ANTIDEGRADATION ANALYSIS
DEMONSTRATING USE OF
LESS THAN 10 PERCENT
OF SUB-BASIN ASSIMILATIVE CAPACITY

Prepared for
Bill Perley
Calaveras County Water District
423 East St. Charles Street
San Andreas, CA 95249

Prepared by
Condor Earth Technologies, Inc.
21663 Brian Lane
Sonora, CA 95370
209.532.0361

May 10, 2012
Condor Project No. 4934A

CONDOR

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ANTIDEGRADATION ANALYSIS
DEMONSTRATING USE OF LESS THAN 10 PERCENT
OF SUB-BASIN ASSIMILATIVE CAPACITY

1.0 INTRODUCTION

This document concerns the assimilative capacity in the groundwater sub-basin at the La Contenta Golf Course (Golf Course) in Calaveras County and the percentage of that capacity used in irrigating the Golf Course with recycled water from the La Contenta Wastewater Treatment Plant (WWTP). Condor Earth Technologies, Inc (Condor) prepared this report at the request of Bill Perley, Director of Utility Services and Engineering of Calaveras County Water District (CCWD). This report includes background information with a discussion of the regulatory framework, and a demonstration that the proposed irrigation uses less than 10 percent of the assimilative capacity of the sub-basin.

2.0 REGULATORY BACKGROUND

The Golf Course is regulated as a land application area for WWTP discharges under Waste Discharge Requirements (WDR) Order No. R5-2002-0222. Upgrades in treatment facilities allow CCWD to increase treatment capacity, with resulting increases in discharge of tertiary treated (Title 22) water. To accommodate increased discharges, CCWD is submitting a Notice of Intent to Comply (NOI) with the *General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water* (General Permit) from the State Water Resources Control Board Order No. 2009-0006-DWQ. The General Permit was adopted to streamline the regulatory process for such use of recycled water. The General Permit recognizes that use of water for irrigation must not conflict with existing policies.

The State Recycled Water Policy recognizes irrigation with recycled water as a benefit to the people of California but also requires that it be consistent with the State Water Board Policy 68-16, known as the Antidegradation Policy. This policy allows limited degradation of water quality consistent with the maximum benefit to the people of the State so long as such degradation does not result in water quality less than that prescribed in policies, such as water quality objectives. Numerical water quality assessment thresholds[1] have been developed to implement the narrative water quality objectives set in the Water Quality Control Plan (Basin Plan)[2].

CCWD's project is within the Central Valley Region where a salt/nutrient management plan is being prepared by CV-SALTS, an organization sanctioned by the Central Valley Regional Water Board. CCWD intends to join CV-SALTS as directed by Resolution R5-3010-0024.[3] In this case, compliance with the General Permit refers to the State Recycled Water Policy section 9(d)(2) that states:

> "A project that meets the criteria for a streamlined irrigation permit and is within a basin where a salt/nutrient management plan satisfying the provisions of paragraph 6(b) is being prepared may be approved by the Regional Water Board by demonstrating through a salt/nutrient mass balance or similar analysis that the project uses less than 10 percent of the available assimilative capacity as estimated by the project proponent in a basin/sub-basin."

[1] California EPA, 2011, *A Compilation of Water Quality Goals*, 16th Ed. Page 2 of 47.
[2] California Central Valley Regional Water Quality Control Board, 2011, *The Water Quality Control Plan (Basin Plan) For The California Regional Water Quality Control Board Central Valley Region Fourth Edition*.
[3] See Attachment 1.

CCWD intends to discharge under the General Permit and provides, below, a salt/nutrient mass balance analysis according to State Recycled Water Policy section 9(d)(2).

The State Water Resources Control Board indicates that the Eastern San Joaquin Sub-basin identified by the Department of Water Resources as Sub-basin 5-22.01 may be used for estimating assimilative capacity for CCWD's NOI.[4] The assimilative capacity of a basin/sub-basin is not defined in the General Permit, but for the purposes of this analysis it is defined as the capacity for a water body to absorb constituents without impeding beneficial uses.

3.0 SALT/NUTRIENT MASS BALANCE ANALYSIS

3.1 THE ASSESSMENT THRESHOLD VALUE FOR EVALUATING ASSIMILATIVE CAPACITY

In the East San Joaquin Sub-basin irrigated agriculture is a ubiquitous beneficial use. Agricultural use generally has the lowest numerical thresholds for salinity parameters: TDS (total dissolved solids) = 450 mg/L, EC = 700 umhos/cm, Na = 69 mg/L, and Cl = 106 mg/L[5]. TDS is a standard parameter in historical water quality sampling, whereas Na and Cl are much less prevalent. Concentrations of Na and Cl are included in TDS measurements. Electrical Conductivity correlates directly with TDS but is not amenable to mass balance analysis. For these reasons, a single water quality assessment threshold value of TDS=450 mg/L will be used for this project. The assimilative capacity of the sub-basin is the amount of annual TDS loading that would cause basin waters to exceed 450 mg/L of TDS.

3.2 TEN PERCENT OF THE ASSIMILATIVE CAPACITY: EASTERN SAN JOAQUIN SUB-BASIN 5-22.01

The La Contenta Golf Course is at the edge of the Eastern San Joaquin Sub-basin 5-22.01 as identified by the California Department of Water Resources in Bulletin 118 update 2003 (Attachment 3). Table 30 identifies 69 water quality stations with TDS values ranging from 30 to 1,632 mg/L and averaging 310 mg/L. Attachment 4 includes the most recent (2006) unpublished update to the description of sub-basin 5-22.01[6]. The currently defined sub-basin is 707,000 acres. DWR estimates of the specific yield of the sub-basin sediments at 7.3 percent. Water tables have declined steadily for 40 years at a rate of 1.7 feet per year, and the sub-basin groundwater is being overdrafted by about 70,000 acre-feet per year (af/yr). The water quality assessment remains unchanged from the 2003 update.

