

Annual Groundwater Report for Water Year 2002

Final

San Benito County Water District



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for Water Year 2002

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LIST OF ACRONYMS

µg/l.....	micrograms per liter, or part per billion
µ S/cm.....	microsiemens per centimeter
af.....	acre-foot
Board	California Regional Water Quality Control Board
Ca	calcium
CalTrans	California Department of Transportation
CaSO ₄	gypsum
cfs	cubic feet per second
CIMIS.....	California Irrigation Management Information System
Cl.....	chloride
CVP	Central Valley Project
District.....	San Benito County Water District
DWR.....	California Department of Water Resources
DWTP.....	domestic wastewater treatment plant
ET.....	evapotranspiration
ft	feet
GIS	Geographic Information System
HCO ₃	bicarbonate
IWTP	industrial wastewater treatment plant
K.....	potassium
K ₂ O.....	potassium
lb/ac/yr.....	pounds per acre per year
MCL	maximum contaminant level
M&I.....	municipal and industrial
Mg.....	magnesium
MGD.....	million gallons per day
mg/l.....	milligrams per liter
Na.....	sodium
NO ₃	nitrate
P ₂ O ₅	phosphate
Reclamation.....	U.S. Bureau of Reclamation
SO ₄	sulfate
Sunnyslope CWD.....	Sunnyslope County Water District

EXECUTIVE SUMMARY

This annual report describes groundwater conditions in northern San Benito County during water year 2002 (October 2001 through September 2002) and water management activities undertaken during that period by San Benito County Water District. Topics covered in the report include water use, water charges, groundwater levels and storage, water quality, shallow water table problems, and groundwater recharge benefits.

Water year 2002 was unremarkable in most respects and provided an opportunity to observe the basin under average conditions. Annual rainfall during water year 2002 was close to average for the fourth year in a row. Water use changed only slightly from the previous year, and there was little net change in groundwater storage.

The District used approximately 22,883 acre-feet of water purchased from the U.S. Bureau of Reclamation and imported to San Benito County via the San Felipe Project. This was approximately the same amount imported the previous year and 67% of the record amount imported. Eighty-three percent (83%) of San Felipe water was consumed by irrigation; 6% was used for domestic, municipal and industrial purposes; 5% was percolated along local streams for groundwater recharge; and 6% was lost to evaporation and seepage from San Justo Reservoir. The City of Hollister and Sunnyslope County Water District commenced operation of their “Lessalt” water treatment plant in November 2002 and will increase municipal and industrial uses of San Felipe water.

Groundwater supplied an estimated additional 45,682 af of use, 76% of which was for agricultural purposes. Groundwater use was close to the average use during the previous 6 years. San Felipe water supplies a relatively high percentage of water use in the Pacheco, San Juan, and Hollister East subbasins, and the percentage has been increasing in the latter two areas. Municipal water use has been steadily increasing as a result of population growth.

Groundwater recharge from percolation of streamflow was below average this year. The total annual release of water from Hernandez Reservoir was also somewhat lower than usual—9,698 af, of which approximately 5,000 af contributed directly to increased groundwater recharge in Zone 3.

Total revenue exceeded total expenses for Zones 3 and 6 during fiscal year 2002 (ending June 30, 2002). There were no major capital expenditures, the operating budget for Zone 6 was in the black, and tax revenues have gradually increased as population has grown and assessed value has increased. Together, these factors created a solid financial condition for the District in 2002. The District’s standby-and-availability and water-use charges for groundwater and San Felipe water remained unchanged from the previous year, except for a slight decrease in the rate for municipal and industrial users of San Felipe water. The District also implemented a new power charge to cover the cost of power used to import and deliver San Felipe water. More energy is required to deliver the water to customers in relatively high parts of the distribution system. With energy costs expected to increase as a percentage of total cost, the District

decided it would be equitable to itemize those costs explicitly by means of a power charge. Four price tiers ranging from \$15 to \$50 per acre-foot were established, and each distribution subsystem was assigned to a tier based on its elevation.

This report recommends that groundwater charges be renewed in 2002, although it may be appropriate to modify the formula used as the basis of the charges. It is no longer necessary to percolate San Felipe water in streams to reverse historical overdraft, but groundwater users continue to benefit from the relatively high groundwater levels made possible by the San Felipe project.

The net change in groundwater storage in Zone 6 between October 2001 and October 2002 was a modest decrease of 2,571 af. Storage increased in the Bolsa, Bolsa Southeast, and Hollister East subbasins, continuing their steady recovery from historical overdraft. Storage decreased in the subbasins along the San Benito River, reflecting below-average percolation of natural runoff and limited percolation of San Felipe and Hernandez water. Water levels have been relatively high in those subbasins, and the decreases are not problematic. Although hydrologic conditions were close to normal during water year 2002 and there was a slight overall decrease in groundwater storage, the amount of San Felipe water imported might be higher than the amount that would be needed on a long-term average basis to balance the groundwater budget. The level of average annual imports that would prevent overdraft, provide some groundwater outflow, and avoid excessive rejection of stream recharge appears to be on the order of 17,000–20,000 af/yr for the basin as a whole.

A long-term effort to improve the quality of water delivered to customers in the City of Hollister and Sunnyslope County Water District service areas came to fruition in 2002 with the completion of the "Lessalt" water treatment plant. The plant treats San Felipe water for municipal use and is expected to improve groundwater quality by eliminating the need for water softeners. Salts discharged by water softeners presently become part of the reclaimed water that is percolated into the groundwater basin at several locations. The plant came on line in November 2002 and will affect water use and quality patterns for water year 2003.

An itemized salt budget for the groundwater basin originally developed in 2001 was refined for 2002. Although many budget items remain uncertain, the general conclusions remain unchanged: inputs greatly exceed outputs, and no single input dominates the budget. Mapping of the geographic distribution of salt loads showed that most of the localized salt inputs are accompanied by high flow rates and do not cause locally high concentrations. An evaluation of the chemical compositions of the salt inputs revealed four general water-quality types: local and imported surface water and groundwater inflows, wastewater, fertilizers, and soil amendments (gypsum).

No unusual trends in ambient water quality were detected, and none of the municipal water purveyors reported that primary drinking water standards were violated during the year. No new groundwater contamination sites have been reported, and cleanup of existing sites is progressing steadily.

The District made progress in 2002 toward implementing many of the recommendations from previous annual reports. Recommendations in this year's report include the review and improvement of the water-

level monitoring network and database, the enhancement of the District's new Geographic Information System, the collection of selected water quality samples to improve the salt balance calculations, and the potential application of the groundwater model to the Hollister West subbasin to evaluate expected changes in the local groundwater balance.

INTRODUCTION

This annual report describes current groundwater conditions in the San Benito County part of the Gilroy-Hollister groundwater basin, the Paicines groundwater basin, and the Tres Pinos Creek Valley groundwater basin. It describes activities undertaken by San Benito County Water District (District) to manage water resources in that area from October 2001 through September 2002. In addition, it describes long-term trends in water use, groundwater levels, overdraft, and water quality. The report was prepared at the request of the District to meet its information needs and to fulfill statutory reporting requirements that specify the minimum content of the report if the District chooses to prepare one. Annual groundwater reports have been prepared every year for many years. The reporting requirements and the additional focus topics featured in recent previous annual reports are described in Appendix A.

Throughout this report, areas are shown to the nearest acre, and water budget items are shown to the nearest acre-foot (af). As a result, large numbers may appear to be accurate to four or five digits, which is not the case. Values for data that are measured directly, such as total subbasin area, water levels, percolation releases, and use of San Felipe water, are probably accurate to two or possibly three significant digits. Values for data that are estimated, such as recharge from natural streamflow, recharge from deep percolation, groundwater storage changes, and groundwater flow between subbasins, are probably accurate to only one or two significant digits. All digits are retained in the text and tables to avoid rounding small numbers to zero, to preserve correct column totals in tables, and to maintain as much accuracy as possible during subsequent calculations based on the information presented in this report.

Elevations stated in this report are referenced to sea level, or more specifically to the National Geodetic Vertical Datum of 1929, unless otherwise indicated.

Basin and Subbasin Boundaries and Hydrogeology

The boundaries of the San Benito County part of the Gilroy-Hollister groundwater basin and of the nearby Paicines and Tres Pinos Creek groundwater basins are shown in Figure 1. Subbasin boundaries and names are also shown in Figure 1; they were delineated in 1996 based on a combination of infrastructure subdivisions (San Felipe subsystems), political boundaries (Zone 6), and geologic structures (faults).

