly indurated gravel and cobbles, sand, and clay and is derived from the reworking and deposition of the Riverbank Formation, Laguna Formation, and Tuscan Formation (DWR 2004). The Modesto Formation was likely deposited by the same stream and river systems that flow today, because it generally borders existing channels (Blake et. al. 1999). This formation may extend across the entire subbasin and where present, may range in thicknesses from 50 to 150 feet (DWR 2000). The sediments of the Modesto Formation are moderately to highly permeable and can yield moderate quantities of water to wells.

The Riverbank Formation

The Riverbank Formation is Pleistocene in age and was deposited between 120,000 and 500,000 years ago (Helley and Harwood, 1985). The Riverbank Formation consists of gravel and small cobbles, and is interbedded with reddish-clay, sand and silt. Like the Modesto Formation, the Riverbank Formation is a stream terrace deposit. However, the Riverbank Formation is older than the Modesto Formation. The

Riverbank Formation may extend across the entire subbasin, underlying the Modesto Formation, with thicknesses ranging from 50 to 200 feet. The Riverbank Formation is poorly to highly permeable and can yield moderate quantities of water to wells.

Sutter Buttes Rampart

The Sutter Buttes Rampart was deposited during the Middle to Lower Pleistocene period and is encountered in the southern portion of the subbasin. This unit is up to 600 feet thick in the subsurface (DWR 2000). In several studies (William and Curtis 1977, Springhorn 2008) the Sutter Buttes Rampart has been separated into two distinct units: the Rhyolitic Rampart and the Andesitic Rampart. The Andesitic Rampart phase of volcanism was much larger than the Rhyolitic phase. All the large peaks of the Sutter Buttes are andesitic domes and comprise the majority of the Rampart on the surface and the subsurface. The Sutter Buttes Rampart consists largely of gravel, sand, silt, and clay sediments which were deposited circumferentially around the Buttes as a geologic apron. These sediments may extend up to 15 miles north of the Sutter Buttes and west beyond the Sacramento River. Certain zones within these units yield large quantities of water (DWR 2004).

Laguna Formation

The Laguna Formation is Plio-Pleistocene in age and was deposited between 4 million and 2 million years ago. The Laguna Formation is comprised of Sierra Nevada sourced sediments, consisting of consolidated alluvial gravel, sand, and silt, comprised of granitic, metamorphic, and volcanic material. Estimates of the thickness of the Laguna Formation range from 180 feet (Helley and Harwood 1985) to 1,000 feet (Olmstead and Davis 1961). The Laguna Formation is characterized as being moderately consolidated and poorly to moderately cemented. Because of this, the permeability of formation is generally low to moderate. Wells completed in this formation have been observed to yield only moderate quantities of water (DWR 2003).

Tuscan Formation

The Tuscan Formation has been the subject of much interest in recent years. The Tuscan Formation is a regional aquifer system wholly or in parts of Tehama, Butte, Glenn, Colusa, and Sutter County. Within Sutter County, there has been limited analysis done on the subsurface extent of the Tuscan Formation. It is likely that the Tuscan Formation is only present in the northern portion of the County and consequently is not a major water resource for the County.

The Tuscan Formation is Plio-Pleistocene in age and was deposited between 4 million and 2 million years ago. The Tuscan Formation was derived by alluvial deposition associated with the erosion of volcanic material derived from Cascade volcanism. The formation outcrops from Red Bluff, in the northern part of the Sacramento Valley, to Oroville, southeast of Chico, and has been recognized in the subsurface at a distance of about 15 miles west of the Sacramento River (DWR 2003a). The deposits of the Tuscan Formation thin from east to west, from about 1,600 feet thick in the foothills of the Sierra Nevada to about 300 feet thick in the subsurface of the Sacramento Valley (Lydon 1969). In surface outcrops, the exposures of the Tuscan Formation are described as four separate, but lithologically similar units: Units A through D (Helley and Harwood 1985). Units A, B, and C are found within the subsurface in the northern part of the subbasin and units A and B are found in the southern part of the subbasin (DWR 2004). All of the units of the Tuscan Formation contain stratigraphic sequences of volcanic mudflows, volcanic conglomerates, volcanic sandstones, siltstones, and tuff deposits. In the subsurface, the Tuscan Formation consists largely of black volcanic sand and gravel, with interbedded layers of tuff breccias and tuffaceous clays (Ferriz, H. 2001). Unit A is the oldest (deepest) water-bearing unit and is distinguished from Units B and C by the presence of metamorphic clasts. Unit B contains equal distributions of volcanic mudflows, conglomerates, and tuffaceous sandstones. Units A and B are referred to as the “Lower Tuscan Formation”. Unit C is capped by massive volcanic mudflows with some interbedded conglomerates and sandstones. In the subsurface, the volcanic mudflows of Unit C act as a confining layer to groundwater flow, separating the more permeable deposits of the Lower Tuscan Formation (Helley and Harwood 1985).

4.2.4.2. Sutter Subbasin (Basin Number 5-21.62)

The Sutter Subbasin underlies the central portion of Sutter County and is wholly within the boundaries of the County. The subbasin is bound by the confluence of Butte Creek with the Sacramento River and the Sutter Buttes to the north, by the Feather River to the east, by the confluence of the Sutter Bypass and Sacramento River to the south, and by the Sacramento River to the west. The Sutter Subbasin aquifer system consists of late Tertiary to Quaternary aged deposits comprised of Sierra-sourced (Sierra Nevada) detritus and volcanic and clastic rocks in the northern portion of the subbasin around the Sutter Buttes. The identified geologic formations that comprise the Sutter Subbasin are (from youngest to oldest):

- Recent Alluvial Deposits;
- the Pleistocene aged Sutter Buttes Rampart and Victor Formation;
- the Pliocene Laguna Formation; and
- the informally named Sutter Formation.

Recent Alluvial Deposits

The Holocene aged stream channel and flood plain deposits occur along the current and ancestral paths of streams and rivers in Sutter County. The stream channel and flood plain deposits consist of unconsolidated gravel, sand, silt, and clay. Both thickness and grain size decrease as the distance increases from their source. Where present, the stream channel and flood plain deposits extend from ground surface to an estimated depth of 100 feet (Helley and Harwood 1985). These units are highly permeable and provide for large amounts of groundwater recharge within the subbasin. This unit is highly permeable, and yields significant quantities of water to wells (DWR 2000).

Sutter Buttes Rampart

The Sutter Buttes Rampart is Middle to Lower Pleistocene aged alluvial deposit that is encountered in the northern portion of the subbasin. This unit can be up to 600 feet thick in the subsurface (DWR 2000). In several studies (William and Curtis 1977, Springhorn 2008), the Sutter Buttes Rampart has been separated into two distinct units: The Sutter Buttes Rhyolitic Rampart and the Sutter Buttes Andesitic Rampart. The deposition and composition of Rhyolitic Rampart reflects the initial stages of volcanism and deposition around the Sutter Buttes, while the Andesitic Rampart reflects the later stages. These fan deposits form an apron around the Buttes and consist largely of gravel, sand, silt, and clay, and may extend up to 15 miles north of the Sutter Buttes and west beyond the Sacramento River. Certain zones within these units yield large quantities of water (DWR 2004).

Victor Formation

The Pleistocene aged Victor Formation is comprised of alluvial fan deposits composed of Sierra-sourced loosely consolidated gravel, sand, and silt. The Victor Formation has an estimated thickness of 100 feet (DWR 2004). This unit is observed to have an impermeable surface due to the presence of hardpan and clay pan soils (DWR 2003). At its base, the Victor Formation has been observed to have moderate permeability and provides most of the groundwater for domestic and shallow irrigation wells in Sutter County (DWR 2003). Wells completed in this unit have been reported to have yields as high as 1,000 gpm.