For this sub-basin the total assimilative capacity would be the difference between the assessment threshold (TDS = 450 mg/L) and the average concentration (TDS=310 mg/L), which is 140 mg/L. Stated in mass balance terms, the assimilative capacity in this sub-basin is the annual mass of salt loading that would raise the concentration 140 mg/L. A project using 10 percent of available assimilative capacity would add enough salt to raise the sub-basin salinity 14 mg/L. Ten percent of assimilative capacity in terms of tons of dissolved salt can be calculated from the equation below:

$$\frac{\text{TDS (tons/yr)}}{\text{70,000 (af/yr)}} = 14 \text{ mg/L}$$

rearranging and converting units (1.10×10^{-9} mg/ton, 1.23×10^{6} L/af),

TDS= 1,326 tons/yr.

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[4] See Attachment 2.

[5] California EPA searchable on line database of numeric water quality thresholds: http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/search.shtml.

[6] http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/5-22.01.pdf.

3.3 SALT MASS LOADING FROM IRRIGATION PROJECT

CCWD is submitting agronomic calculations with the NOI that show the total additional mass loading of salt as TDS from recycled water applied to irrigate the Golf Course will be 918 pounds per acre per year (lbs/ac/yr)[7]. The application area is 70 acres, so total annual additional TDS loading will be:

$$\text{TDS} = 918 \text{ lbs/acre/yr} \times 70 \text{ acres} \times 1/2000 \text{ tons/lbs}$$
$$\text{TDS} = 32 \text{ tons/yr}$$

3.4 DISCUSSION OF MASS BALANCE ANALYSIS

The analysis presented above ignores many salt budget components and relies on relatively old official public information. For example, no effort was made to estimate the salt storage that occurs in the soil as the aquifer declines. This would very likely result in a much higher assimilative capacity than cited above. Nor was there any analysis of the DWR-cited data to sufficiently characterize current groundwater quality, which could result in a lower assimilative capacity than cited above. Large uncertainties in assimilative capacity used in this analysis are mitigated by the relative insignificance of the CCWD project salt loading to the total sub-basin salt budget. Based on public information, there is little doubt that the project uses less than 10 percent of available assimilative capacity.

The CV-SALTS program has been meeting for many months and has spent millions of dollars on research among stake holders to develop tools for assessing salt loading. Their work is not complete, nor without controversy[8]. CCWD will join the CV-SALTS initiative as a stake-holder to help bring this important work to conclusion in 2014. Regardless, there is an urgent ongoing need to permit, control and encourage the use of recycled water in California under the General Permit.

3.5 PROJECT USES LESS THAN TEN PERCENT OF SUB-BASIN ASSIMILATIVE CAPACITY

The annual TDS loading from the project (32 tons/yr) is much less than 10 percent of the assimilative capacity of the sub-basin (1,326 tons/yr); therefore, the project qualifies for streamlined permitting under the General Permit.

4.0 CONCLUSION

Condor concludes that the discharges of recycled water for landscape irrigation at the Golf Course will use less than 10 percent of the assimilative capacity of the Eastern San Joaquin Sub-basin and that CCWD qualifies for streamlined discharge permitting under the General Order.

5.0 LIMITATIONS AND SIGNATURE

Condor has endeavored to compile as much pertinent information about the site as practical using conventional practices given our scope of services. Information provided with this report includes professional opinions based on limited information obtained at the time of our work. Condor makes no representation as to the subsurface conditions at locations or times other than those reported in this document. If any changes are made or errors found in the information used for this report, the interpretations and conclusions contained herein shall not be considered valid unless the changes or errors are reviewed by Condor and either appropriately modified or re-approved in writing. Condor is not responsible for the accuracy and completeness of information collected and developed by others.

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[7] CCWD, 2012, *Calculation of Agronomic Rates for Landscape Irrigation of Recycled Water at La Contenta Golf Course*, Prepared by Condor Earth Technologies, Inc.

[8] http://cvsalinity.org/index.php/documents/cat_view/39-docs/49-documents-related-to-salt-and-nutrient-management-planning - see Knowledge Gained Supporting Docs for 11.10.11

This report was prepared by Condor under the direct supervision of a California Certified Hydrogeologist with experience in waste discharge permitting. The report was prepared for at the request of Mr. Bill Perley. It is for the sole use of CCWD. The contents of this report may not be used or relied upon by any other person(s) without the express written consent and authorization of CCWD and Condor. Any unauthorized use or reliance on this report by a third party is at such party's sole risk. Any questions regarding the content of this document should be addressed to either Mr. Bill Perley at 209.754.3543.

Respectfully submitted,

CONDOR EARTH TECHNOLOGIES, INC.

John H. Kramer
California Certified Hydrogeologist No. 182

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ATTACHMENT 1

CONDOR

John Kramer

From: Bill Perley <billp@ccwd.org>
Sent: Wednesday, May 02, 2012 11:56 AM
To: dcozad@cvsalinity.org; John Kramer
Cc: Bill Perley; farmeratlaw@comcast.net; pklassen@unwiredbb.com
Subject: RE: Assimilative Capacity of Sub-basins

Daniel,

CCWD will be joining CV Salts very soon.

Thank You

Bill Perley

From: Daniel Cozad [mailto:dcozad@cvsalinity.org]
Sent: Wednesday, May 02, 2012 7:32 AM
To: 'John Kramer'
Cc: Bill Perley; farmeratlaw@comcast.net; pklassen@unwiredbb.com
Subject: RE: Assimilative Capacity of Sub-basins

John and Bill:

Thanks for your email. We are very happy to hear CCWD will soon become a member of the Central Valley Salinity Coalition.