Generally, the basins consist of relatively permeable, unconsolidated deposits in valleys bounded by hills consisting of less permeable materials. Although approximately the same boundaries as those shown in

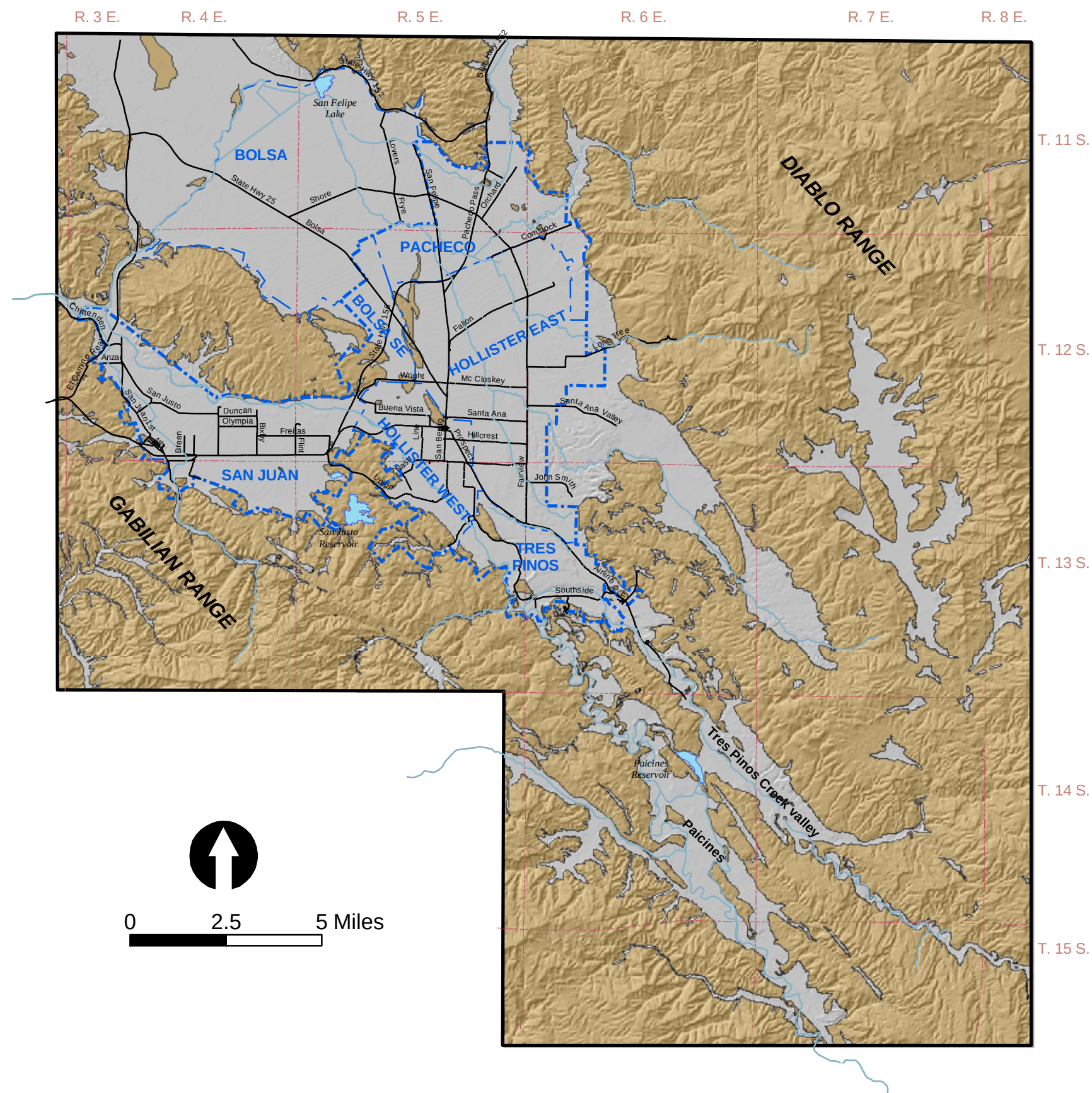
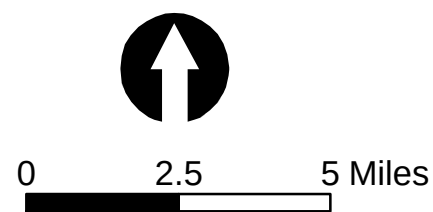


Figure 1a: Location of Zone 6 and Groundwater Subareas

LEGEND

-  Basin boundary
-  Zone 6 boundary
-  Subbasin boundary
-  Subbasin name
-  Township and Range line
-  Major road



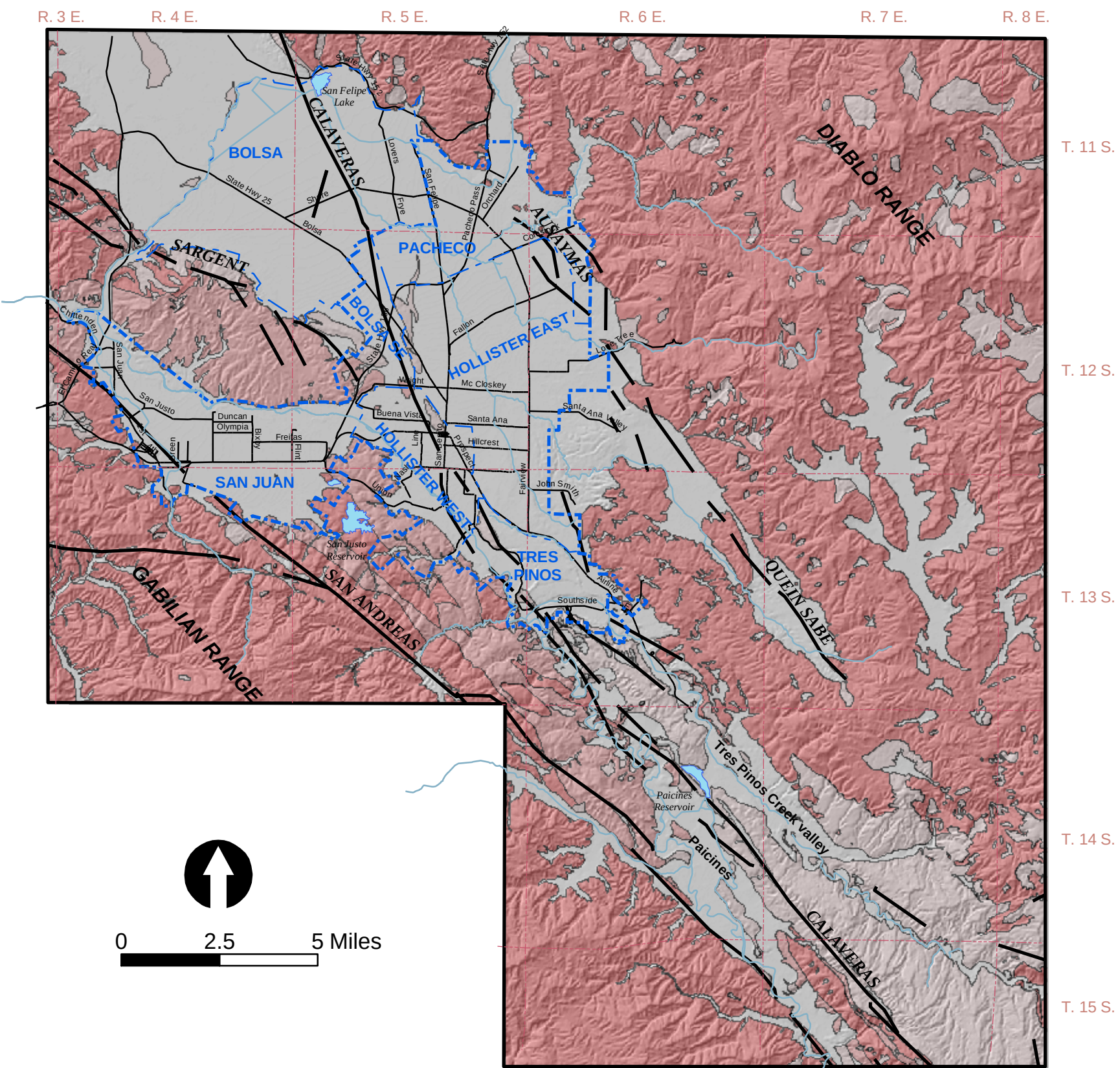


Figure 1B: Relative Permeability and Major Faults

LEGEND

- Relative permeability
 High--consists of Holocene and late Pleistocene alluvial deposits
- Moderate--consists mainly of Pliocene-Pleistocene continental deposits
- Low--consists of Pliocene continental deposits
- Very low--consists of pre-Pliocene rocks
- Fault
- Zone 6 boundary
- Subbasin boundary
- Subbasin name
- River or creek
- Township and Range line
- Major road

Relative permeability based on geologic mapping from California Geological Survey, Wagner and others CD-ROM 2002-04 (2002), Geologic map of Monterey 30' x 60' quadrangle and adjacent areas..
 Faults from California Geological Survey, CD-ROM 2000-006 (2000), Digital database of faults from the Fault Activity Map of California and adjacent areas.

Figure 1 were used in previous groundwater investigations, the geologic materials do not fall cleanly into two categories of permeability, such as bedrock and basin fill. Some hills, such as the Lomerias Muertas and the hills along the south side of the San Juan Valley, are simply upward folds of the same formations that make up much of the groundwater basin thickness beneath the valley floor. In such cases, the areas outside the indicated basin boundaries might store and transmit significant quantities of groundwater to the basin. Accordingly, the geologic formations shown in Figure 1 have been loosely grouped into four permeability classes based on the age and type of material.

The surficial geology shown in Figure 1 is from a recent 1:24,000-scale digital map produced by the California Geological Survey (Wagner and others 2002). The mapping and formation names differ slightly from previous investigations, which were thoroughly reviewed and summarized by Luhdorff and Scalmanini Consulting Engineers (1991). These differences are immaterial with respect to the general shape, thickness, and lithology of the groundwater basins.

Several faults form partial barriers to groundwater flow within the basin. The San Andreas Fault cuts across the southwest corner of the San Juan Valley. The few wells located on the southwest side of the fault have notably high, stable groundwater levels. The Calaveras Fault crosses the basin between Hollister and San Felipe Lake and is associated with abrupt changes in groundwater levels. The Ausaymas Fault crosses the northeastern part of the Pacheco subbasin. One spring appears to be associated with the fault, but water level data are too sparse in that area to determine if there is an abrupt drop in water levels across the fault. The Tres Pinos Creek Fault parallels Highway 25 along the northern edge of the Tres Pinos subbasin. Calibration of a groundwater model in 2001 indicated that steep water level gradients in this area are more likely the result of low formation permeability than localized effects of the fault (Yates and Zhang 2001).

Most wells draw water from the alluvium, terrace deposits, and upper part of the Purisima Formation. Substantial additional thickness of Purisima Formation is present below this depth. An inventory of 103 wells by the U.S. Geological Survey (Farrar 1981) indicated that 84% of the wells were between 100 and 500 feet (ft) deep. Only 4% of these wells were less than 100 ft deep.