Laguna Formation

The Laguna Formation is comprised of Sierra sourced, consolidated alluvial gravel, sand, and silt, which consist of granitic, metamorphic, and volcanic material. Estimates of the formations thickness range from 180 feet (Helley and Harwood 1985) to 1,000 feet (Olmstead and Davis 1961). The Laguna Formation is characterized as being moderately consolidated and being poorly-to-moderately cemented, because of this, the formation generally has a low to moderate permeability. Wells completed in this formation have been observed to yield only moderate quantities of water (DWR 2003).

Sutter Formation

The Mio-Pliocene aged Sutter Formation is an informally named stratigraphic unit that underlies the area around the Sutter Buttes and the central portion of Sutter County. The extent of the deposits have been characterized on a local to sub-regional scale and have been generally classified as volcanic and epiclastic[3] sediments derived from volcanic sources located to the east in the Sierra Nevada, western Nevada, and the southern Cascade Volcanic Province (Springhorn 2008). Due to the complexity of identifying distinguishable characteristics within these deposits, informal and formal stratigraphic units within this region have been grouped together. Some of the major regional stratigraphic units that have been included in the Sutter Formation (from youngest to oldest) are the Tuscan, Mehrten, and Princeton Valley fill deposits.

4.2.4.3. North American Subbasin (Basin Number 5-21.65)

A portion of the North American Subbasin underlies the southeastern section of Sutter County. The North American subbasin is bound by the Bear River to the north, the Feather River to the west, the Sacramento River to the south, and in the east by a north-south trending line that represents the approximate edge of the alluvial basin (DWR 2004). The North American Subbasin is dominated by late Tertiary to Quaternary aged deposits consisting of Sierra-sourced volcanic sediments and alluvial derived sediments. The identified geologic formations that comprise the North American Subbasin are (from youngest to oldest):

[3] Consisting of fragments of preexisting rocks

- Recent Alluvial Deposits;
- Older alluvial deposits (the Pleistocene aged Modesto, Riverbank, Victor, and Laguna Formations); and
- the Mio-Pliocene aged Mehrten Formation.

Recent Alluvial Deposits

Stream channel deposits are Holocene in age and were deposited between 11,000 years ago and present day. The stream channel deposits occur along the current and ancestral paths of streams and rivers in Sutter County. The stream channel deposits consist of unconsolidated gravels, sand, silt, and clay, derived from active stream deposition, overbank sedimentation, and the erosion and deposition of existing Quaternary stream terrace deposits such as the Modesto and Riverbank Formations. Where present, the stream channel deposits extend from ground surface to a depth of 100 feet (Helley and Harwood 1985). This unit is highly permeable, and yields significant quantities of water to wells (DWR 2000).

The flood plain deposits consist primarily of silt and clay size sediments, with intermittent lenses of stream channel deposits. These deposits are generally observed along the flanks of existing and ancestral stream and river systems. These deposits have an estimated thickness up to 100 feet. Being that this unit is primarily comprised of finer-grained material, permeability is generally poor and generally yields low quantities of water. Brackish water is commonly encountered within this unit (DWR 2000).

Older Alluvial Deposits

Within this subbasin, a number of geologic formations have been assigned to the category "older alluvium" including: the Modesto, Riverbank, Victor, and Laguna Formations (DWR 2004). These deposits generally underlie the Recent Alluvial Deposits and consist of loosely to moderately compacted gravel, sand, silt, and clay size sediments that were derived and deposited under alluvial conditions. The thickness of these units ranges from approximately 100 to 650 feet (DWR 2004).

Mehrten Formation

The Mehrten Formation is Mio-Pliocene in age and consists of a sequence of volcaniclastic and volcanic rocks. In the subsurface, the Mehrten Formation ranges in thickness from 200 feet to 1,000 feet along the axis of the Sacramento Valley (DWR

2003). The Mehrten Formation is comprised of two distinct geologic units. The first unit consists of sediments deposited under alluvial and fluvial conditions and are comprised of gravel, sand, silt, and clay size sediments. This unit is highly permeable and wells constructed within this unit have been observed to produce yields exceeding 1,000 gpm (DWR 2003). The second unit consists of dense volcanic flows of tuff breccias with some interbedded conglomerates and sandstones. This unit acts as a confining layer between sand intervals and has a thickness that ranges from 200 to 1,200 feet in the subsurface (DWR 2003).

4.2.5. Areas Outside a Designated Groundwater Basin

The only part of the County that is not within a designated groundwater basin is the area consisting of the Sutter Buttes. Groundwater is likely found in the subsurface in fractures of the volcanic rock; however, historic groundwater levels and water quality were not reviewed in the preparation of this GMP. There are no local entities, aside from private domestic water users, that utilize groundwater resources in this area.

4.3. Groundwater Levels

DWR does not currently consider any of the groundwater subbasins underlying the County to be in overdraft. Overdraft is characterized by a declining trend in groundwater levels over multiple years without recovery during recharge events. Historic groundwater level data were reviewed for each of the subbasins within the County. DWR maintains a publicly available on-line database, which includes groundwater level data for the County. The DWR Water Data Library (WDL) website can be found at http://www.wdl.water.ca.gov. Wells monitored by DWR and cooperating agencies are identified by the State Well Number (SWN). Data can be obtained for specific wells by means of a map interface, by groundwater basin, or by the assigned SWN.

A 79-year period of record for water level measurements in Sutter County depicts a groundwater system that has experienced changing conditions over time. A number of DWR monitored wells were selected throughout the County to represent these changes. The locations of these wells, along with their associated hydrographs illustrating the historic groundwater levels, are shown in Figure 9. Groundwater level data from well 10N/4E-12A1, a 290-foot-deep well located in the southeast portion of Sutter County, and well 13N/3E-32N1, a shallow (less than 100 feet deep) well located in the southern portion of the County show the groundwater levels typical of different areas of the County. Groundwater levels in well 10N/4E-12A1 are characteristic of areas of high groundwater use and differing water conditions. Water levels fluctuate, sometimes dramatically, in response to changes in groundwater use and hydrologic conditions. This well is located in an area where agricultural demands are supplied entirely with groundwater. The Sacramento County Department of Water Resources website includes published groundwater elevation maps and indicates that this well is in close proximity to a large pumping depression in northern Sacramento County. Groundwater levels in well 13N/3E-32N1 are characteristic of areas with lower groundwater use and more stable water conditions, and as such, water levels have not exhibited significant fluctuations over times. This well is located in an area where agricultural demands have been met almost entirely with surface water and groundwater demands have consequently been small.

Groundwater levels in well 10N/4E-12A1 have varied from 20 to 80 feet below ground surface over time. The combination of high groundwater use, the close proximity to a pumping depression, and changing climatic conditions has led to significant declines in groundwater levels from the early 1950' through the late 1970's. In the middle to late 1970's, drought conditions increased the rate of decline of groundwater levels on an even larger scale. In the mid 1980's and early 1990's, private and municipal water agencies in a collaborative effort started to implement conjunctive water use programs. With the availability of surface water, and the decrease in groundwater pumpage, groundwater levels have been steadily recovering from the early 1980's through present. Groundwater levels in this well are currently about 35 to 40 feet higher than they were in the late 1970's.

Groundwater measurements in well 13N/3E-32N1 shows very stable groundwater levels since measurements began in 1942. Groundwater levels have remained virtually unchanged, with water levels within 5 to 6 feet of ground surface and seasonal fluctuations of less than 10 feet.

The direction of groundwater flow during the fall season within the County has not changed significantly from 1912-1913 (Bryan 1923) to 2007; with the exception of the southeastern portion of the County. Contours of equal groundwater levels from fall 1912-1913 and fall 2007 were compared to identify changes over the 95 year period. Figure 10 depicts changes in groundwater levels over the aforementioned period. In most areas within the County, groundwater levels were not dramatically different in 2007 than they were in 1912-1913. In the central portion of the County, an increase in groundwater levels is observed in the data, which may be likely due to applied surface water for irrigation. In the southeastern portion of the County, a significant decline in groundwater levels is observed, which can be related to the high usage of ground water for irrigation of crops, and the influence of the large pumping depression in the northern portion of Sacramento County.