I appreciate the background and status of the project, I have not received any update in many months. In answering the question you pose at the end of your email I would refer you to two additional approved documents. Resolution R5 2010-024 http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/resolutions/r5-2010-0024.pdf which directs recycled water projects to CV-SALTS Process and the Executive Committee Policy Consensus Determinations document attached. The answer to your question from a process perspective is answered on page 3 Item 4, excerpted below:

4. Recycled Water Policy planning areas

The CV-SALTS process is the program process the Regional Board has approved for the development of recycled water policy Salt and Nutrient Management Plans (SNMP). Project proponents of any recycled water project for which a SNMP is beneficial shall work through CV-SALTS (Resolution R5-2010-24). For proponents or stakeholder groups working on projects these programs will be integrated and supported in the following process:

1. Regional Board will refer the proponents to the CV-SALTS Process (Resolution R5-2010-24)
2. SNMP groups will be coordinated active participants in CV-SALTS and financially participate in the Central Valley Salinity Coalition to support costs for the overall program, for inclusion of the project and to gain the benefits afforded in the eventual basin plan amendments.
3. SNMP groups will propose the area of benefit or impact, where they will be responsible. They will provide a work plan and timetable for the data and planning they are preparing to undertake and will incorporate issues and requirements provided by CV-SALTS in order to integrate their plan into the

Basin plan amendment for the region. The workplan will be approved by CV-SALTS with participation from the Regional Board.

4. SNMP groups will be responsible for all items that are not included in the CV-SALTS Work Plan.
5. SNMP groups will provide regular updates of data and progress the appropriate CV-SALTS committee.
6. A preliminary or draft report will be presented to the appropriate CV-SALTS Committee and include the required information to be integrated into the regional basin plan amendment.
7. SNMP groups will be responsible to implement such projects as required by the timeline in the implementation plan of the basin plan amendment
8. CV-SALTS commits to integrate the SNMP group projects and plans into the final Salt and Nitrate Management Plan and incorporate it into the resulting Basin Plan Amendment if all requirements and deadlines are met.

To answer your technical questions including calculation of assimilative capacity; this would be done with the technical committee prior to or in step 3 above, workplan review. Your active participation in the Technical Committee and Executive Policy meetings would give you some feel for what to propose and some say in how you believe it should be done. You may be the first area to have a plan come to the Technical Committee and some of what you need answers for may not be fully developed. It will be important to participate so the process and policy rules do not impact your project. We are letting technical contracts now for elements of this work related to the Initial Conceptual Model and SSALTS Implementation efforts. If you want formal response or questions not answered in the board or Executive Committee Policy we can schedule the issue for a future Technical or Executive Committee Meeting.

We are very excited to have you as new Coalition Members please forward your membership payment to the address below. Also please let me know if we can be of further assistance. I have CC'd the Coalition Chair and Executive Committee Chair for their information.

Thanks again.

Daniel Cozad
Central Valley Salinity Coalition.
360 Lakeside Ave Redlands, CA 92373
(888) 826-3635 FAX (860) 736-8498
dcozad@cvsalinity.org www.cvsalinity.org

From: John Kramer [mailto:jkramer@condorearth.com]
Sent: Tuesday, May 01, 2012 7:13 PM
To: dcozad@cvsalinity.org
Cc: Bill Perley (billp@ccwd.org)
Subject: Assimilative Capacity of Sub-basins

Mr. Cozad,

I am a California Certified Hydrogeologist consulting for the Calaveras County Water District (CCWD). CCWD informed me they intend to join CV-SALTS in order to file a Notice of Intent to Comply with the SWRCB *General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water* Order No. 2009-0006-DWQ (General Permit). The General Permit was adopted to streamline the regulatory process for use of recycled water. As a member of CV-SALTS, CCWD would be part of an organization sanctioned by the Central Valley Regional Water Board that is actively developing a basin-wide Salt/Nutrient management plan. To obtain their permit, CCWD must demonstrate through a salt/nutrient mass balance or similar analysis that the project uses less than 10 percent of the available assimilative capacity as estimated by the project proponent in a basin/sub-basin.

Methods for modeling salt loading were developed by CV_SALTS in *Salt and Nitrate Sources Pilot Implementation Study Report* (2010). Three pilot areas were tested using the Watershed Analysis Risk Management Framework (WARMF) model. The CV-SALTS report predicted positive salt fluxes into both shallow and deeper groundwater at all pilot areas tested, but it did not present a methodology for calculating assimilative capacity. *A Framework for Salt/Nitrate Identification Studies* appears to be a draft document that presents a comprehensive outline and recommended data visualizations, but is much too cumbersome and specific a process to support a General Permit for reuse of small volumes of Title 22 water. The subsequent *Supporting Documents for the Knowledge Gained Committee* dated November 2011 suggest a GIS framework in lieu of WARMF for defining assimilative capacity in specific regions. These methods are complicated and appropriate for specific WDR or collaborative regional efforts, but not for a *streamlined* General Permit process. Has there been more recent progress on identifying available assimilative capacity by sub-basin, or have any methodologies for evaluating assimilative capacity been accepted by CV-SALTS since those reports?

This is a matter of practical significance to CCWD. If CCWD will be the first discharger to attempt to develop a convincing demonstration under this General Order, how can we coordinate with CV-SALTS ?

Thank you in advance for a response,

John

ATTACHMENT 2

From: Gordon Innes [mailto:ginnes@waterboards.ca.gov]
Sent: Wednesday, April 25, 2012 12:48 PM
To: Bill Perley
Cc: John Kramer; Anne Olson; James Marshall; Jagroop Khela; Lonnie Wass; Scott Couch; Shahla Farahnak; Tim Regan
Subject: RE: FW: Clarification on SWRCB General Permit 2009-006-DWQ

Bill:

Here are the responses to your questions.

1. Under the conditions described in a) and b) above, would irrigation with recycled water at La Contenta violate Prohibition A.11 of the General Permit?

No. When the Recycled Water Policy was adopted, the State Water Board recognized that salt/nutrient management issues would have to be resolved by adoption of regional plans and the Recycled Water Policy established a process for doing this. For the interim period while the salt/nutrient management plans are being developed, the policy has provision 9d(2), which states that:

"A project that meets the criteria for a streamlined irrigation permit and is within a basin where a salt/nutrient management plan satisfying the provisions of paragraph 6(b) is being prepared may be approved by the Regional Water Board by demonstrating through a salt/nutrient mass balance or similar analysis that the project uses less than ten percent of the available assimilative capacity as estimated by the project proponent in a basin/subbasin (or multiple projects using less than 20 percent of the available assimilative capacity as estimated by the project proponent in a groundwater basin)."