Water Supply System

The dominant land use in the valley floor areas is irrigated agriculture, which accounted for 75% of total water use in water year 2002. Municipal and domestic water use was concentrated in the Hollister area (City of Hollister and Sunnyslope County Water District), San Juan Bautista, and Tres Pinos. Almost all of the municipal and rural domestic water demand and 44% of the agricultural water demand were supplied by wells in 2002, with the remainder supplied by imported surface water.

Locations of various components of the water supply system are shown in Figure 2, including water supply facilities, wastewater treatment plants, and hydrologic measurement stations used in 2002. Hernandez Reservoir (capacity 17,200 af) is located on the San Benito River, 43 miles southeast of Hollister, and stores runoff from the upper San Benito River watershed. Paicines Reservoir, with a capacity of 2,870 af,

is an offstream reservoir between the San Benito River and Tres Pinos Creek approximately 5 miles south of Tres Pinos (Figure 2). It is filled by water diverted from the San Benito River, with some of the diversions consisting of natural runoff and some consisting of redirection of water stored and released from Hernandez Reservoir. The stored water is released for percolation to Tres Pinos Creek and the San Benito River to provide additional groundwater recharge during the dry season. The reservoirs are owned and operated by the District under operating permits issued by the Division of Safety of Dams and the California Department of Water Resources (DWR). Current District policy is to limit percolation flows to river and creek reaches upstream of Cienega Road.

The District also purchases Central Valley Project (CVP) water from the U.S. Bureau of Reclamation (Reclamation). This water is imported from San Luis Reservoir through the Hollister Conduit, which is a component of the San Felipe Unit of the CVP. The conduit is a pressurized pipeline that terminates at San Justo Reservoir, located in the foothills 3 miles southwest of Hollister. San Justo has a capacity of 11,000 af, and is used exclusively to store and re-regulate imported water. The imported water is delivered to agricultural, municipal, and industrial customers in the Pacheco, Bolsa Southeast, San Juan, Hollister East, Hollister West, and Tres Pinos subbasins through 12 subsystems containing approximately 120 miles of pressurized pipeline laterals (Figure 2). The remainder of the water is released at controlled rates to several local creeks and the San Benito River to percolate and supplement natural groundwater recharge. San Felipe percolation activities are described in greater detail in the next section.

The District, which has jurisdiction throughout San Benito County, has formed three zones of benefit to obtain funds to support surface water management and groundwater replenishment activities. Zone 1 covers the entire county and provides the funding base for certain District administrative expenses. Zone 3 generally covers the San Benito River Valley, from the Highway 25 bridge nine miles south of the town of Paicines to San Juan Bautista and Tres Pinos Creek Valley, from Paicines to the San Benito River. It provides the funding base for operation of Hernandez and Paicines Reservoirs and related percolation and groundwater management activities. Zone 6 includes the Pacheco, Bolsa Southeast, San Juan, Hollister West, Hollister East, and Tres Pinos subbasins (Figure 1) and provides the funding base for importation and distribution of San Felipe water and related groundwater management activities.

Table 1 shows the irrigated area in each subbasin that received San Felipe water during water year 2002 and the irrigated area that used groundwater. Some areas use both San Felipe water and groundwater; therefore, the sum of the San Felipe and groundwater use areas is greater than the amount of irrigated cropland physically present in each subbasin. An analysis of District billing records for 2002 cataloged by land parcel indicated that San Felipe water was used for irrigation of 19,517 acres and groundwater for irrigation of 16,191 acres. Parcels that use both types of water are included in both totals, but parcels that are served entirely by offsite wells are not included in either total. The total amount of irrigated cropland in zone 6 during 2002 was estimated by summing the areas of all parcels recorded in the database as using one or both sources of water. The resulting total of 26,465 acres is very close to the total area mapped as cropland by DWR in 1997 (26,087 acres). The total land area within zone 6 is 48,338 acres, which includes urban areas, nonirrigated cropland, native vegetation, and the San Benito River channel.

Table 1. Subbasin Areas and Water Use during Water Year 2002

A. Area (acres)

Subbasin	San Felipe Direct Use Areas (Blue Valves)			Groundwater Use Areas		Total Subbasin Area
	Agricultural	Domestic	Municipal	Agricultural	Domestic, Municipal, & Industrial	
Pacheco	3,847	302	0	4,211	2,417	8,346
Bolsa Southeast	308	0	0	1,291	465	3,122
San Juan	5,738	624	200	4,131	3,613	11,778
Hollister West	490	57	271	1,419	1,461	5,727
Hollister East	8,921	1,686	0	3,866	4,990	14,649
Tres Pinos	212	899	591	1,273	1,557	4,716
Zone 6 subtotal	19,517	3,568	1,062	16,191	14,504	48,338
Bolsa	0	0	0	11,818	n.m.	16,891
Paicines	0	0	0	3,400	n.m.	6,876
Tres Pinos Creek Valley	0	0	0	900	n.m.	4,063
Grand total	19,517	3,568	1,062	32,309	14,504	76,168

B. Annual Water Use during Water Year 2002 (acre-feet)

Subbasin	San Felipe Direct Use Areas (Blue Valves)			Groundwater Use Areas		Total Water Use
	Agricultural	Domestic	Municipal	Agricultural	Domestic, Municipal, & Industrial	
Pacheco	3,807	33	0	2,149	173	6,162
Bolsa Southeast	497	0	0	2,179	14	2,690
San Juan	6,704	119	419	6,641	930	14,812
Hollister West	643	13	50	1,564	5,013	7,283
Hollister East	7,322	68	0	1,574	1,014	9,978
Tres Pinos	126	11	599	1,150	2,844	4,730
Zone 6 subtotal	19,098	244	1,068	15,256	9,988	45,654
Bolsa	0	0	0	12,235	n.m.	12,235
Paicines	0	0	0	5,413	n.m.	5,413
Tres Pinos Creek Valley	0	0	0	1,743	47	1,790
Grand total	19,098	244	1,068	34,647	10,035	65,092

Notes:

n.m. = not measured, but much less than corresponding agricultural area or water use.

Bolsa subbasin water duty assumed to equal the average water duty for Zone 6. Paicines and Tres Pinos Creek Valley agricultural use equals estimated long-term average use. Municipal use was estimated from measured groundwater pumping by Tres Pinos County Water District during water year 2000.

Most entries are significant only to two digits. However, all digits are retained to avoid rounding small amounts to zero and to preserve correct column totals.

Municipal use of San Felipe water is principally for golfcourse irrigation and the Stonegate development.

Overview of Hydrologic Conditions during Water Year 2002

Rainfall in Hollister during water year 2002 almost exactly equaled the long-term average (13.24 versus 13.09 inches). However, most of the rain fell in autumn and early winter and did not produce much runoff because soils in the watershed are quite dry at that time. Rainfall in November and December were 347% and 156% of average, but rainfall during the remaining wet-season months was below average and generated little runoff. Annual discharge in the San Benito River at the Willow Creek School gage upstream of the basin was only 7143 af, including releases from Hernandez Reservoir. This was the smallest annual discharge since 1991, although it was greater than the discharge in all of the years during the 1987–1991 drought. Flow patterns in other streams surrounding the basin showed similar patterns. Climate data for water year 2002 can be found in Appendix B and streamflow data for gages and miscellaneous measurement stations are in Appendix C. The locations of streamflow measurement stations used during 2002 are shown in Figure 2.

Land and water use changed only incrementally from the previous year, which is usually the case. Gradual long-term trends toward increased municipal water use and increased use of San Felipe water for irrigation continued in 2002.

WATER MANAGEMENT ACTIVITIES, COSTS, AND REVENUES

Water Resources Planning

The District initiated or participated in several water resources planning efforts during water year 2002. Several years of joint planning with the City of Hollister and Sunnyslope County Water District (Sunnyslope CWD) came to fruition in November 2002 with the completion of the “Lessalt” water treatment plant. The plant treats San Felipe water for potable municipal use in the Hollister area. Although initially operating only 8 hours per day, the plant has a capacity of 3 million gallons per day (MGD) and could potentially produce as much as 3,360 af/yr of the municipal supply. Sunnyslope CWD plans to construct a second water treatment plant to further decrease the salt load entering the Ridgemark wastewater treatment plant, but it has not been determined whether the plant will be designed to treat San Felipe water or groundwater.

The District received a \$200,000 grant from the State to study groundwater quality, pursuant to the AB303 program for local groundwater investigations. Work will commence during water year 2003.

The District installed 11 monitoring wells between Hollister and San Juan Bautista to establish a network for monitoring shallow groundwater conditions in the San Juan Valley. The network was recommended by a study of shallow groundwater problems in that area completed in 1999 (Yates and others 1999).

Previous annual reports and the groundwater management plan for northern San Benito County recommended that the capability to blend groundwater and San Felipe water be developed to provide flexibility in balancing the groundwater budget. The higher quality of San Felipe water has prompted agricultural users in some areas to shift substantially from groundwater to San Felipe water as a source of irrigation supply, and this has resulted in decreased groundwater pumping and high groundwater levels. For almost all crops grown in the area, a blend of groundwater and San Felipe water can meet the necessary quality objective while maintaining a moderate level of local groundwater pumping. Centralized blending by injecting groundwater into the Hollister Conduit or other major pipelines in the San Felipe distribution system appears more promising than point-of-use blending by individual farmers. The District has designed a blending project in the Hollister West subbasin for which environmental documentation and test-well construction are in progress. Groundwater pumping in this subbasin might decrease substantially beginning in water year 2003, when the City of Hollister and Sunnyslope County Water District shift some of their municipal supply to treated San Felipe water. A similar project is under consideration for the Pacheco subbasin where groundwater levels are also high..