Fall and spring contour maps of equal groundwater elevation for 2007, 2008, 2009, and spring 2010 were reviewed (Figures 11 through 17) to determine groundwater gradient and flow direction. The fall 2009 and spring 2009 groundwater contours generally follow the topography of the County and indicate that groundwater flows from the Sierra Nevada toward the Sacramento Valley (east to west), and north to south within the Valley. The fall 2007 contour map of equal groundwater elevations indicates a few locations where small pumping depressions are present, but in general, suggests the same direction of groundwater flow as seen in the spring 2007 groundwater contour map. Differences in groundwater levels between fall and spring appear to be a result of normal fluctuations in groundwater conditions from seasonal pumping and from wet and dry climatic cycles.

Data from the nested monitoring well at the extensometer site in the southern portion of the County indicates that, for the 14 years of available data, the spring groundwater levels in the monitored aquifer zones have been very similar, within a few feet of one another; except for the deepest completion where groundwater levels are approximately 10 feet lower than the shallower completions.

4.4. Groundwater Quality

The quality of groundwater is a product of the material through which it flows, or that flows into it. Local variations in the quality of the County's groundwater can limit its use for either potable water supply and/or agricultural applications. Groundwater contamination is a result of naturally occurring, point source contamination, and/or regional contamination. Naturally occurring contaminants of concern include dissolved salts [as measured by the specific conductance or electrical conductance (EC)], boron, nitrate, manganese, arsenic, and mercury. Point source contamination typically involves solvent releases originating mostly from gas stations and dry cleaners. Regional sources of contamination include applied fertilizers, salts, and leaky septic systems (nitrate and salt loading).

Historic and current water quality data (collected by the DWR, USGS, and local water purveyors) for wells located within the County were analyzed to characterize spatial and depth dependent water quality trends within the County's groundwater subbasins. The data was separated by well depth into the following three categories: less than 150 feet deep, 150 to 400 feet deep and more than 400 feet deep, as shown in Figures 18 through 23. The categories were chosen based on the occurrence at which certain stratigraphic units are observed in the subsurface in Sutter County.

4.4.1. Specific Conductance

Specific conductance was selected as an indicator of overall water quality. Specific conductance is a property of groundwater that is relatively simple to collect in the field at the well head and can help identify and characterize the condition of the non-marine fresh water bearing aquifer system. Specific conductance is a measure of how effectively water will conduct electricity and is reported in micro Siemens (µS/cm) per centimeter and provides for the indirect measurement of the amount of dissolved solids (salts) in the groundwater. Lower specific conductance generally indicates better water quality (fresh water) while higher specific conductance generally indicates poorer water quality (brackish to saline water).

Applied irrigation and fertilizers can add salts to the water that percolate into the hydrogeologic system, increasing the specific conductance of the groundwater. Increased specific conductance values of the groundwater can also be attributed to naturally occurring brackish or saline water, such as geologic formations (aquifers) which are, or have been in the past, directly connected to a salt water body or where geologic formations were deposited under marine (salt water) conditions and which have inherently high dissolved salt concentrations. As shown in Figures 18 and 19, specific conductance values within the County are generally acceptable for agricultural and domestic use east of Highway 99 and in the northern half of the County. Elevated values for specific conductance are near to and/or exceed the recommended maximum contaminant level (MCL)[4] for domestic use in the shallow aquifers near the Sacramento River and in the aquifers below 900 feet. The elevated specific conductance could potentially be problematic for agricultural use. It is unclear why there is elevated specific conductance in this area.

4.4.2. Boron

Boron is a naturally occurring element. As shown in Figure 20, boron concentrations in the County are generally acceptable. Some deeper wells, which likely encounter more marine sediments, do contain elevated boron concentrations. Boron is a necessary element for agriculture, but may become toxic to crops above 500 micrograms per liter (µg/L). For public drinking water systems, the California Department of Public Health (CDPH) has established a notification level of 1,000 µg/L for boron. Increased concentrations of boron are observed in wells greater than 400 feet as well as in the southwestern portion of the County.

4.4.3. Nitrate

Nitrate is a contaminant which does not naturally occur in the subsurface. Elevated concentrations of nitrate are widespread in the Sacramento Valley. As shown in Figure 21, concentrations of nitrate in the populated areas of Sutter County are near or above the MCL for nitrate (as NO_3). The CDPH has established a primary MCL of 45 milligrams per liter (mg/L) for nitrate (as NO_3). Near the Sutter Buttes and Yuba City, nitrate concentrations in several wells (less than 150 feet) exceed the MCL. Where present, elevated concentrations of

[4] Recommended CDPH MCL for Specific Conductance is 900 µS/cm; upper limit is 1,600 µS/cm; short term is 2,200 µS/cm

nitrate are likely a result of overlying land uses, such as septic systems, animal enclosures, or applied fertilizers.

4.4.4. Manganese

Manganese is a naturally occurring element found in rocks and minerals. Its presence in groundwater is a result of the dissolution of the naturally occurring element in sediments containing minerals composed of manganese. As illustrated in Figure 22, manganese concentrations are elevated in all portions of the County, at levels that may cause aesthetic problems (odor or staining) for domestic and municipal uses, but generally below levels that could represent a health risk. There are, however, a few locations where manganese concentrations are near or exceed the CDPH established Notification Level of 50 µg/L, and may pose a health risk.

4.4.5. Arsenic

Arsenic is a naturally occurring element commonly found in alluvial sediments. Its presence in groundwater is a result of the dissolution of the element in sediments containing minerals containing arsenic. The CDPH has established a primary MCL of 10 µg/L for arsenic. As illustrated in Figures 19 and 23, arsenic concentrations are near to or above the CDPH MCL throughout the County in each of the aquifer zones assessed; conversely, concentrations of arsenic below the CDPH MCL are also present throughout the County in each of the aquifer zones assessed. Countywide, arsenic concentrations do not appear to be isolated to any one specific aquifer zone in the subsurface. However, recent data analysis suggests a possible correlation between elevated arsenic concentrations and the presence of volcaniclastic material of the Sutter Buttes Rampart formation. Concentrations of arsenic in the stratigraphic units that occur above and below the Rampart are generally less than 10 µg/L, whereas concentrations of arsenic within the Rampart material are between 10 to 370 µg/L (Springhorn, 2008). Concentrations of arsenic tend to be under the CDPH MCL southeast of Highway 99 and in the shallow aquifers.

4.4.6. Mercury

Historic gold mining processes and operations introduced toxic mercury into the surface water system throughout Northern California in the late 1800's. Due to the proximity of these operations to Sutter County, the PAG requested an assessment of the concentrations of mercury in the groundwater. A limited number of wells have been sampled within Sutter County for mercury, and as such, concentrations of mercury in the groundwater within Sutter County can not be well characterized. The few wells that have been sampled for mercury indicate that mercury concentrations were low. In most cases, the concentrations were below the analytical detection limit (not detectable by the laboratory method used at the time).

4.5. Land Subsidence

Land subsidence is the gradual or sudden lowering of the land surface due to compaction of the underlying sediments. Two types of land subsidence are observed within alluvial sediments: inelastic and elastic. Inelastic land subsidence is a result of the compression of geologic formations and is irreversible. Inelastic land subsidence can be caused by excessive extractions of groundwater, oil, or natural gas. In discussing land subsidence, it is important to note that elastic (reversible) land subsidence is a normal occurrence, whereas inelastic land subsidence has associated negative impacts.

Although there are several causes of inelastic land subsidence, the compression of clay as a result of groundwater extraction is considered the most likely cause of subsidence north of the Sacramento-San Joaquin Delta (Page 1998). Once water is removed (mined) from compressible clay, the clay compresses and cannot accept water again, thus resulting in the permanent lowering of the overlying land surface (inelastic land subsidence). Clay compression has occurred in several locations in California, including the San Joaquin Valley. Compressible clay, such as the Corcoran Clay member of the Tulare Lake Formation, has been mapped over much of the western side of the San Joaquin Valley and can be over 130 feet thick. The subsidence documented in the San Joaquin Valley extends over a very large area, with over 30 feet of subsidence recorded in some areas.