The direction for approving projects while salt/nutrient management plans are being developed is to analyze regional assimilative capacity and to approve the project if such capacity is available. Under the conditions you described, the La Contenta project would not violate Prohibition A.11. This decision is partly based on the low TDS of your recycled water. For a project with recycled water containing high TDS, the Regional Water Board might insist on some controls to lower the TDS of the recycled water.

2. Can a project proponent use the assimilative capacity of a sub-basin beyond the immediate perimeter of the project to justify a discharge, even if local water is of lesser quality than that in policies?
Yes. For the interim period while salt/nutrient management plans are being developed, the direction of the Recycled Water Policy is to analyze assimilative capacity over a basin/subbasin.

3. How is a sub-basin for assimilative capacity delineated? Are the sub-basins defined by DWR in Bulletin 118 sufficient for mass loading analysis of specific projects?
Yes, the DWR Bulletin 118 sub-basins are sufficient for mass loading analyses for a specific project.

4. Does the State Board or the Regional Board, as suggested in c) above, approve the notice of applicability for the General Permit?

The State Water Board wouldissue the notice of applicability. Issuance would be contingent on the State Water Board receiving a memorandum from the Regional Water Board staff stating that the assimilative capacity analysis is approved.

Gordon Innes
Senior Water Resource Control Engineer
State Water Resources Control Board
(916) 341-5517

>>> Bill Perley <billp@ccwd.org> 4/18/2012 9:32 AM >>>
Gordon,

Do you have any word from the regional board.

Bill Perley

From: Gordon Innes [mailto:ginnes@waterboards.ca.gov]
Sent: Tuesday, April 03, 2012 4:53 PM
To: Bill Perley
Subject: Re: FW: Clarification on SWRCB General Permit 2009-006-DWQ

Bill:

I am working on a reply. I need to consult with regional board staff before responding.

Gordon

>>> Bill Perley <billp@ccwd.org> 3/30/2012 3:18 PM >>>
Gordon,

Can you give us some guidance. We are trying to finish the LaContenta General Order application.

Thank you

Bill Perley

From: John Kramer [mailto:jkramer@condorearth.com]
Sent: Friday, March 30, 2012 2:46 PM
To: Bill Perley
Cc: David Belt; Teresa Tanaka
Subject: Clarification on SWRCB General Permit 2009-006-DWQ

Hello Bill,

The Condor has identified the following issues related to the applicability of the *SWRCB General Permit for Landscape Irrigation Uses of Municipal Recycled Water* at the La Contenta Gold Course.

a) Irrigation with recycled water up to 233 acre feet per year at agronomic rates is feasible at the La Contenta Golf Course. Precipitation, irrigation efficiencies, and leaching requirement will result in soil flushing, an agronomic necessity for turf health and the secondary beneficial use. Deep percolation to shallow groundwater is unavoidable.

b) Irrigation by recycled water will contribute mass loading of salt (TDS) to groundwater. Recycled water contains less TDS than the water quality objective of 450 mg/L. Groundwater already exceeds the water quality objective for TDS. General Permit Prohibition A.11. States: "The discharge or use of recycled water in a manner that causes or contributes to an exceedance of an applicable water quality objective is prohibited."

c) Finding 13 of the General Order specifically references paragraphs 9(d) of the Recycled Water Policy. This paragraph states that a project that meets the criteria for a streamlined irrigation permit and is within a basin where a salt/nutrient management plan is being prepared may be approved by the ***Regional Board*** if the proponent can demonstrate through a mass balance analysis that the project uses less than 10 percent of the available assimilative capacity of the basin/sub-basin.

Condor recommends CCWD seek clarification from the State General Permit staff as follows:

1. Under the conditions described in a) and b) above, would irrigation with recycled water at La Contenta violate Prohibition A.11 of the General Permit?
2. Can a project proponent use the assimilative capacity of a sub-basin beyond the immediate perimeter of the project to justify a discharge, even if local water is of lesser quality than that in policies?
3. How is a sub-basin for assimilative capacity delineated? Are the sub-basins defined by DWR in Bulletin 118 sufficient for mass loading analysis of specific projects?
4. Does the State Board or the Regional Board, as suggested in c) above, approve the notice of applicability for the General Permit?

I will suspend further work on this project until you can get some guidance from the State Board on these questions.

Best Regards,

John

John H. Kramer, Ph.D., CHG
Principal Hydrogeologist
Condor Earth Technologies, Inc.
21663 Brian Lane, Sonora, CA 95370
office direct: 209.532.0388 x 2032
cell: 209.601.0517
office: 209.532.0361
fax: 209.532.0773
www.condorearth.com