An updated groundwater management plan was completed in August 2002 by the Water Resources Association of San Benito County, of which the District is an active member. The update provides implementation details that were not included in the original plan (Jones & Stokes Associates, Inc., and CH2M-HILL, Inc., 1998). The update was finalized and a notice of preparation for an environmental impact report was issued in November 2002. No environmental documentation was ever prepared for the original plan.

The District's participation in the water supply element of the City of San Juan Bautista's infrastructure improvement plan culminated in a design for a 1-MGD membrane filtration plant that would improve the quality of the municipal water supply. The City is seeking funds to construct the plant.

Problems associated with localized ponding of rainfall runoff in the San Juan Valley prompted the District to prepare a scope of work for a drainage study in that area. The investigation will be coordinated with drainage studies by the California Department of Transportation (CalTrans) related to Highway 156 improvements.

Table 2. Reservoir Water Budgets for Water Year 2002 (acre-feet)

	Hernandez	Paicines	San Justo
Inflows			
Rainfall	455	92	177
San Benito River	3,468	1,652	n.a.
Hernandez-Paicines transfer	n.a.	0	n.a.
San Felipe Project	n.a.	n.a.	6,934
Total	3,923	1,744	7,110
Outflows			
Hernandez spills	0	n.a.	n.a.
Hernandez-Paicines transfer	0	n.a.	n.a.
Tres Pinos Creek percolation releases	n.a.	310	n.a.
San Benito River percolation releases	9,698	0	n.a.
San Felipe Project	n.a.	n.a.	4,254
Evaporation and seepage	689	977	1,351
Total	10,387	1,287	5,605
Storage Change			
Reservoir capacity	17,200	2,870	11,000
Maximum storage	7,174	918	10,310
Minimum storage	496	200	7,356
Net water year storage change	-5,781	92	1,514
Unaccounted for Water	683	-365	9

Notes:

n.a. = not applicable

Entries are accurate to approximately two significant digits. All digits are retained to avoid rounding small numbers to zero and to preserve correct column totals.

Unaccounted for water equals net water year storage change minus total inflows plus total outflows. It reflects the errors in the measurements of inflows, outflows and storage. A positive number means that storage at the end of the water year was larger than expected based on the sum of the cumulative inflows and outflows.

Evaporation and seepage for San Justo Reservoir has been decreased by the amount of water returned to the reservoir by seepage interceptor wells.

Recharge of Local Surface Water

The District operates Hernandez and Paicines Reservoirs in the San Benito River watershed to store runoff and release it during the dry season to augment groundwater recharge. Reservoir inflows, outflows, and storage changes during water year 2002 are shown in Table 2. Inflow to Hernandez Reservoir was only 3,468 af, and total percolation releases were 9,698 af. Part of the reason for the excess of releases over inflows was the need to empty the reservoir at the end of water year 2002 for construction activities in November 2002 related to modifying the outlet structure. Percolation releases were confined to the reach upstream of Cienega Road to avoid competing for percolation capacity near the City of Hollister's wastewater percolation ponds. A flow-partitioning analysis indicated that the releases augmented groundwater recharge in Zone 3 by 5,000 af (see Groundwater Storage Accounting).

Paicines Reservoir serves as a percolation facility for local groundwater recharge and as a regulating reservoir for San Benito River diversions and percolation releases to Tres Pinos Creek. Reservoir seepage is related to the reservoir storage level, so the level is managed to provide adequate recharge while avoiding localized downgradient soil saturation problems. Accordingly, the reservoir remained less than one-third full throughout the year. A total of only 310 af of water was released from Paicines Reservoir for percolation in Tres Pinos Creek in October and January, but approximately 780 af seeped out of the reservoir to become groundwater recharge.

The combined net change in storage in Hernandez and Paicines Reservoirs during water year 2002 was a decrease of 5,689 af (28% of their combined storage capacities).

Distribution and Recharge of San Felipe Water

A total of 22,883 af of San Felipe water was used in San Benito County during water year 2002. This includes 19,098 af directly used by agricultural customers and 1,312 af directly used by domestic or M&I customers. Sales of San Felipe water for direct use are shown by subbasin and type of use (agricultural or domestic) in Table 1. Domestic use is principally for irrigation at rural residences; potable water at those residences is supplied by onsite wells. However, Stonegate (a rural subdivision between Hollister and Tres Pinos) treats San Felipe water for direct potable use. Municipal and industrial (M&I) use includes irrigation at Ridgemark and San Juan Oaks golf courses.

Only 1,122 af of San Felipe water was percolated in local creek channels for groundwater recharge. This was the lowest amount since at least 1994 and continued a pattern of minimal percolation in recent years. Of the 13 discharge points historically used by the District, only five locations in the southern part of the Hollister East subbasin and the Tres Pinos and Hollister West subbasins were used. High groundwater levels obviated the need for additional direct recharge at the other locations. Table 3 shows the monthly releases during water year 2002, and Figure 2 shows the locations of the active discharge points. Percolation in the San Benito River was primarily at a six-acre off-channel pit near the Cienega Road bridge. Historical discharge locations and amounts are documented in Appendix D.

Table 3. Releases of San Felipe Water for Percolation in Local Streams and the San Benito River during Water Year 2002 (acre-feet)

	Pacheco Creek	Arroyo de las Viboras			Arroyo Dos Picachos		Santa Ana Creek			Airline Highway	Ridge- mark	Tres Pinos Creek	San Benito River	Total
		Road	Creek 1	Creek 2	Fallon Road	Jarvis Lane	Creek	John Smith Road	Maranatha Road					
Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec.	0	0	0	0	0	0	0	0	0	17	0	0	47	64
Jan.	0	0	0	0	0	0	0	18	0	42	0	137	185	381
Feb.	0	0	0	0	0	0	0	32	0	43	0	201	178	454
March	0	0	0	0	0	0	0	9	0	13	0	88	60	171
April	0	0	0	0	0	0	0	0	2	0	0	0	0	2
May	0	0	0	2	0	0	0	0	0	0	0	0	0	2
June	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sept.	0	0	0	0	0	0	1	19	0	28	0	0	0	48
Total	0	0	0	2	0	0	1	78	2	143	0	426	470	1,122

Finally, net seepage and evaporation from San Justo Reservoir accounted for 1,351 af of San Felipe water use. There was a net increase in storage at the San Justo Reservoir of 1,514 af. The storage change is not included in the aforementioned total annual use of San Felipe water because it is not a consumptive use.

The accuracy of systemwide flow metering could theoretically be verified by comparing the sum of the aforementioned locally metered uses with the metered volume of San Felipe water entering the county via the Hollister Conduit. It was not possible to compare these numbers for 2002 because of chronic malfunctioning of the meter at the intake to the Hollister Conduit. The agency that operates the meter has not yet repaired it.

Recharge of Reclaimed Water

There are five wastewater treatment plants in northern San Benito County that process significant quantities of wastewater. The treated volume of water and estimated evaporation and percolation occurring at each plant are listed in Table 4. All of the plants except the San Juan Bautista plant dispose of their treated water by percolation into the ground. The San Juan Bautista plant discharges to a small tributary of San Juan Creek where percolation rates are low. Part of the discharge reaches Anzar Creek and from there continues as surface flow to the Pajaro River. The locations of the percolation sites are shown in Figure 2.

The flume-type meter used to gage inflow to the City of Hollister's Domestic Wastewater Treatment Plant (DWTP) no longer functions because of backwater conditions created by high pond levels. An alternative method has been implemented on an interim basis but produces inaccurate results. For example, the reported inflow for August (5.2 MGD) was nearly double the fairly steady rate reported earlier in January–April (2.6–3.0 MGD), with no logical explanation for the additional flow in the middle of the dry season (Holdren pers. comm.).

The questionable high values in July, August, and September were replaced with the average of the values reported in the first 9 months of the water year. The City of Hollister has committed to improving the headworks at the DWTP, which will restore accurate inflow metering. Some of the wastewater treated at the DWTP is sent to the nearby industrial wastewater treatment plant (IWTP) for percolation. The IWTP also receives inflows from cannery discharges, which occur primarily in summer and early fall.

Wastewater from the Ridgemark development southeast of Hollister is treated at the Ridgemark wastewater treatment plant operated by Sunnyslope CWD and discharged to percolation ponds in the Ridgemark Golf and Country Club golf course. The Tres Pinos wastewater percolation ponds were relocated to a new site along Tres Pinos Creek in 2000 after the previous ponds were repeatedly damaged during high-flow events in the creek.

Table 4. Percolation of Municipal Wastewater during Water Year 2002

	Pond Area (acres)	Water Year 2002 Discharge (acre-feet)	Evaporation (acre-feet)	Percolation (acre-feet)	Percolation Distribution by Subbasin		
					Tres Pinos (%)	Hollister West (%)	San Juan (%)
Hollister -- municipal	92.9	2,100	217	1,884	0	25	75
Hollister -- industrial	39.0	1,636	91	1,545	0	50	50
Ridgemark	7.2	300	17	283	100	0	0
Tres Pinos	1.8	28	4	24	100	0	0
San Juan Bautista	3.0	224	7	217	0	0	100
Total	140	4,289	336	3,953			

Notes:

Average annual evaporation = 56 inches (DWR Bulletin 73-79)

Assumes 50% of total pond area in use at any time. Hollister pond areas are from Dickson and Kenneth D. Schmidt and Associates (1999) and include treatment ponds in addition to percolation ponds at the domestic wastewater treatment plant.

The discharge for the Tres Pinos plant was estimated from data for water year 2000.

Flow data are accurate to a maximum of two significant digits. All digits are shown to avoid rounding small numbers to zero and to preserve correct column totals.

A small package wastewater treatment plant at the Cielo Vista residential development at the intersection of Fairview Road and Highway 25 processes a small amount of wastewater (less than 50 af/yr) and is not included in Table 4.