North of the Sacramento-San Joaquin Delta in the Sacramento Valley, inelastic land subsidence, which has been directly related to clay compression as a result of groundwater extraction, has occurred in portions of Solano, Yolo, and Colusa Counties (Page 1998). Recorded land subsidence of more than two feet, and possibly as much as five feet, has occurred in this area. Subsidence in the Sacramento Valley appears to extend from Davis to Arbuckle. The area of subsidence appears to follow a local geologic feature known as the Zamora Syncline. A syncline is a structural fold that is formed by compressional forces which cause the sedimentary layers to have a concave, or a bowl-like geometry. Lakebeds are often associated with structural lows such as synclines. Lakebed deposits typically consist of fine-grained, clayey sediments, which settle out to the bottom of standing bodies of water and of which can include large volumes of freshwater diatoms[5]. Along with sediments, the microscopic diatoms settle and collect on the bottom of a lakebed. In Yolo County, diatomaceous (diatom rich) clay sediments have been identified within the geologic formations of Zamora Syncline. These diatomaceous clay sediments were identified to be

[5] Diatoms are unicellular aquatic algae, typically 20 to 200 microns (Prothero, 1998)

highly compressible (Page 1998). Although diatomaceous clay has been identified in numerous boreholes drilled in Sutter County, there have not been any recorded land subsidence issues.

Elastic land subsidence is observed to be cyclical and does not result in permanent compaction of subsurface materials. One example of elastic land subsidence is seasonal fluctuations in ground surface elevations that coincide with fluctuations in groundwater levels (and associated aquifer pressure). In elastic land subsidence, the subsurface pressures acting on the aquifer do not decrease enough so that subsurface materials permanently compact.

The DWR, in cooperation with federal, state and local agencies, installed and surveyed Global Positioning System (GPS) monuments to be able to measure and monitor ground surface elevations over time in the Sacramento Valley. The project, titled “The Sacramento Height-Modernization Project”, consists of 339 monuments, spaced approximately 7 kilometers apart, in 10 counties. There are 32 monuments located in Sutter County. The GPS monuments will augment the existing network of extensometers which DWR currently monitors for land subsidence. In total, there are 13 extensometers located in Glenn, Colusa, Butte, Yolo, and Sutter Counties. The land subsidence monitoring network is shown in Figure 24. Only one of these extensometers, State Well Number 11N/4E-04, is located within Sutter County. It is located in the south-central part of the County along Highway 99, and extends to a depth of 1,003 feet, extending over a large portion of the fresh-water formations. The extensometer is installed in a dedicated monitoring well and is designed to measure any change in distance between the bottom of the well and the ground surface. DWR reports the accuracy of the extensometer to be ±0.001 feet. The extensometer provides for ongoing, real-time data collection, of land surface elevation changes. The Sutter County extensometer has been recording data since early 1994. In the 14 years since it began recording, the extensometer in Sutter County has recorded seasonal (cyclic) elastic land subsidence of approximately 0.03 feet (approximately one-third inch). There has been no indication over the period of record that any inelastic subsidence has occurred.

4.6. Groundwater-Surface Water Interaction

Several clustered monitoring wells located throughout the county adjacent are used to monitor changes in surface flow or quality that directly affect the groundwater system (levels or quality), and/or to monitor changes in surface flow or quality that are caused by groundwater pumping. These monitoring wells are adjacent to surface water bodies, and have a river stage gage located in the immediate vicinity.

Several of the network wells are located along the banks of the Sacramento, Feather, and Bear Rivers, as shown in Figure 25. The relationship between the volume of water flowing in the major rivers/streams and the influence the surface water imparts on groundwater elevation are being monitored with a combination of nested monitoring wells and river stage gages. Four stations exist in the County for observing this interaction: on the Sacramento River below Wilkins Slough (WLK), on the Bear River at Pleasant Grove Road (BPG), on the Sutter Bypass at RD 1500 pump (SBP), and along the Feather River above Star Bend (FSB). Sutter County also monitors a river stage gage at Boyd's Landing (FBL). At stations BPG and FBL, observations of water surface/groundwater elevations trend closely during high flow/stage events in the rivers, suggesting a significant hydrologic connection between the groundwater in the shallow aquifers and the surface water.

4.7. Groundwater Recharge

Groundwater recharge is the process in which groundwater is replenished. The geologic formations that comprise the aquifer system underlying the County extend well beyond the County's jurisdictional boundaries. Several processes are responsible for recharge of the groundwater basin. On a regional scale, surface water flowing over the surface expression of the geologic formations (surface outcrops) allows for direct infiltration into the hydrogeologic system. Figure 26 depicts contours of equal groundwater elevations, superimposed over the surface geology, for the Sacramento Valley Groundwater Basin. Groundwater flow is perpendicular and down gradient to the contour interval. On the east side of the Sacramento Valley Groundwater Basin, the groundwater contours become parallel to and follow the margin of the valley, indicating groundwater is moving through the subsurface from the east to the west. Locally, groundwater recharge occurs where surface water flows over permeable sediments (gravel and sand) in the river channels, allowing for the direct infiltration of surface water. Deep percolation of applied irrigation water also recharges the groundwater basin. Additionally, surface water deliveries have increased the quantity of water flowing down the river, adding available water to recharge the underlying aquifers helping to improve groundwater elevations.

The amount of groundwater recharge is dependent on the available storage space within the aquifer(s). Depending on the degree of separation between the elevation of the bottom of the river or stream and that of the groundwater, streams can either "lose" water into the underlying aquifer(s) or "gain" water. Where groundwater levels are at or above the elevation of surface water, groundwater will discharge into the stream (gaining stream). Where there is a separation between the groundwater and surface water, water flowing downstream will recharge into (losing stream) the groundwater basin (although the contribution has not been studied). Conversely, if groundwater levels are at land surface, there will be refusal of any "new" water into the subsurface.

The State Water Resources Control Board has identified hydrogeological vulnerable areas, meaning vulnerable to groundwater contamination, where geologic conditions allow recharge to the underlying aquifers. Generally, these areas include the coarse deposits associated with the Feather River.

4.8. Groundwater Infrastructure

According to DWR records, 6,742 well completion reports have been filed for wells constructed in Sutter County. Well completion reports are not always filed with DWR, even though they are required by law, so the number of reports likely under-represent the actual total for the County. Of the wells for which well completion reports have been filed:

- 3,344 are domestic wells
- 1,167 are irrigation wells
- 854 have unknown or other uses
- 308 are monitoring wells
- 75 are municipal wells
- 34 are industrial wells
- 13 are test wells
- Seven (7) are stock-watering wells
- 12 are fire or frost protection wells
- Two (2) are cathodic protection wells

Figure 27 shows the number of DWR well completion reports filed for Sutter County from 1928 through 2007. The figure only illustrates wells that were classified as either: domestic, irrigation, or public supply. Domestic wells were constructed at a rate of approximately five per year from 1941 through 1950, but have been constructed at a rate of approximately 59 per year since then. Irrigation wells tend to be constructed more frequently during drought periods, in the mid-1970's and early 1990's. On average, 16 irrigation wells are constructed per year; however, significantly more wells are constructed during droughts. Municipal well construction has averaged two-and-a-half per year. Of the wells for which records exist, approximately 700 wells are classified as either abandoned or destroyed.

Figure 28 shows the average depth of wells constructed from 1950 through 2005. The average depth of domestic wells has fluctuated since the 1930's, but has generally been about 100 feet deep. The average depth of irrigation wells has fluctuated significantly, but has been about 160 feet deeper than the average depth of domestic wells in any give year, or an average of about 260 feet deep. Municipal well depths are inconsistent and vary widely in depth, from about 50 to 700 feet deep. Combined with the small number constructed annually, calculation of an average depth of new municipal wells would not be meaningful.