ATTACHMENT 3

CONDOR

San Joaquin River Hydrologic Region

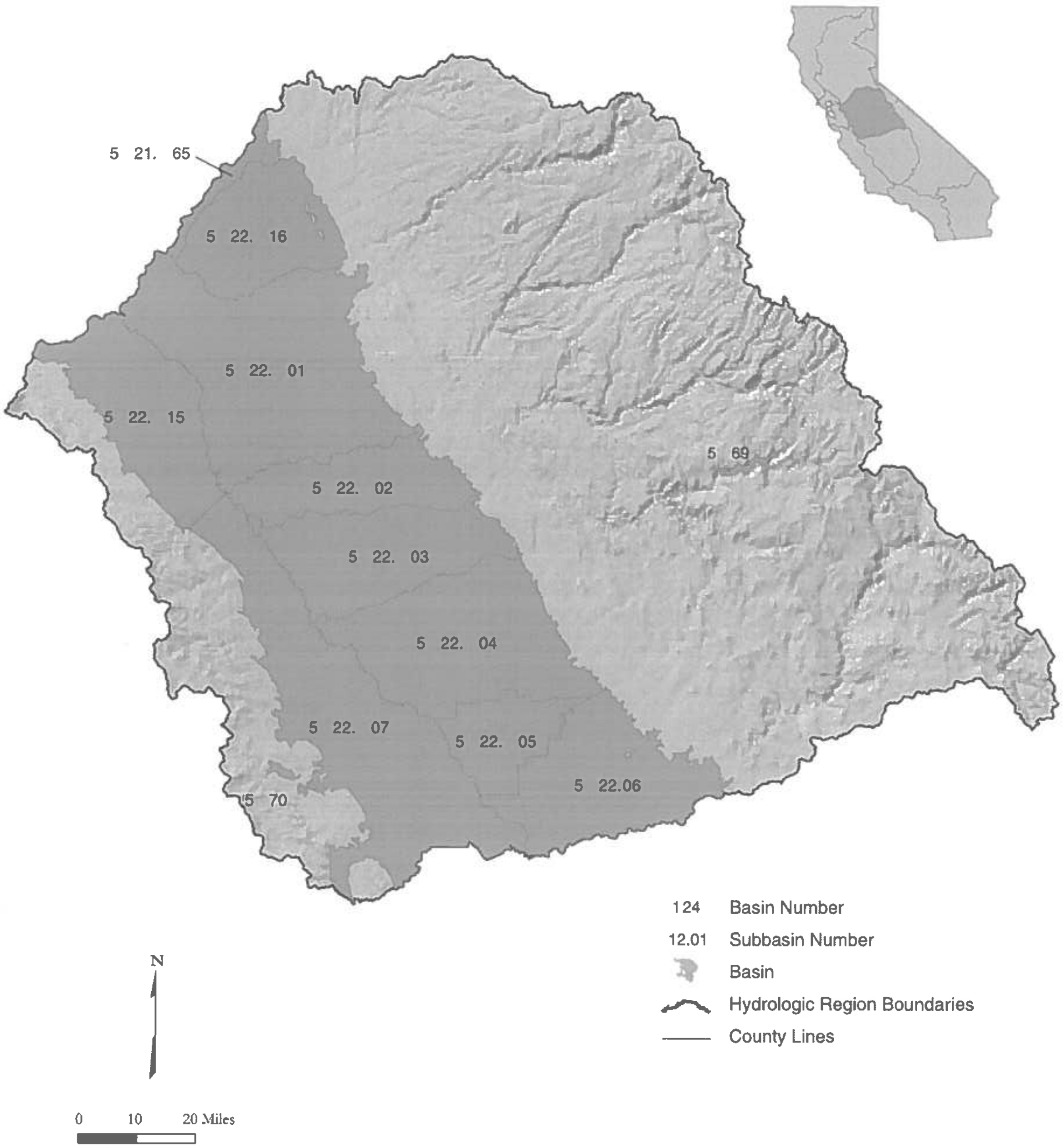

Figure 35 San Joaquin River Hydrologic Region

Basins and Subbasins of the San Joaquin River Hydrologic Region

Basin/subbasin	Basin name
5-22	San Joaquin Valley
5-22.01	Eastern San Joaquin
5-22.02	Modesto
5-22.03	Turlock
5-22.04	Merced
5-22.05	Chowchilla
5-22.06	Madera
5-22.07	Delta-Mendota
5-22.15	Tracy
5-22.16	Cosumnes
5-69	Yosemite Valley
5-70	Los Banos Creek Valley

Description of the Region

The San Joaquin River HR covers approximately 9.7 million acres (15,200 square miles) and includes all of Calaveras, Tuolumne, Mariposa, Madera, San Joaquin, and Stanislaus counties, most of Merced and Amador counties, and parts of Alpine, Fresno, Alameda, Contra Costa, Sacramento, El Dorado, and San Benito counties (Figure 35). The region corresponds to a portion near the middle of RWQCB 5. Significant geographic features include the northern half of the San Joaquin Valley, the southern part of the Sacramento-San Joaquin Delta, the Sierra Nevada and Diablo Range. The region is home to about 1.6 million people (DWR 1998). Major population centers include Merced, Modesto, and Stockton. The Merced area is entirely dependent on groundwater for its supply, as will be the new University of California at Merced campus.

Groundwater Development

The region contains two entire groundwater basins and part of the San Joaquin Valley Groundwater Basin, which continues south into the Tulare Lake HR. The San Joaquin Valley Groundwater Basin is divided into nine subbasins in this region. The basins underlie 3.73 million acres (5,830 square miles) or about 38 percent of the entire HR area.

The region is heavily groundwater reliant. Within the region groundwater accounts for about 30 percent of the annual supply used for agricultural and urban purposes. Groundwater use in the region accounts for about 18 percent of statewide groundwater use for agricultural and urban needs. Groundwater use in the region accounts for 5 percent of the State's overall supply from all sources for agricultural and urban uses (DWR 1998).

The aquifers are generally quite thick in the San Joaquin Valley subbasins, with groundwater wells commonly extending to depths of up to 800 feet. Aquifers include unconsolidated alluvium and consolidated rocks with unconfined and confined groundwater conditions. Typical well yields in the San Joaquin Valley range from 300 to 2,000 gpm with yields of 5,000 gpm possible. The region's only significant basin located outside of San Joaquin Valley is Yosemite Valley. Yosemite Valley Basin supplies water to Yosemite National Park and has substantial well yields.

Conjunctive Use

Since near the beginning of the region's agricultural development, groundwater has been used conjunctively with surface water to meet water needs. Groundwater was and is used when and where surface water is unable to fully meet demands either in time or area. For several decades, this situation was more of an incidental conjunctive use than a formal one. Historical groundwater use has resulted in some land subsidence in the southwest portion of the region.

Groundwater Quality

In general, groundwater quality throughout the region is suitable for most urban and agricultural uses with only local impairments. The primary constituents of concern are TDS, nitrate, boron, chloride, and organic compounds. The Yosemite Valley Groundwater Basin has exceptionally high quality groundwater.