Allowing for approximately 336 af of evaporation loss from the percolation ponds at the major wastewater treatment plants, the total amount of groundwater recharge from reclaimed water was 3,953 af. This figure assumes that all of the discharge from the San Juan Bautista plant becomes groundwater recharge, which probably overstates the case. The allocations of wastewater percolation to subbasins shown in Table 4 are based on water level gradients near the plants. The allocations for the DWTP and IWTP reflect an average of the gradient in the shallow aquifers near the river channel and the gradient in the deeper water-supply aquifers, which is somewhat different.

Water Banking

The District was involved in several water exchange and transfer agreements during water year 2002. An exchange involving approximately 11,000 af that had commenced during water year 2001 was completed during the first few months of water year 2002. The District also obtained 1,000 af of additional CVP water by means of a direct purchase from the San Joaquin River exchange contractors. This was the first time that actual demand for San Felipe within the District was less than the supply available through normal deliveries, prompting the District to purchase additional water from another CVP user. Finally, the District obtained 1,340 af of "critical needs" water and 421 af of surplus water by taking advantage of one-time opportunities offered by Reclamation.

District Revenues and Expenses

The District derives its income from a variety of charges levied on landowners and water users. Approximately half (45–58%) of the revenue comes from property taxes, one third (26–36%) comes from normal operating revenues in Zone 6, and a small amount (12% in 2002) comes from grants, interest, and flood disaster assistance programs. The District's fiscal year ends in June, and separate budgets are maintained for Zones 3 and 6. There are no water charges for Zone 3 water users, except for water sold to Sunnyslope CWD for use outside of Zone 3. Consequently, almost the entire operating budget is covered by property taxes. In Zone 6, most of the operating revenue derives from standby and availability charges and water usage charges for San Felipe users and groundwater users. The charges are adjusted annually in March, and the current charges are shown in Table 5. The charges vary depending on the type of user; with non-full-cost agricultural users representing the majority of use. The charges have remained fairly stable in recent years. The only changes in the standby and availability, groundwater, and San Felipe water charges from last year were slight decreases in the rates for San Felipe full-cost and M&I users.

Table 5. Zone 6 Water Charges for March 2002 - February 2003

Charge	Unit	Agricultural		Municipal & Industrial
		Non--Full Cost (1)	Full Cost (1)	
Standby and Availability	dollars/acre	\$6.00	\$6.00	\$6.00
Groundwater	dollars/acre-foot	\$1.50	\$1.50	\$25.00
San Felipe Project (Blue Valve)				
Water charge	dollars/acre-foot	\$75.00	\$245.00	\$150.00
Power charge				
Subsystem 6H	dollars/acre-foot	\$40.00	\$40.00	\$40.00
Subsystem 9H	dollars/acre-foot	\$50.00	\$50.00	\$50.00
Subsystem 9L	dollars/acre-foot	\$30.00	\$30.00	\$30.00
All other subsystems	dollars/acre-foot	\$15.00	\$15.00	\$15.00

Notes:

- 1 Full-cost rates for agricultural users apply to lands in excess of the 960-acre ownership limitation established by Reclamation for non--full-cost users and to corporations that exceed a certain threshold of foreign ownership. One or two users in Zone 6 are full-cost users.

For the first time, the District modified its rate structure for San Felipe water to explicitly itemize the energy costs associated with delivering the water from the Delta to the customer. Because of differences in elevation among the distribution subsystems, more energy is required to deliver water to some customers than others. Energy costs for CVP and local pumping plants are expected to increase in future years, as is the amount of water delivered to some of the higher-elevation subsystems. The District decided that the most equitable way to address the differences in actual cost of delivery was to itemize energy costs separately through a power charge. The new power charge has four price tiers ranging from \$15 to \$50 per af.

Most of the District's expenses are for purchases of San Felipe water and infrequent large capital expenditures. Planning activities, engineering studies, salaries, and other administrative expenses comprise the bulk of the remaining expenses. Overall, revenues have exceeded expenses in each of the past 7 years, allowing the District to maintain a reserves fund to cover major infrastructure improvement or replacement costs when the need arises.

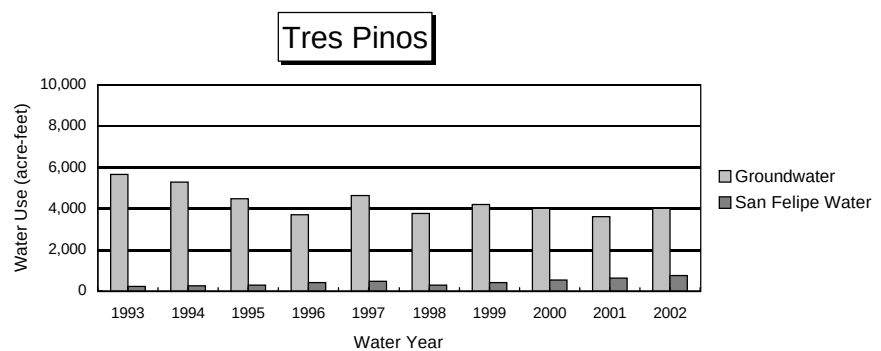
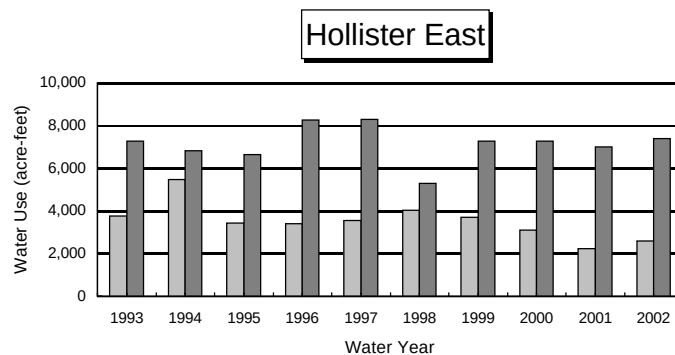
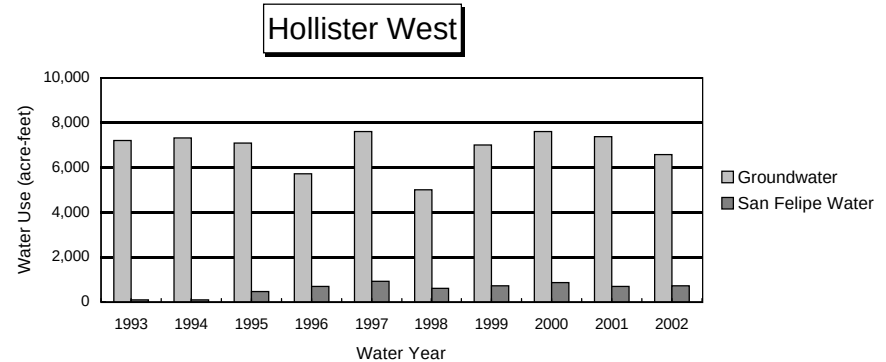
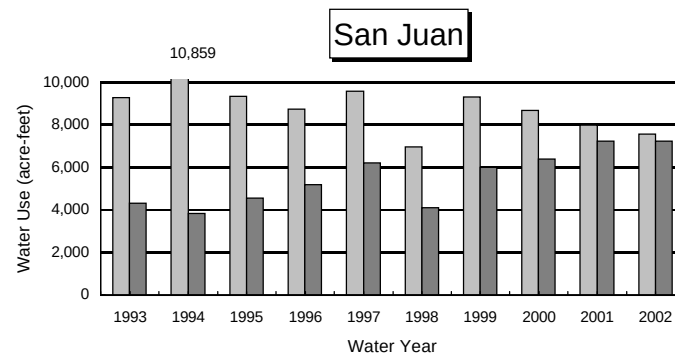
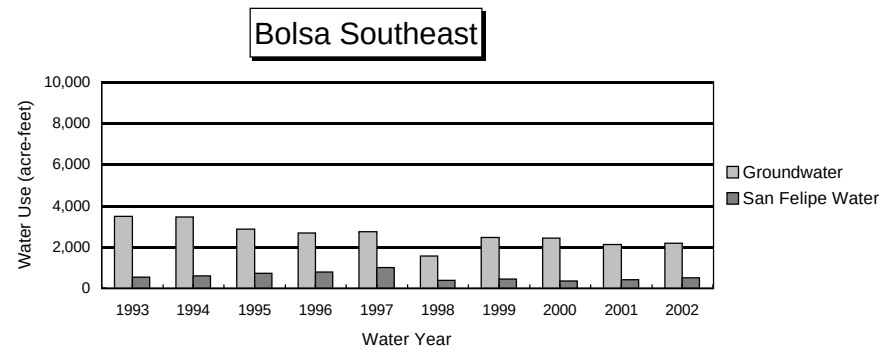
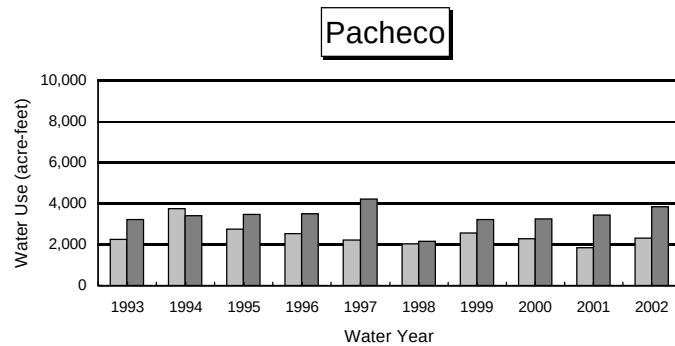
A detailed itemization of revenues and expenses is presented in Appendix E, along with a breakdown of Reclamation's charges for San Felipe water and the calculations used to establish groundwater charges.