5. GROUNDWATER MANAGEMENT PLAN REQUIRED, VOLUNTARY, AND RECOMMENDED COMPONENTS

California Water Code §10750 et seq., as amended by Senate Bill (SB) 1938, defines the required and voluntary components of a GMP and establishes procedures by which they must be developed. DWR recommends additional elements to include in a GMP in Bulletin 118 Update 2003, Appendix C. The Sutter County GMP includes the components required in the Water Code and has been developed in accordance with the required procedures. This GMP also includes many of the voluntary and recommended GMP components. This GMP also includes components designed to address the requirements of California Water Code §10920 et seq., which establish requirements for groundwater monitoring that affect eligibility for grant funding.

5.1. California Water Code Requirements

Section 10750 et seq. of the California Water Code, as amended by SB 1938, requires GMPs to include six mandatory components to be eligible for the award of funds administered by DWR for the construction of groundwater projects or groundwater quality projects. These components are listed below.

Description	***GMP Section***
Make available to the public a written statement describing the manner in which interested parties would be allowed to participate in the development of the GMP.	1.4
Include Basin Management Objectives (BMOs), including components relating to the monitoring and management of groundwater levels, groundwater quality degradation, inelastic land subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping.	6.2
Prepare a plan that involves other agencies that enables Sutter County to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin.	7.1.5
Prepare a map that details the area of the groundwater basins, Sutter County's boundaries, and other local agencies within the groundwater basins.	Figure 1

Description	*GMP Section*
Adopt monitoring protocols to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence, and flow and quality of surface water that directly affects groundwater levels or quality or are caused by groundwater pumping.	7.1
For areas outside the groundwater basins, use geologic and hydrologic principles appropriate to those areas.	4.2.5;7.1.4

5.2. DWR Bulletin 118 Recommended Components

DWR's Bulletin 118 recommends other components that may voluntarily be included in a GMP. These are listed below.

Description	*GMP Section*
Establish an advisory committee of stakeholders to help guide the development and implementation of the plan and provide a forum for resolution of controversial issues.	1.4
Describe the area to be managed under the GMP.	1.3
Describe how meeting each BMO will contribute to a more reliable long-term groundwater supply, and describe management actions to achieve each BMO.	6.2
Describe GMP monitoring program.	7.1
Describe integrated water management planning efforts.	7.1.5
Periodically report groundwater basin conditions and management activities.	7.1.6
Evaluate GMP periodically.	7.1.6

5.3. California Water Code Voluntary Requirements

California Water Code §10753.8 lists twelve issues of groundwater management which may voluntarily be included in a groundwater management plan.

Description	*GMP Section*
Control of saline water intrusion.	6.1.3
Identification and management of wellhead protection areas and recharge areas.	4.7; 6.1.3
Regulation of the migration of contaminated groundwater.	N/A
Administration of well abandonment and well destruction program.	6.1.3
Mitigation of conditions of overdraft.	4.3
Replenishment of groundwater extracted by water producers.	N/A
Monitoring of groundwater levels and storage.	4.3; 5.4
Facilitating conjunctive use operations.	6.1.3
Identification of well construction policies.	6.1.3
The construction and operation of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.	N/A
The development of relationships with state and federal regulatory agencies.	7.1.5
Review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination.	7.1.6

5.4. California Water Code Groundwater Monitoring Components

On November 4, 2009 the State Legislature amended the Water Code with Senate Bill SBx7-6, which mandates a statewide groundwater elevation monitoring program to track seasonal and long-term trends in groundwater elevations in California's groundwater basins. To achieve that goal, the amendment requires collaboration between local monitoring entities and DWR to collect groundwater elevation data. Collection and evaluation of such data on a statewide scale is an important fundamental step toward improving management of California's groundwater resources.

In accordance with this amendment to the Water Code, DWR developed the California Statewide Groundwater Elevation Monitoring (CASGEM) program. The intent of the CASGEM program is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. The CASGEM program will rely and build on the many, established local long-term groundwater monitoring and management programs. DWR's role is to coordinate the CASGEM program, to work cooperatively with local entities, and to maintain the collected elevation data in a readily and widely available public database. DWR will also continue its current network of groundwater monitoring as funding allows.

The law anticipates that the monitoring of groundwater elevations required by the enacted legislation will be done by local entities. The law requires local entities to notify DWR in writing by January 1, 2011 if the local agency or party seeks to assume groundwater monitoring functions in accordance with the law (Water Code §10928).

Additionally, on or before January 1, 2012, the law requires that Monitoring Entities shall begin reporting seasonal groundwater elevation measurements to DWR (Water Code §10932).

Local entities in Sutter County that have submitted official notifications to DWR to be considered for CASGEM Monitoring Entities include:

- Sutter Extension Water District
- Feather Water District
- Reclamation District 1500 (including RD 1500, Pelger Mutual Water Company and Sutter Mutual Water Company)
- Natomas Central Mutual Water Company
- South Sutter Water District

Garden Highway Mutual Water Company has shown interest in participating in CASGEM but has not yet completed the official notification submittal process include.

Local entities that submit complete Monitoring Entity notifications and adequate groundwater monitoring plans and well networks will be officially designated by DWR to be the Monitoring Entities for their respective subbasin or portion of a subbasin for the purposes of the CASGEM Program. However, if no local monitoring entity volunteers or is identified for a particular area or groundwater basin, DWR may assume the monitoring and reporting duties and certain entities in the basin may not be eligible for water grants or loans administered by the state.

Sutter County is severely limited in its ability to take a lead in groundwater monitoring because of budget and staff shortages. Furthermore, the County does not own any groundwater monitoring wells and does not conduct any groundwater monitoring on its own. For this reason, Sutter County does not seek to assume groundwater monitoring functions under California Water Code §10920 et seq. However, the County does promote the coordinated collection of groundwater elevation data through its Groundwater Monitoring Program, discussed in Section 7.1 of this GMP.

6. GROUNDWATER MANAGEMENT GOALS AND BASIN MANAGEMENT OBJECTIVES

6.1. Groundwater Management Goals

Sutter County's groundwater management goals represent the overarching intent of the County with regard to groundwater management. Basin Management Objectives (BMOs) and Management Actions must be consistent with these Groundwater Management Goals, and must contribute to achieving the goals. Sutter County's goals for groundwater management (as developed with input from the public through PAG meetings and workshops) are:

- To promote responsible groundwater use in Sutter County so groundwater is available to meet present and future demands.
- To provide groundwater users with information and guidance to help them be responsible stewards of the groundwater resources in Sutter County.
- To discourage activities that could reduce the long-term availability of high-quality groundwater in Sutter County.

Each of the Groundwater Management Goals is discussed below.

6.1.1. To Promote Responsible Groundwater Use in Sutter County So Groundwater is Available to Meet Present and Future Demands.

One of Sutter County's main goals for groundwater management is to ensure that a reliable water supply is available so that water users in the County can be confident that water will be available to meet domestic, irrigation, and other demands on an ongoing basis.

The goal to promote responsible groundwater use in Sutter County is intended to provide the County with useable groundwater resources now and in the future. This is important because the socio-economic well being of the County could be adversely affected if the groundwater supply becomes less useable from a supply or quality standpoint. Ensuring responsible groundwater use will help protect groundwater rights and maintain local control because adjudication of the groundwater basin will not be warranted if long-term groundwater sustainability can be achieved.

6.1.2. To Provide Groundwater Users with Information and Guidance to Help Them Be Responsible Stewards of the Groundwater Resources in Sutter County.

It is important to understand that in order to responsibly manage groundwater to ensure long-term groundwater sustainability, it is necessary to thoroughly understand the groundwater system underlying the County, along with its capabilities and limitations. Sutter County's water resources should be viewed as a dynamic system with the amount of available surface water and groundwater varying over time with fluctuations in hydrologic and climatic conditions. The implementation of a surface/groundwater monitoring program to observe and document the County's resources is essential to provide the community with the necessary information to accomplish this management objective.

6.1.3. To Discourage Activities that Could Reduce Long-Term Availability of High-Quality Groundwater in Sutter County.

It is important to recognize that this management objective is not intended to restrict the users within the community from exercising their legal rights to groundwater. Groundwater is a resource that should remain available for the people of the County to use beneficially on their property. The intent of this objective is for groundwater management to be accomplished in a way that minimizes activities that could potentially reduce the long-term availability of high-quality groundwater in Sutter County. There are a number of management practices that can be utilized to accomplish this goal. Two of the main practices that should be considered are conjunctive use programs and improving County well standards.