Areas of high TDS content are primarily along the west side of the San Joaquin Valley and in the trough of the valley. The high TDS content of west-side groundwater is due to recharge of streamflow originating from marine sediments in the Coast Range. High TDS content in the trough of the valley is the result of concentration of salts due to evaporation and poor drainage. Nitrates may occur naturally or as a result of disposal of human and animal waste products and fertilizer. Boron and chloride are likely a result of concentration from evaporation near the valley trough. Organic contaminants can be broken into two categories, agricultural and industrial. Agricultural pesticides and herbicides have been detected in groundwater throughout the region, but primarily along the east side of the San Joaquin Valley where soil permeability is higher and depth to groundwater is shallower. The most notable agricultural contaminant is dibromochloropropane (DBCP), a now-banned soil fumigant and known carcinogen once used extensively on grapes and cotton. Industrial organic contaminants include TCE, dichloroethylene (DCE), and other solvents. They are found in groundwater near airports, industrial areas, and landfills.

Water Quality in Public Supply Wells

From 1994 through 2000, 689 public supply water wells were sampled in 10 of the 11 basins and subbasins in the San Joaquin River HR. Samples analyzed indicate that 523 wells, or 76 percent, met the state primary MCLs for drinking water. One-hundred-sixty-six wells, or 24 percent, have constituents that exceed one or more MCL. Figure 36 shows the percentages of each contaminant group that exceeded MCLs in the 166 wells.

Table 28 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Changes from Bulletin 118-80

The subbasins of the San Joaquin Valley, which were delineated as part of the 118-80 update, are given their first numeric designation in this report. Additionally, the Cosumnes Subbasin has been added to the subbasins within the San Joaquin River HR. It is worth noting that the southern portion of the South American Subbasin of the Sacramento Valley Groundwater Basin is also included as part of this HR. The subbasin names and numbers within the region are listed in Table 29.

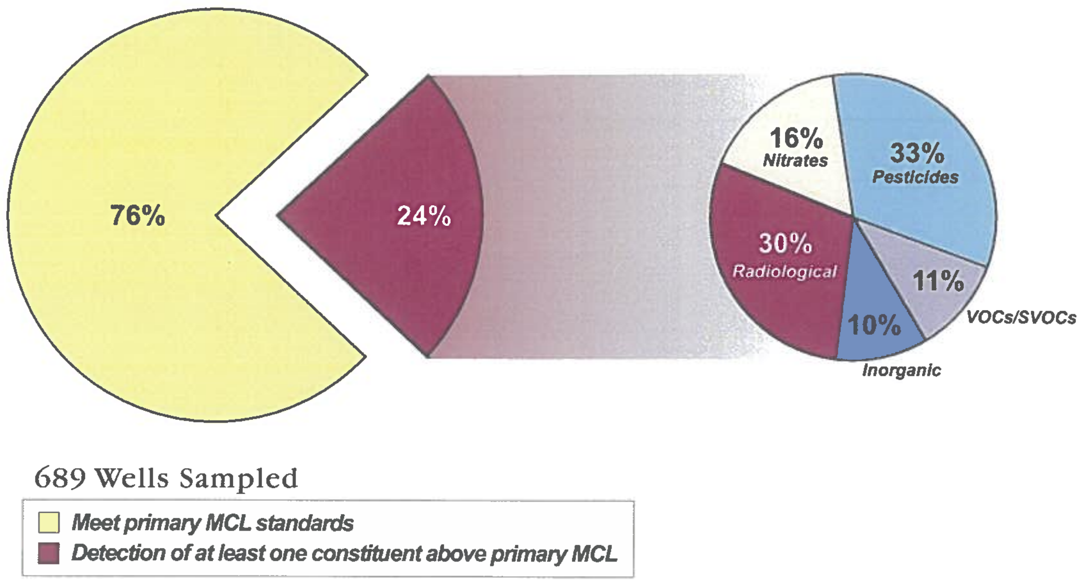

Figure 36 MCL exceedances in public supply wells in the San Joaquin River Hydrologic Region

Table 28 Most frequently occurring contaminants by contaminant group in the San Joaquin River Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Aluminum – 4	Arsenic – 4	4 tied at 2 exceedances
Inorganics – Secondary	Manganese – 123	Iron – 102	TDS – 9
Radiological	Uranium – 33	Gross Alpha – 26	Radium 228 – 6
Nitrates	Nitrate (as NO_3) – 23	Nitrate + Nitrite – 6	Nitrate Nitrogen (NO_3-N) – 3
Pesticides	DBCP – 44	Di(2-Ethylhexyl)phthalate – 11	EDB – 6
VOCs	PCE – 8	Dichloromethane – 3	TCE – 3

DBCP = Dibromochloropropane
EDB = Ethylenedibromide
PCE = Tetrachloroethylene
TCE = Trichloroethylene
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound

Table 29 Modifications since Bulletin 118-80 of groundwater basins and subbasins in San Joaquin Hydrologic Region

Subbasin name	New number	Old number
Eastern San Joaquin	5-22.01	5-22
Modesto	5-22.02	5-22
Turlock	5-22.03	5-22
Merced	5-22.04	5-22
Chowchilla	5-22.05	5-22
Madera	5-22.06	5-22
Delta-Mendota	5-22.07	5-22
Tracy	5-22.15	5-22
Cosumnes	5-22.16	5-22

Table 30 San Joaquin River Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
5-22	SAN JOAQUIN VALLEY									
5-22.01	EASTERN SAN JOAQUIN	707,000	A	1,500	-	345	69	540	310	30 - 1,632
5-22.02	MODESTO	247,000	B	4,500	1000-2000	230	15	209	60-500	200-8300
5-22.03	TURLOCK	347,000	B	4,500	1000-2000	307	0	163	200-500	100-8300
5-22.04	MERCED	491,000	B	4,450	1500-1900	378	0	142	200-400	100-3600
5-22.05	CHOWCHILLA	159,000	B	4,750	750-2000	203	0	28	200-500	120-6400
5-22.06	MADERA	394,000	B	4,750	750-2000	378	0	127	200-400	100-6400
5-22.07	DELTA-MENDOTA	747,000	B	5,000	800-2000	816	0	120	770	210-86,000
5-22.15	TRACY	345,000	C	3,000	500-3,000	18	14	183	1,190	210-7,800
5-22.16	COSUMNES	281,000	A	1,500	-	75	13	72	218	140-438
5-69	YOSEMITE VALLEY	7,500	C	1,200	900	0	0	3	54	43-73
5-70	LOS BANOS CREEK VALLEY	4,840	C	-	-	0	0	0	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