WATER USE PATTERNS AND TRENDS

The source and type of water use in each subbasin during 2002 were compared with water use in prior years to identify any trends in water use patterns. Trends can reflect changes in land use, improvements in water use efficiency, or changes in the relative proportions of San Felipe water and groundwater used for various purposes. Such trends would result in long-term changes in groundwater budgets and water levels. Additional information on water use patterns and trends is included in Appendix F.

Sources of Water

The amounts of San Felipe water and groundwater used in each subbasin during 1993–2002 for all purposes except stream percolation are shown in Figure 3. The relative amounts of San Felipe water and groundwater differ substantially among the subbasins. Groundwater supplies the great majority of use in the Bolsa Southeast, Hollister West, and Tres Pinos subbasins, while San Felipe water supplies most use in the Pacheco and Hollister East subbasins. The total amount of water used and the proportions of San Felipe and groundwater used in 2002 were very similar to 2001, but a few long-term trends can be detected. There is a clear trend toward decreasing groundwater use and increasing San Felipe use in the San Juan subbasin. There was a corresponding increase in groundwater levels during 1993–1998, but levels have remained stable since then. The lack of continued increase in groundwater levels could have resulted from relatively low natural recharge or from increased groundwater discharge into drains, San Juan Creek, and the San Benito River when water levels reached the invert elevations of those waterways.



Note: For 1993-1996, water years are March-February. For 1997-2002, water years are October-September.

Figure 3. Historical Annual Use of San Felipe Water and Groundwater by Subbasin during Water Years 1993-2002

There has been a trend toward decreased percentage use of groundwater in the Hollister East subbasin, which has undoubtedly supported the steady rise of groundwater levels in that subbasin. A similar but smaller shift in the Pacheco subbasin has not resulted in rising groundwater levels, because further increases are limited by local creekbed elevations. If present trends continue, water levels in the central part of the Hollister East subbasin will reach the elevation of Santa Ana Creek in a few years and then level off, similar to the patterns observed in the Pacheco and San Juan subbasins.

Changes in the relative use of groundwater and San Felipe water in the other subbasins are small. For Zone 6 overall, San Felipe use has increased fairly steadily from about 30% in 1988 to a new record of 45% in 2002.

Types of Use

Annual water use in Zone 6 for agricultural and nonagricultural uses during water years 1988–2002 is shown in Figure 4. The data include use of San Felipe water and groundwater. Agricultural water use has fluctuated by plus or minus 30%, reflecting primarily variations in annual rainfall and to a lesser extent reference evapotranspiration (ET), irrigated acreage, and availability of San Felipe water. The unusually low water use in 1998 resulted from an exceptionally large number of rainy days in spring of that year. In spite of this variability, there has been a barely statistically significant declining trend in agricultural use, both during the past 4 years of near-average rainfall and for the period of record overall.

The source of agricultural water has also been steadily shifting from groundwater to San Felipe water. Only 44% of agricultural water was obtained from wells during water year 2002, which is the lowest percentage since San Felipe imports began in 1988. This percentage has steadily decreased from 60–70% in the early 1990s.

Annual variations in M&I water use are relatively small, making the long-term increasing trend much more apparent. The rate of increase has slowed somewhat during the past 4 years, but the average rate of increase since 1988 (446 af/yr) remains statistically significant.

GROUNDWATER LEVELS AND TRENDS

Groundwater levels were generally quite similar to water levels during the previous 2 years, partly because rainfall and recharge rates approximately equaled their long-term averages for the third year in a row and partly because there were no large changes in water use. Water-level data used to evaluate patterns and trends in groundwater levels are described in Appendix G and include measurements from the District's quarterly monitoring program in Zone 6 and the Bolsa area, supplemented by data from the Paicines, Tres Pinos Creek Valley, and Gilroy areas. Data for the Gilroy area were supplied by Santa Clara Valley Water District (Merritt pers. comm.).

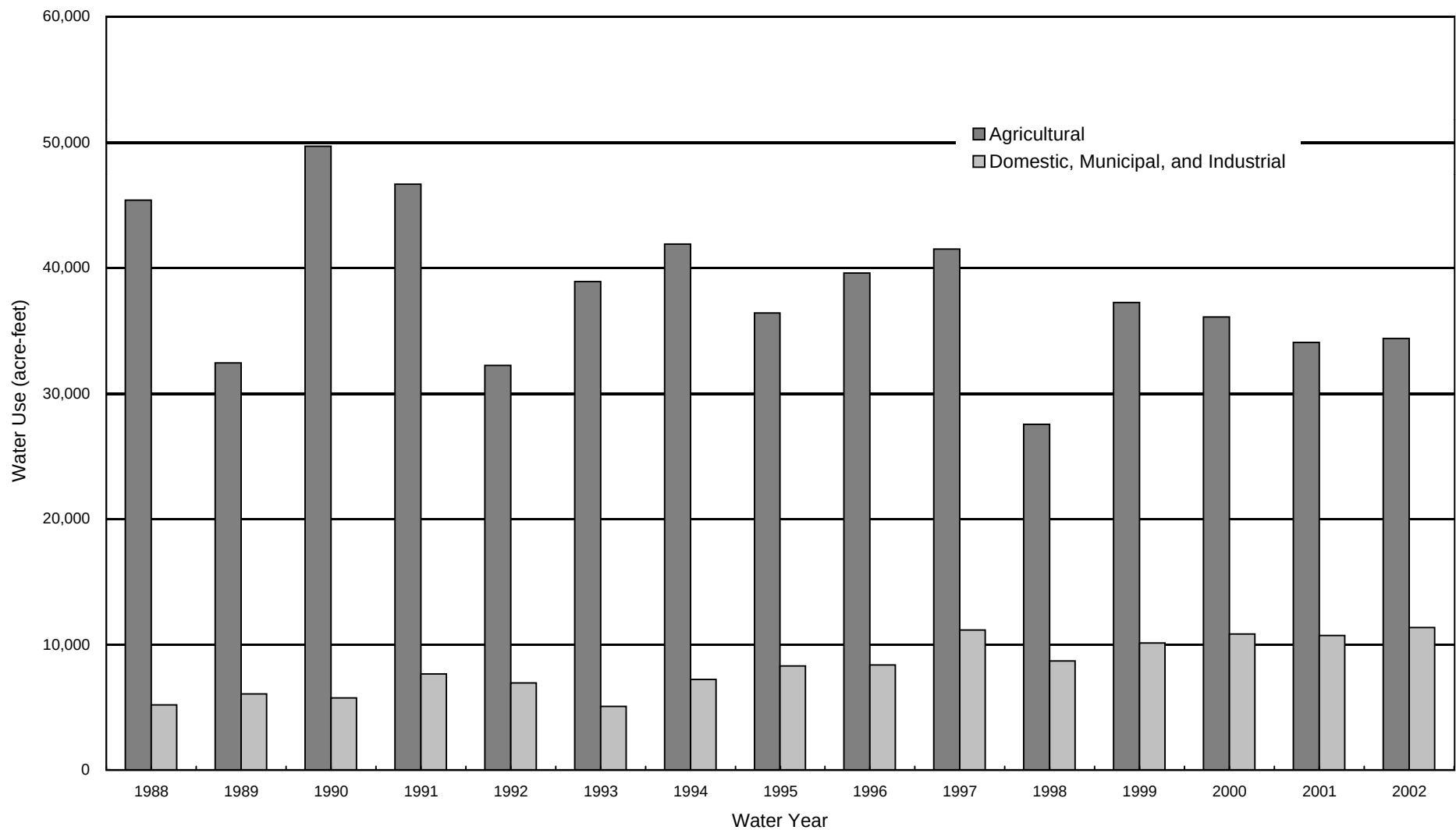


Figure 4. Annual Water Use for Agricultural as well as Domestic, Municipal, and Industrial Purposes in Zone 6 during Water Years 1988-2002