The goal of optimizing the conjunctive use of surface water and groundwater will enhance the County's water supply reliability and maximize the available water supply. The term "conjunctive use" basically means using surface water and groundwater together to meet water demands, using different proportions of each depending upon availability. For example, in years of reduced surface water availability, more groundwater would be used and groundwater levels might decline. Conversely, in years of full surface water availability, less groundwater would be used and groundwater levels would be allowed to recover. Optimizing conjunctive use generally means that, whenever possible, surface water is used to the fullest extent with groundwater serving as a "back-up" supply. This maximizes the available water supply because unused surface water generally flows downstream and is lost, but unused groundwater remains in the ground and would be available for later use.

On the other hand, the potential may exist in some areas of the County where groundwater levels are (and have historically been) high, to utilize more groundwater and thus induce more recharge (by creating additional storage space within the aquifer) thereby increasing the total water supply available in the County.

A related goal is to "even out" water availability in the County. There are cases when surplus water is available in some areas of the County, but other areas have inadequate supplies. For example, an area with high groundwater levels may have adequate or excess surface water, while another area may have low groundwater levels and inadequate surface water. In this case, groundwater could be pumped in the area with high groundwater levels, and their surface water could be transferred to the area with low groundwater levels so that area does not have to rely as much on groundwater. If possible, undertaking such projects will help improve the overall water supply reliability in the County.

The goal for updating the County's well standards is to add additional levels of protection to ensure that the design of new well structures prohibit the downward migration of surface/shallow contaminants or cross contamination of aquifers. The County has adopted standards as set forth in Chapter II of the State Department of Water Resources Bulletin 74-81, and as supplemented by Bulletin 74-90, entitled "Water Well Standards: State of California", except as otherwise provided in Section 700, Chapter 765 "Water Wells" of the Sutter County Municipal Code[6]. Some amendments that could be made to the existing well standards are: (1) require the use of geophysical surveys for all new well projects, (2) increase the required minimum sanitary seal depths, (3) institute water quality sampling during cable tool well drilling, (4) institute well restriction zones where poor water quality is known, and (5) improve/implement well destruction programs.

Requiring the use of geophysical surveys (spontaneous potential, 16- and 64-inch resistivity) in all new boreholes can help to enhance groundwater protection by identifying the zone(s) of poor water quality, as well as the depths of confining layers, which can be used to design adequate sanitary/annular seals. With this data, future wells can be designed to effectively seal against poor water quality while providing adequate measures for aquifer protection.

Increasing the minimum sanitary seal depth required for new wells is a proactive measure that can effectively increase aquifer protection. Increasing the required sanitary seal to a minimum depth of 50 feet for all new wells can seal off shallower aquifers with poorer water quality from the deeper aquifers with better water quality, as well as impede the

[6] http://www.co.sutter.ca.us/doc/government/bos/ordinance

downward migration of surface contaminants. Currently, the standards in force require a minimum 50-foot sanitary seal for municipal supply wells and 20-foot sanitary seal for all other wells (Bulletin 74-90).

Many wells in Sutter County have been drilled and constructed utilizing the cable tool drilling method. One of the main troubles with cable tool wells is that they usually are constructed across, and connect, multiple aquifer zones. Some of these well structures likely have become conduits for the downward migration and cross contamination of aquifer zones. Water quality sampling during the drilling of these wells (field tests for TDS or specific conductance) would delineate between problematic and non-problematic aquifer zones. If an existing well is deemed problematic (i.e. poor water quality), corrective measures through well modification or even well destruction could help mitigate the movement of poorer water quality between aquifer zones.

Implementing well restriction zones where water quality contamination is known to exist in specific aquifers can aide in protecting aquifers with acceptable water quality. Restricting the construction of wells or requiring specific seal intervals can provide an additional level of aquifer protection. Certain areas within Sutter County have localities of poorer water quality. It may be beneficial to assess the risk of drilling and constructing new wells within these areas. If adequate aquifer protection can not be achieved during construction activities, it may be warranted to designate well exclusion zones.

Unused, unsecured, abandoned, or improperly destroyed wells can act as a direct conduit for surface water infiltration or degradation of one or more aquifers, if they are connected by the well structure. Well destruction requirements adopted by the County currently require abandoned wells to be destroyed. Currently, these requirements require the uppermost 20 feet of the well/borehole be filled with impervious material. Special situations, in the case where vertical movement of poor water quality could contaminate an aquifer with good water quality, require impervious sealing material to be placed adjacent to confining layers. Increasing oversight of the permitting process during the planning and design of well destruction programs can ensure added protection against the vertical migration of poor water quality.

6.2. Basin Management Objectives

Basin Management Objectives (BMOs) are guidelines established to ensure that the County's basin management goals are being fulfilled. BMOs create a systematic method for collecting and monitoring data for specific components of the groundwater system and to provide for the dissemination of such information to the public. The objective of the BMOs is not to assign a fixed value, or level, to each parameter, but to allow for the early identification of potential problems with sufficient time for the County and its groundwater users to formulate an action plan to mitigate adverse effects to its groundwater resource.

Sutter County's BMOs address the following parameters:

- Groundwater levels
- Groundwater quality
- Inelastic land subsidence
- Surface water
- Coordination

6.2.1. Groundwater Levels BMO

There are three BMOs for groundwater levels:

- *Avoid ongoing declines in groundwater levels during water year types identified by DWR to be "above normal" or "wet" for the Sacramento Valley.*
- *Avoid problematically high groundwater levels.*
- *Provide assistance with assessing problems and resolve disputes related to groundwater levels.*

Groundwater levels are to be managed to ensure adequate water supplies while avoiding adverse impacts and mitigating them if and when they do occur. Adverse impacts related to groundwater levels can occur from excessively high or low groundwater levels. What constitutes an excessively high or low groundwater level may change over time, and will also vary by land use and hydrologic and climatic conditions.

Excessively high groundwater levels are problematic in some areas of the County. High groundwater levels in Sutter County are often naturally occurring. However, groundwater levels can be raised by application of water to the ground surface through irrigation, surface storage, or recharge projects. When groundwater levels are high, there is no storage capacity available in the underlying aquifer for groundwater recharge from precipitation, stream flow, or excess applied irrigation water. This represents a lost opportunity to capture recharge and increase the overall water supply for the County. Adverse impacts related to high groundwater levels include:

- Damage to foundations, roads, and other infrastructure.

- Water-logging the root zone of certain crops.

Groundwater levels decline when pumping exceeds recharge and rise when recharge exceeds pumping. It is important to note that periodic short-term declines in groundwater levels (during drought periods and/or increased pumping), which are then followed by recovery to at or near historic highs (during wet periods and/or decreased pumping), are normal and do not represent overdraft. Excessively low groundwater levels that are caused by long-term declines without recovery, thus overdraft, can be avoided by reducing pumpage. This can be accomplished by expanding the conjunctive use with surface water. Adverse impacts related to low groundwater levels include:

- Infrastructure problems when lowered groundwater levels dewater pumps or wells, so groundwater cannot be extracted using existing infrastructure even though it is available at greater depths.
- Depleted available groundwater supply.
- Inelastic land subsidence.
- Riparian and/or native vegetation destroyed.
- Reduced surface water flow due to increases in streambed infiltration, or increases in the capture of groundwater that otherwise would have contributed to increasing the base flow of a surface water system.