ATTACHMENT 4

CONDOR

San Joaquin Valley Groundwater Basin
Eastern San Joaquin Subbasin

Groundwater Basin Number: 5-22.01
- County: San Joaquin, Stanislaus, and Calaveras
- Surface Area: 707,000 acres (1,105 square miles)

Basin Boundaries and Hydrology

The San Joaquin Valley comprises the southernmost portion of the Great Valley Geomorphic Province of California. The Great Valley is a broad structural trough bounded by the tilted block of the Sierra Nevada on the east and the complexly folded and faulted Coast Ranges on the west. The Eastern San Joaquin Subbasin is defined by the areal extent of unconsolidated to semiconsolidated sedimentary deposits that are bounded by the Mokelumne River on the north and northwest; San Joaquin River on the west; Stanislaus River on the south; and consolidated bedrock on the east.

The Eastern San Joaquin Subbasin is bounded on the south, southwest, and west by the Modesto, Delta-Mendota, and Tracy Subbasins, respectively and on the northwest and north by the Solano, South American, and Cosumnes Subbasins. The Solano and South American are subbasins of the Sacramento Valley Groundwater Basin.

The Eastern San Joaquin Subbasin is drained by the San Joaquin River and several of its major tributaries namely, the Stanislaus, and Calaveras, and Mokelumne Rivers. The San Joaquin River flows northward into the Sacramento and San Joaquin Delta and discharges into the San Francisco Bay. Annual precipitation within the subbasin ranges from about 11 inches in the southwest to about 25 inches in the northeast.

Hydrogeologic Information

Water Bearing Formations

Water bearing formations of significance in the Eastern San Joaquin Subbasin consist of the Alluvium and Modesto/Riverbank Formations, Flood Basin Deposits, Laguna Formation, and Mehrten Formation. The Mehrten Formation is considered to be the oldest fresh water-bearing formation on the east side of the basin, even though the underlying Valley Springs Formation produces minor quantities. Information on water bearing units and groundwater conditions was taken primarily from (DWR 1967).

Alluvium and Modesto/Riverbank Formations (Undifferentiated). These units are exposed within the subbasin along a band approximately 15 miles wide that extends from about Stockton eastward. These units are Recent to Late Pleistocene in age and consist primarily of sand and gravel in the fan areas while clay, silt, and sand are dominant in the interfan areas. These units range in thickness from a thin veneer on the east side of the basin to over 150 feet near the center of the basin. Groundwater occurs unconfined within these units. Well yields to 650 ± gpm are reported. Because these units are limited in thickness, most wells penetrate them in order to tap deeper aquifers in the area. Average specific yields in the 10- to 200-foot depth range vary from about 7 to 15 percent within the boundaries of the

Tuolumne River Storage Unit (Davis et al. 1959). The average specific yield for fresh water bearing units in the San Joaquin County Groundwater Investigation area as defined in (DWR 1967) is 7.3 percent. The Victor Formation as defined in (DWR 1967) is correlative with these units.

Flood Basin Deposits. This unit is exposed in the Delta area of the San Joaquin Valley. These deposits are basinward, fine-grained forms of the Laguna, Riverbank, Modesto, and Recent formations and, therefore, range in age from Pliocene to Recent. They are generally much finer grained with a higher percentage of fine sand and clays than their depositional equivalents to the east and west. Occasional gravel beds occur along the present waterways and are probably representative of the type of underlying lithology distribution. This unit ranges in thickness from 0 to 1,400 ± feet. Groundwater in this unit occurs under unconfined to confined conditions. The unit, in general, has low permeabilities and may create semi-confined to confined conditions when interfingered with the Alluvium and Modesto/Riverbank Formations. Occasional pockets of fresh water are found in the Delta deposits, but generally speaking the formation contains poor quality water. This unit is designated as Dos Palos Alluvium by (Wagner et al. 1990).

Laguna Formation. The Laguna Formation is Plio-Pleistocene in age and consists of discontinuous lenses of stream laid sand and silt with lesser amounts of clay and gravel. There are no regionally significant fine-grained intervals that could cause water pressure conditions, although the heterogeneous nature of the sediments causes local confinement. From the Mokelumne River area, the formation thickens from approximately 400 feet to approximately 1,000 feet in the Stockton area. Regionally, yields of 1,500 gpm have been reported from highly permeable beds, but average yields are about 900 ± gpm. Groundwater occurs under unconfined to locally semiconfined conditions within this unit. Occasional minor perched water zones are encountered in this formation, particularly in the Mokelumne River area.

Mehrten Formation. This formation is exposed in the easternmost part of the subbasin where it forms readily identifiable, nearly flat-topped hills. The formation is late Miocene to Pliocene in age and is composed of moderately to well indurated andesitic sand to sandstone interbedded with conglomerate, tuffaceous siltstone, and claystone. The Mehrten Formation is approximately 400 feet thick in eastern surface outcrops to over 600 feet thick in the subsurface near Stockton. It is reported to be 1,300 ± feet thick at McDonald Island. The top of the Mehrten Formation occurs at depths of approximately 800 to 1,000 feet in the Stockton area. Regional studies indicate that Mehrten Formation sands commonly yield on the order of 1,000 gpm from wells. The formation appears to be semiconfined at least locally in the Stockton area, due to the inferred extensive fine-grained beds in its upper part. The average specific yield for fresh water bearing units in the San Joaquin County Groundwater Investigation area as defined in (DWR 1967) is 7.3 percent.