Figure 5. Contours of Groundwater Elevation, October 2002

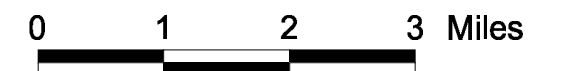
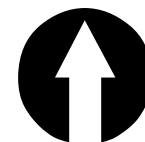
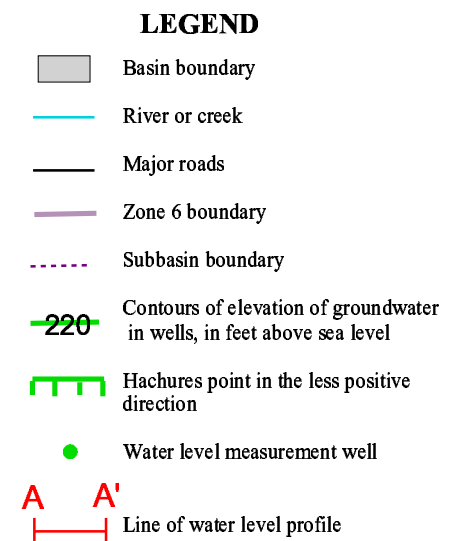
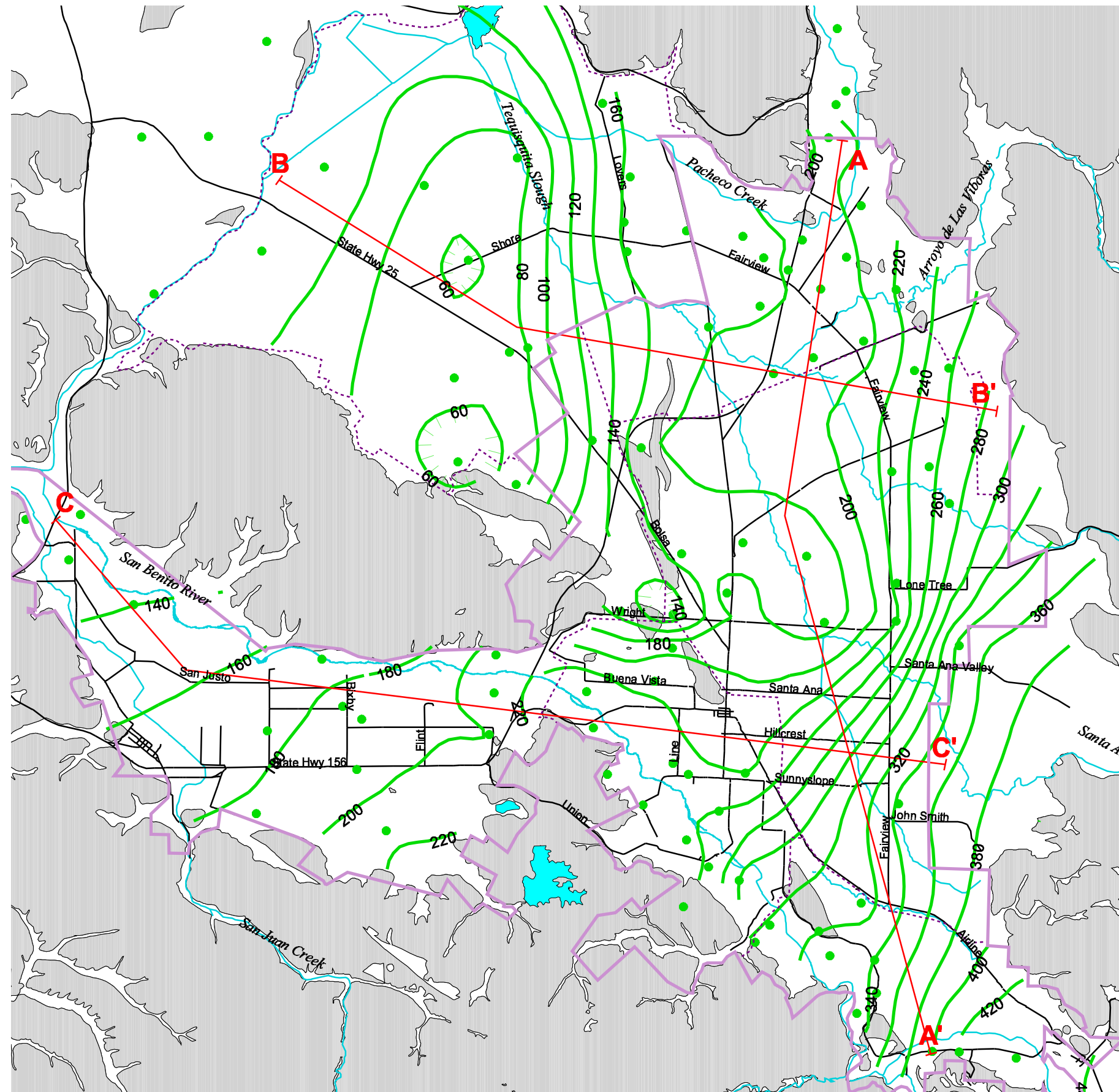
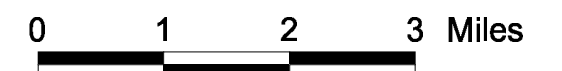
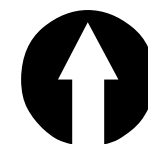
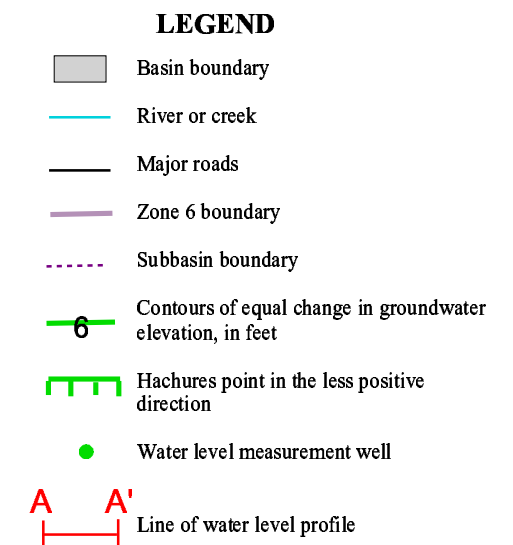
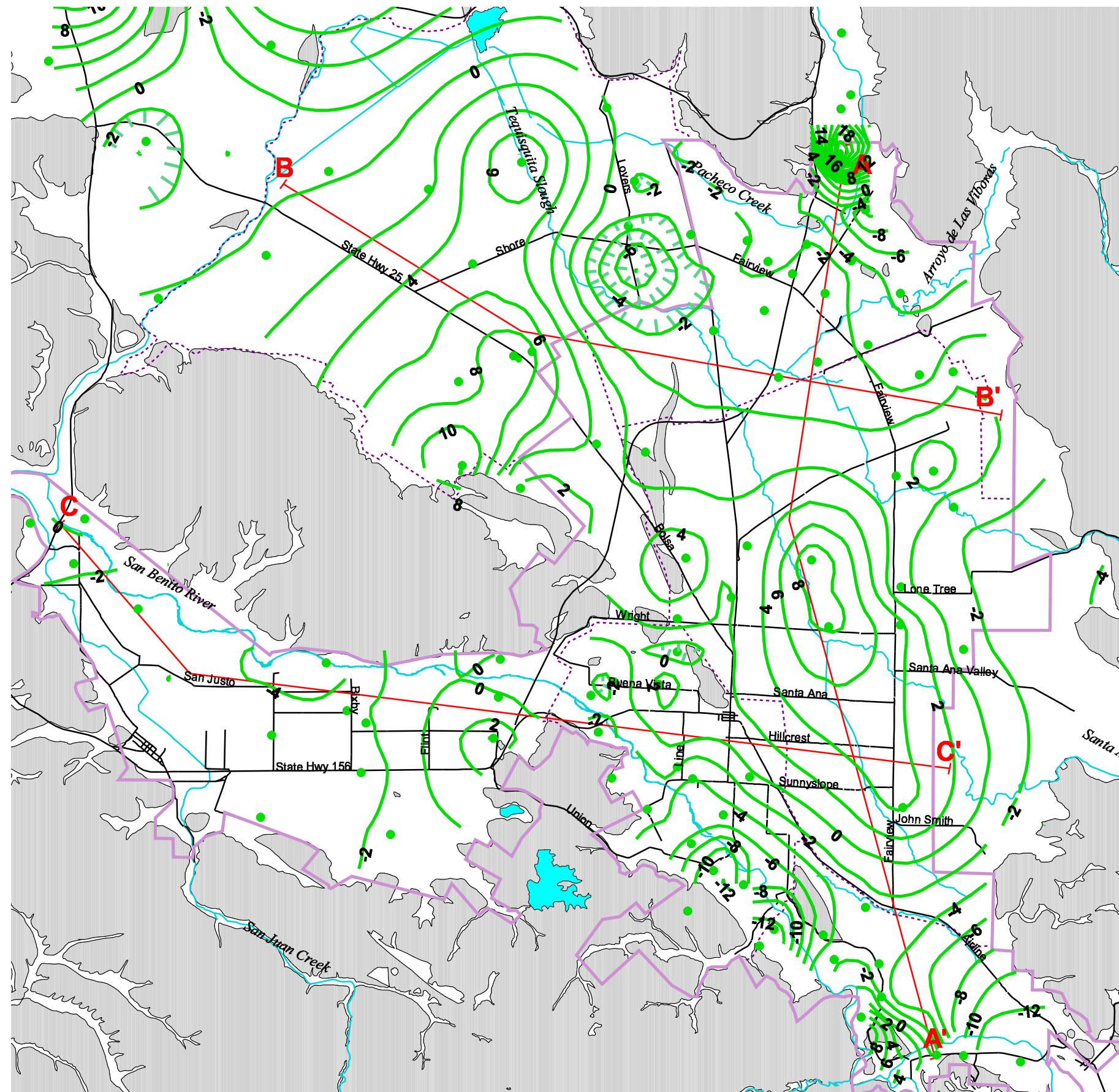


Figure 6. Contours of Change in Groundwater Elevation, October 2001 to October 2002