6.2.2. Groundwater Quality BMO

The BMO for groundwater quality is to:

- *Improve the understanding of groundwater quality in Sutter County.*
- *Maintain or improve groundwater quality.*

Adverse impacts to groundwater quality most commonly occur when degradation of groundwater renders groundwater unsuitable for intended uses. Accordingly, what constitutes a significant adverse impact to groundwater quality is related to the purposes for which groundwater is used, and may change over time as land uses and water quality regulations change. Groundwater quality degradation can occur when groundwater pumping causes poor quality water (surface water or groundwater) to migrate into areas with good quality groundwater. It can also occur when surface contaminants migrate into groundwater. As a consequence, it is important to coordinate land use planning and resource management activities in order not to create opportunities for water quality deterioration. Adverse impacts related to groundwater quality include:

- Degradation of groundwater quality so that yields are reduced for crops irrigated with groundwater.
- Degradation of groundwater quality so that it does not comply with drinking water quality standards.
- Degradation of groundwater quality so that it is no longer suitable for beneficial uses.

There are some areas in Sutter County that currently have problems with groundwater quality (particularly arsenic and salinity) that appear to be naturally-occurring. The BMO of maintaining or improving groundwater quality reflects the County's desire to improve the quality of naturally-occurring groundwater where possible, so that it is more useful as a water supply.

6.2.3. Inelastic Land Subsidence BMO

The BMO for inelastic land subsidence is to:

- *Avoid inelastic land subsidence that is linked to declines in groundwater levels.*

Inelastic land subsidence is the permanent compaction of the subsurface. In Sutter County, the activities that have the most potential to cause inelastic land subsidence are withdrawals of groundwater or natural gas from the subsurface. Adverse impacts related to inelastic land subsidence include:

- Reduction in the volume of the subsurface that results in a permanent loss in aquifer storage.
- Damage to foundations, roads, bridges, and/or other infrastructure.
- Change in surface topography that reverses the gradients in canals and ditches, and/or changes floodplains.

6.2.4. Surface Water

There are three BMOs for surface water:

- *To improve the understanding of the relationship between surface water and groundwater.*

- *To avoid changes in surface water flow and surface water quality that adversely affect groundwater levels or are caused by groundwater pumping.*

- *Avoid changes in surface water flow and water quality that adversely affect groundwater quality.*

Pumping from very shallow aquifer zones or poorly sealed wells has the potential to affect surface water or wetlands. Adverse impacts related to surface water or wetlands include:

- Depletion of surface flows and/or degradation of water quality.

- Destroying riparian and/or native vegetation and habitat.

6.2.5. Coordination

This BMO for coordination is to:

- *Coordinate County groundwater management efforts with other groundwater management efforts within and surrounding Sutter County.*

This BMO establishes the importance of local coordination of groundwater management and sharing of hydrogeologic data. To make effective and relevant decisions, the County must rely on current data regarding the quality and quantity of the underlying groundwater.

7. PLAN IMPLEMENTATION

Sutter County intends to implement this GMP through a Groundwater Monitoring Program and an Action Plan. In order to recognize and mitigate adverse impacts to the underlying groundwater system, a system is required to collect and disseminate information to the appropriate groundwater users and agencies.

7.1. Groundwater Monitoring Program

The role of monitoring is essential to implementing the BMOs. Monitoring is the process of collecting data that is used to better understand the groundwater basin underlying the County, evaluate groundwater conditions, facilitate groundwater management, and other related activities. In order for the County to promote sustainable groundwater management, as well as for groundwater users to make effective and relevant decisions, the data needs to be made publicly available.

7.1.1. Groundwater Level Monitoring

There is an extensive network of DWR monitored wells, both dedicated monitoring wells and wells with other uses, within Sutter County. Additionally, several water purveyors within the County monitor groundwater levels within their service areas by means of dedicated monitoring wells and production wells. There is an extensive inventory of wells with groundwater measurements within Sutter County. Historically, DWR and its partners have monitored 172 wells in Sutter County, including 15 dedicated monitoring wells. The earliest recorded DWR water level measurement in Sutter County took place in 1929. Wells accessible to DWR are typically agricultural or domestic wells in which the land owners have previous agreements with DWR to allow access for measurements. Overall, the County has adequate spatial distribution of its current network to obtain groundwater level measurements. For this GMP, DWR utilized 122 of the 172 wells to produce groundwater contour maps of equal elevation.

Water level measurements are generally made two times each year, in spring and fall. Measurements have been made at some monitoring wells on an almost-monthly basis. Twice-annual (spring/fall) water level measurements are generally sufficient for the purpose of determining changes in overall groundwater conditions over time. However, these measurements should reflect the annual high (spring) and low (fall) water levels. More frequent (i.e. at most monthly) measurements are necessary to confirm that the months chosen for spring and fall measurements reflect the months with the highest and lowest groundwater elevations, on average. Water level data is currently available from DWR's Water Data Library, at: http://well.water.ca.gov.

7.1.1.1. Vertical Groundwater Gradients – Nested and/or Clustered Monitoring Wells

The vertical gradients between aquifer zones are important because they give an indication of the direction (up or down) that groundwater will migrate if a pathway, such as a well that connects multiple aquifer zones, is present. To evaluate the vertical gradient between aquifer zones, data for the different aquifer zones at a single location is needed. The preferred way to obtain this data is with nested and/or clustered monitoring wells. Nested monitoring wells have multiple wells within a single borehole, with each well isolated from the others by annular seals. Clustered monitoring wells have a single well in each borehole, with the boreholes in close proximity to one another. Figure 19 shows the locations of the 15 nested and/or clustered monitoring wells in Sutter County. Eleven of these wells are in the DWR monitoring network with measurements taken twice a year, in spring and fall. The remaining four nested monitoring wells are pending inclusion into the network because they were constructed by private parties. All of these wells are dedicated monitoring wells.

7.1.1.2. Groundwater Flow Direction – Contour Maps

The direction of groundwater flow is evaluated with groundwater level contour maps. Groundwater contours are created which connect surfaces of equal elevation (or levels). Figure 17 illustrates the contours of equal groundwater elevation for measurements taken in the spring of 2010.

The current water level monitoring network spacing is suitable for contouring groundwater elevations. Additionally, it would be beneficial to include data from nearby monitored wells in Butte, Yolo, Sacramento, and Yuba Counties to better characterize the groundwater flow direction at the County lines.

7.1.2. Water Quality

Water quality samples from wells within the County have, in the past, been obtained either by local water purveyors, the DWR, or the USGS. Currently, the County only samples groundwater in Robbins, its only public water supply system. Groundwater samples have been collected for analysis in a total of 133 wells. The DWR has sampled 34 of these wells in Sutter County, fifteen of which are nested multiple-completion monitoring wells, as shown in Figure 19. The USGS has sampled 94 of these wells, and the remaining wells were sampled by water purveyors which have shared their data. The DWR expects to conduct water quality sampling of these wells every three years, or as funds are available. The water quality data is disseminated on the DWR WDL.

The results for the USGS water quality sampling are available on the National Water Information System (NWIS) website[7]. The USGS sampled these wells as part of a larger investigation to document the condition of the groundwater throughout the valley. It is not expected that the USGS will routinely sample these wells.

The current water quality monitoring network consists of DWR owned multiple-completion monitoring wells with a sparse distribution covering the entire County. Routine sampling of these wells will allow for water quality trends to be identified. As stated within this GMP, the County does not own any dedicated monitoring wells. In conjunction with DWRs efforts to collect and distribute water quality information of the groundwater resource, the County encourages private water purveyors to disseminate their water quality data to aid in documenting depth specific and County-wide water quality trends.

7.1.3. Land Subsidence

Land subsidence has not been historically reported or documented within Sutter County. Nevertheless, DWR installed an extensometer and began monitoring for ground surface displacement in 1994. Measurements are recorded on a daily basis, offering real-time and site specific measurements. On a more regional scale, DWR and its cooperating agencies, have implemented the Sacramento Valley GPS Height Modernization Project which will provide significant enhancements to a Sacramento Valley subsidence monitoring program. It is reported by DWR that the GPS monuments will be re-surveyed approximately every three years. The monitoring of land surface elevations will allow for periodic measurements of permanent land subsidence induced by groundwater pumping and/or natural processes. The surveys will be conducted in accordance with the National Geodetic Survey Standards for two centimeter accuracy.

When used in conjunction with surface subsidence survey data (GPS), the extensometer data could aide in identifying whether subsidence is occurring over the total depth of the monitoring well.