Groundwater Level Trends

Measurements over the past 40 years show a fairly continuous decline in groundwater levels in Eastern San Joaquin County (USACE 2001). Groundwater levels have declined at an average rate of 1.7 feet per year and have dropped as much as 100 feet in some areas. It is estimated that groundwater overdraft during the past 40 years has reduced storage in the basin by as much as 2 million acre feet.

Due to the continued overdraft of groundwater within the subbasin, significant groundwater depressions are present below the City of Stockton, east of Stockton, and east of Lodi (SJCFC 1999). Several of these groundwater depressions extend to depths of about 100 feet below ground surface (or more than 40 feet below mean sea level).

Groundwater Storage

Groundwater Storage Capacity. The total available groundwater storage capacity from a depth of 20 feet to the base of the groundwater basin is about 42,400,000 af based on a total aquifer material volume of 579,900,000 af and an average specific yield of 7.3 percent (DWR 1967). This estimate was based on a study area that encompassed approximately 586,000 acres. Since the currently defined subbasin size is over 707,000 acres, the storage value mentioned above underestimates the total storage capacity for the subbasin as defined in Bulletin 118 – Update 2002.

Groundwater in Storage. No published groundwater in storage estimates were identified.

Groundwater Budget (Type A)

A hydrologic balance for a study area approximately matching the subbasin was prepared by Brown & Caldwell (SJCFC 1985). The balance consists of an inventory of inflow and outflow items for the period 1963 – 1982. Inflow estimates include: average annual infiltration from applied water and precipitation (593,356 af); average annual seepage from surface water (141,127 af); and average annual net subsurface inflow (3,586 af). Outflow estimates include: average annual municipal and industrial pumpage (47,493 af); and average annual agricultural pumpage (761,828 af). This balance shows that there has been a total net outflow from the system of about 1.5 million acre feet over the 20 year study period which represents an average annual outflow (or overdraft) of about 70,000 acre feet.

The (USBR 1996) estimated the 1990 annual groundwater extraction in San Joaquin County to be about 731,000 af/year, which exceeds the estimated safe yield of 618,000 af/year. This results in an estimated overdraft of 113,000 af/year. It is estimated that 70,000 af/year of overdraft occurs in northeastern San Joaquin County and about 35,000 af/year of overdraft occurs in the Stockton East Water District area.

Groundwater Quality

Characterization. The majority of the groundwater in the basin is characterized by calcium-magnesium bicarbonate or calcium-sodium bicarbonate types (Sorenson 1981). Bicarbonate is the predominant anion in the eastern part of the basin. Large areas of chloride type water occur along the western margin of the subbasin along the San Joaquin River. Based on analyses of 174 water supply wells in the subbasin, TDS ranges from 30 to

1,632 mg/L and averages about 310 mg/L. TDS ranged from 50 to 3,520 mg/L with a mean of 463 and median of 269 according to the groundwater chemistry study in San Joaquin County and part of Contra Costa County by (Sorenson 1981). Specific conductance of groundwater ranged from 78 to 5,390 μmhos/cm, with a mean value of 685 and a median of 356. Some of the highest specific conductance values were found along the western part of the subbasin and San Joaquin River alignment.

Impairments. As a result of declining water levels, poor quality water has been moving east along a 16-mile front on the east side of the Delta (DWR 1967). The degradation was particularly evident in the Stockton area where the saline front was moving eastward at a rate of 140 to 150 feet per year. Data from 1980 and 1996 indicate that the saline front has continued to migrate eastward up to about one mile beyond its 1963 extent (USACE 2001). Large areas of elevated nitrate in groundwater exist within the subbasin located southeast of Lodi and south of Stockton and east of Manteca extending towards the San Joaquin – Stanislaus County line.

Water Quality in Public Supply Wells

Constituent Group[1]	Number of wells sampled[2]	Number of wells with a concentration above an MCL[3]
Inorganics – Primary	182	8
Radiological	179	8
Nitrates	189	7
Pesticides	191	21
VOCs and SVOCs	185	6
Inorganics – Secondary	182	71

[1] A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).
[2] Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.
[3] Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

Well Production characteristics

	Well yields (gal/min)
Municipal/Irrigation	Well yields in the fresh water-bearing formations underlying the basin range (in general) from about 650 to 1,500 gpm.
	Total depths (ft)
Domestic	Range: 25-993 Average: 242 (Based on 1551 well completion reports)
Municipal/Irrigation	Range: 75-780 Average: 349 (Based on 224 well completion reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	99 /semiannually, and 15 /monthly
San Joaquin County Flood Control and Water Conservation District (SJCFC) and cooperators	Groundwater levels	246 /semiannually
SJCFC and cooperators	TDS, turbidity, chloride, and EC	Approximately 26 /annually
Department of Health Services and cooperators	Title 22 water quality	540 /annually

Basin Management

Groundwater management: (DWR 1999)	San Joaquin County enacted a groundwater management ordinance in 1996; AB 3030 plans have been adopted by the following entities: County of Stanislaus ; North San Joaquin WCD (3/5/96); Oakdale ID (9/22/95); San Joaquin County FC&WCD (2/11/97); South San Joaquin ID (2/14/95); Stockton East WD (11/1/95); and Woodbridge ID.
Water agencies: Public and Private	Lockeford CSD, North Delta WA, North San Joaquin WCD, Oakdale ID, City of Lathrop WD, City of Lodi Service Area, City of Manteca WSA, Calaveras County WD, California Water Service Company, Central Delta WA, Central San Joaquin WCD, City of Escalon WSA, Reclamation District No. 828, River Junction Reclamation District No. 2064, Rock Creek WD, South Delta WA, South San Joaquin ID, Stockton East WD, Valley Springs PUD, Woodbridge ID, Woodbridge WUCD, and City of Stockton MUD. Northeastern San Joaquin County Groundwater Banking Authority adopted a groundwater management plan.

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Errata

Changes made to the basin description will be noted here.