7.1.4. Future Groundwater Monitoring

The County's existing monitoring network is described above. Groundwater monitoring within the County is currently conducted by DWR and local water purveyors. The County will continue to cooperate with DWR and encourage the local water purveyors to continue to monitor groundwater levels. Under the voluntary guidelines of SBx7-6, selected local water purveyors will continue to monitor groundwater elevations for their

[7] http://waterdata.usgs.gov/nwis

respective service area(s), along with the DWR, under protocols established by DWR. The possibility exists that in the future, DWR may cease their monitoring if they lose funding for groundwater level measurements, and the responsibility of groundwater level monitoring will be entirely upon the local water purveyors.

All new wells should be sampled for basic water chemistry (i.e. specific conductance, arsenic, manganese, and nitrate). Although not required, the County may, in the future, consider requesting copies of laboratory reports to be submitted through the permit process. Water quality results from wells sampled by DWR are routinely placed on the WDL, and are often sampled every three years, or as funding allows.

The overall subsidence monitoring program should continue to be monitored by the extensometer and GPS monuments throughout the County. The Sacramento Valley GPS Network incorporates existing GPS networks and monuments to create a regional network that covers part or all of Colusa, Sutter, Glenn, Butte, Yolo, Yuba, Tehama, and Placer Counties.

For the area encompassing the Sutter Buttes, which is outside of a DWR delineated groundwater basin, groundwater is likely contained in the fractures of the volcanic rock as well as in the marine sands that compromise the Sutter Buttes. The area encompassing the Sutter Buttes is primarily privately owned and groundwater use is unknown but is likely limited to domestic wells or stock watering wells. It is suggested that private well owners monitor groundwater levels at least twice a year (fall and spring) in order to realize changing conditions. It is also good practice to test the quality of the groundwater for health based constituents.

7.1.5. Local and Regional Groundwater Management Coordination

Coordinating local and regional groundwater management is important to meeting Sutter County's Groundwater Management Goals because groundwater, like other resources, does not respect administrative/jurisdictional boundaries, and actions outside the County can affect groundwater in the County. Further, in order to achieve the Groundwater Management Goals, the County needs to be an "effective participant" in local and regional management efforts and work cooperatively with water managers to conduct effective groundwater management. To be an "effective participant", the County needs to be informed of its groundwater conditions and activities underway or planned, which may affect the resources positively or negatively. With time and appropriate documentation of water management activities and monitoring, an understanding of the resources can be obtained so that groundwater conditions can be the result of deliberate water management choices.

Coordinating groundwater management across local and regional jurisdictions will contribute to ensuring a reliable water supply by working towards management of entire groundwater basins, not just the portions underlying the County. Involvement in regional activities will help ensure that activities outside of Sutter County that affect the reliability of the groundwater supply in the County can be addressed through regional management actions. This involvement will also help protect water rights because the County's involvement with regional groundwater management will allow it to be part of a larger group that can exert more influence in preserving water rights north of the Delta. Finally, regional coordination will help the County maintain local control by ensuring that the County's interests are represented in regional groundwater management activities.

Sutter County recognizes the importance of regional coordination, collaboration, and communication and is signatory to the "Four-County Group," which has evolved into the "Northern Sacramento Valley – Integrated Regional Water Management Group", consisting of Butte, Glenn, Colusa, Tehama, Shasta, and Sutter Counties.

In addition to the water management coordination addressed above, which is more at a technical and operational level, it is important that coordination occur at the policy level as well. This is especially important for effective and consistent operations within water purveyors whose geographic jurisdiction extends beyond Sutter County. The processes to addressing water transfers, in particular, are different in each of the three counties. It would be important, as the GMP is implemented and the institutional structure and management processes become solidified, that a dialogue be established with the neighboring counties to address the need for developing consistency in processes that affect the management and operation of the respective water purveyors.

7.1.6. State of the Basin Report - Groundwater Condition and Groundwater Management Plan Evaluation

In the future, Sutter County and local water purveyors may benefit from preparing an annual report of the conditions of its groundwater basin. However, the present County staffing and funding levels are unable to accommodate this work effort. Groundwater elevation data for the County will be available through the CASGEM program and continued DWR monitoring. Additionally, new and/or current water quality data is periodically submitted and is available through the DWR Water Data Library. The County encourages cooperation among all groundwater users to share data (groundwater level and/or quality) which is not reported or what is readily available through the Water Data Library. Water quality data is also accessible through the Department of Public Health for permitted public water systems. Through this report, the County will encourage its groundwater users to be responsible stewards of the County's resources.

This GMP prepared by the County is not intended to be a static document. As conditions change, such as population, land uses, or climate, it may be warranted to revisit the County's goals and BMOs to ensure that the overall goals of sustaining its groundwater resources to meet current and future demands for the County are being satisfied. The County encourages cooperation among its groundwater users to keep these goals in mind. It is not Sutter County's intent of this GMP to be an enforcer with regards to groundwater use; however, as climatic and groundwater usage change in the future, it may be necessary to "check in" and adjust or expand this GMP.

7.2. Action Plan

7.2.1. Actions for Groundwater Levels BMO

To avoid ongoing declines in groundwater, to avoid abnormally high groundwater levels, the County has taken and will take the following actions:

Action	*Frequency*	*Status*
Participation in the "Northern Sacramento Valley – Integrated Regional Water Management Group"	As needed	2008 - Present
Maintain relationships with state and federal agencies	Annual	1850 - Present
Promote conjunctive use through public outreach	Annual	2008 - Present
Coordination with local and regional jurisdictions on groundwater.	Annual	2008 - Present
Ensure compliance with adopted policies in 2008 General Plan (Goal ER 6)	Annual	2008 - Present
Review groundwater contour maps prepared by DWR	Annual	2008 - Present
Disseminate groundwater level data on County's website	As needed	2010 - Present

7.2.2. Actions for Groundwater Quality BMO

To improve the understanding of groundwater quality, the County has taken and will take the following actions:

Action	*Frequency*	*Status*
Cooperate with DWR in its monitoring efforts	Annual	2010 - Present
Maintain relationships with neighboring counties	Annual	1850 - Present
Ensure compliance with adopted policies in 2008 General Plan (Goal ER 6)	Annual	2008 - Present
Ongoing coordination with local and regional jurisdictions on groundwater	Annual	unknown - Present

7.2.3. Actions for Inelastic Land Subsidence BMO

To avoid inelastic land subsidence that is linked to declines in groundwater levels, the County has taken and will take the following actions:

Action	*Frequency*	*Status*
Cooperate with DWRs monitoring efforts	Annual	2010 - Present
Participate in the "Northern Sacramento Valley – Integrated Regional Water Management Group"	Annual	2008 - Present
Establish and update a groundwater management plan website	Annual	2008 - Present
Review data from the extensometer installed in Sutter County	6 months	2010 - Present
Maintain relationships with state and federal agencies	Annual	1850 - Present

7.2.4. Actions for Surface Water BMO

To improve the understanding of the relationship between surface water and groundwater; to avoid changes in surface water flow and surface water quality that directly affect groundwater levels or are caused by groundwater pumping; and to avoid changes in surface flow and surface water quality that directly affect groundwater quality, the County has taken and will take the following actions:

Action	*Frequency*	*Status*
Engage in the "Northern Sacramento Valley – Integrated Regional Water Management Group"	Annual	2008 - Present
Establish a groundwater management plan website	Annual	2008 - Present
Maintain relationships with state and federal agencies	Annual	1850 - Present
Ensure compliance with adopted policies in 2008 General Plan (Goal ER 5)	Annual	2008 - Present

7.2.5. Actions for Coordination BMO

To coordinate County groundwater management efforts with other groundwater management efforts within and surrounding Sutter County, the County has taken and will take the following actions:

Action	*Frequency*	*Status*
Engage in the "Northern Sacramento Valley – Integrated Regional Water Management Group"	Annual	2008 - Present
Maintain relationships with state and federal agencies	Annual	1850 - Present
Establish and update a groundwater management plan website	As needed	2008 - Present

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