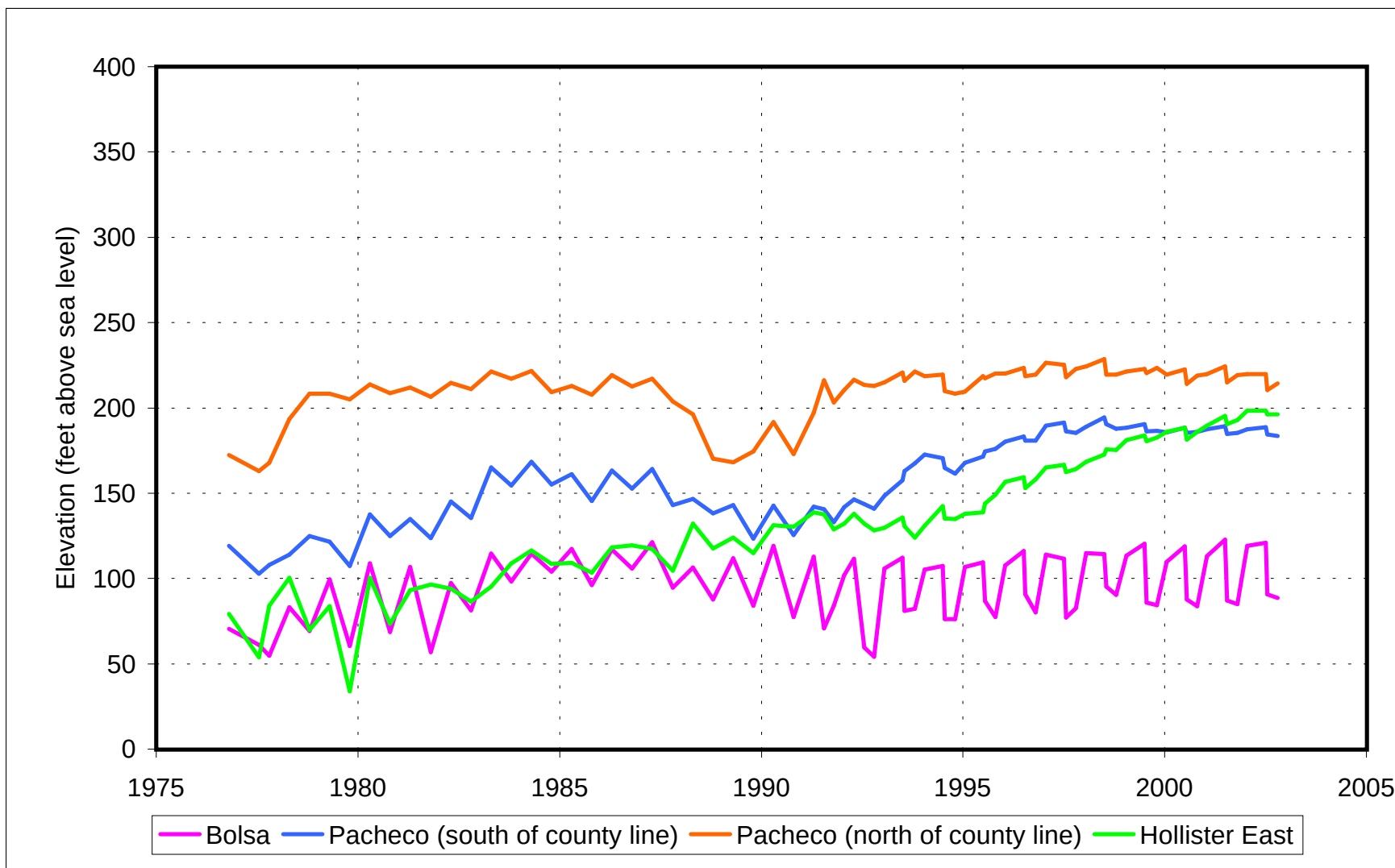


Figure 7. Hydrographs of Average Groundwater Elevation in Each Subbasin during Water Years 1977-2002

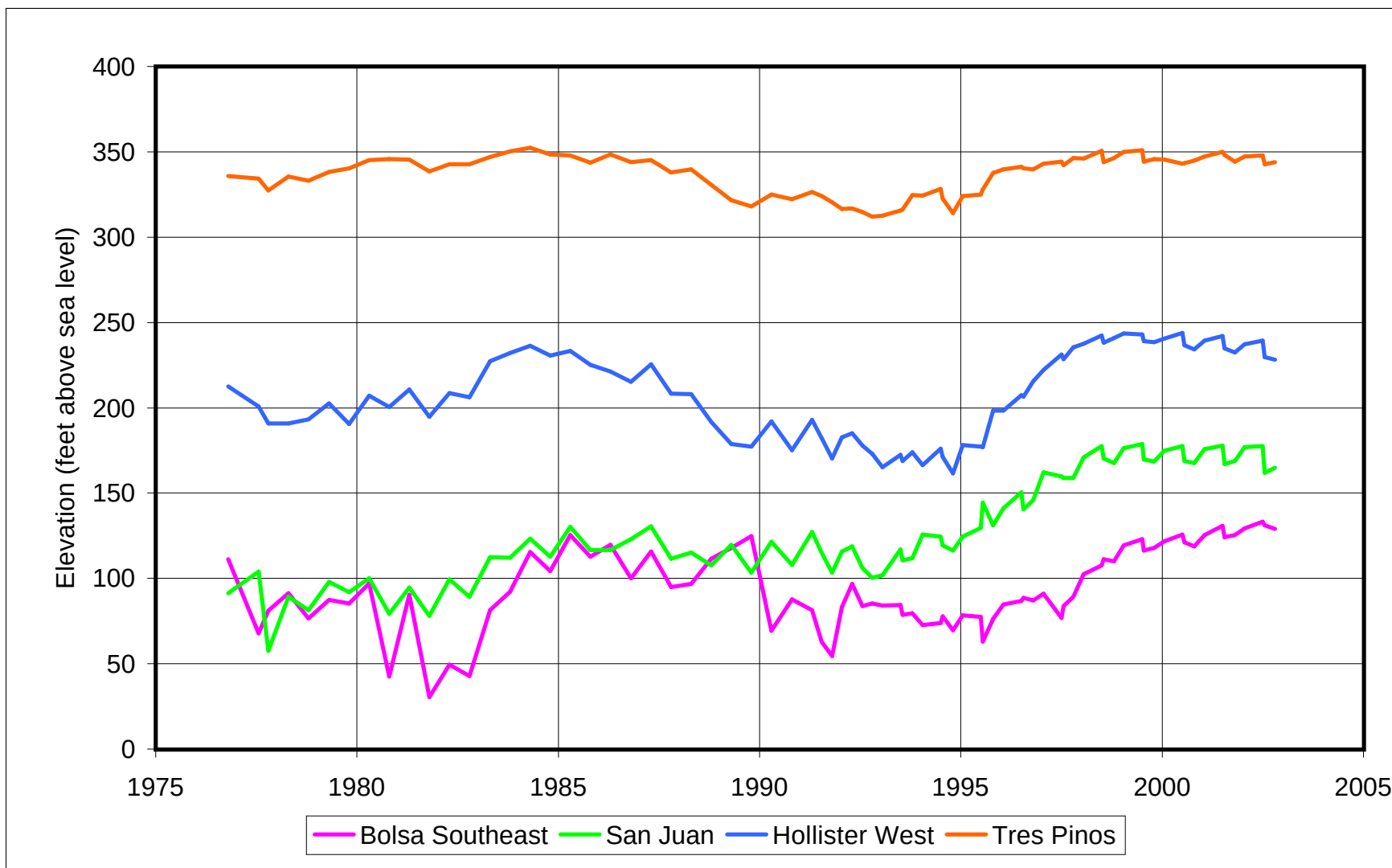


Figure 7. Continued

Contours of groundwater elevation in the basin in October 2002 are shown in Figure 5. The general pattern of the contours has remained essentially unchanged over the past decade; areas of relatively low water levels in October 1993 were also areas of relatively low water levels in October 2002. The principal water-level depressions are located in the south-central part of the Bolsa subbasin (near Hudner), the western part of the Hollister East subbasin (along Santa Ana Creek between McCloskey and Fallon Roads), and the Bolsa Southeast subbasin (near Wright Road and the Union Pacific railroad tracks). However, water levels have risen throughout the basin, especially in these low areas. Water levels at the center of the Bolsa depression rose 40 feet between 1993 and 2002, and water levels in the Hollister East and Bolsa Southeast depressions rose 95 and 75 feet, respectively.

Net changes in water levels during water year 2002 were generally small, as shown in Figure 6. Water levels in the low areas rose by 4–8 feet, continuing the trend described above. Water levels in the northern part of the Pacheco Creek subbasin and in the Tres Pinos subbasin experienced slight net declines in water levels, probably because of below-average streamflow and artificial percolation amounts. Water levels in other parts of the basin increased or decreased by less than 4 feet. The apparently large and uneven water-level changes in the Gilroy area result from large seasonal fluctuations in water levels, a relatively high percentage of missing data values (several of the wells measured in October 2002 were not measured in October 2001 and vice versa), and possibly large local water level gradients.

Hydrographs of average water level elevations in each subbasin during 1976–2002 are shown in Figure 7. The hydrographs cover the entire period during which water levels have been systematically monitored. Consistent with the contour plots, the hydrographs indicate that average water levels were nearly the same in October 2002 as in October 2001. The most noticeable trends are the continuing gradual rising trends in the Bolsa Southeast and Hollister East subbasins. Groundwater levels in the Hollister West and San Juan subbasins have declined very slightly during the past 3 years, most noticeably in summer, again because of low-moderate runoff and limited percolation of San Felipe water. The magnitude of seasonal water level fluctuations were also similar to those in previous years. Average fluctuations are typically 5–15 feet except in the Bolsa subbasin, where confined groundwater conditions result in seasonal fluctuations of 30–40 feet.

Contour maps of water levels in October 2001 and March 2002 are included in Appendix G, along with water-level profile plots along section lines A-A', B-B', and C-C'. These all further substantiate the pattern of little net change during water year 2002.

GROUNDWATER BUDGETS

Groundwater budgets provide a consistent basis for comparing the importance of various factors—such as rainfall recharge, stream percolation, and artificial percolation—on the water balance. Groundwater budgets were developed for each of the subbasins in Zone 6, the Bolsa subbasin, and the Paicines and Tres Pinos Creek Valley basins. Imbalances in the water budgets and changes in the budgets from year to year form the basis for estimating groundwater overdraft, identifying needs and opportunities for water management actions, and evaluating the effectiveness of past management actions.

Table 6. Estimated Subbasin Groundwater Budgets for Water Year 2002 (acre-feet)

	Pacheco	Bolsa Southeast	San Juan	Hollister West	Hollister East	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines	Tres Pinos Creek Valley	Grand Total
Inflows											
Stream percolation (1)											
Natural streamflow	655	0	256	921	1,061	1,287	4,180	1,000	1,455	1,115	7,751
San Felipe releases	2	0	0	470	81	569	1,122	0	0	0	1,122
Hernandez/Paicines releases	0	0	231	1,181	0	1,196	2,608	0	1,866	0	4,474
Deep percolation through soils											
Rainfall (2)	1,348	536	3,132	1,479	2,366	842	9,702	1,696	551	0	11,949
Irrigation (3)	596	268	1,335	221	890	128	3,436	1,224	541	174	5,375
Reclaimed water percolation	0	0	2,402	1,243	0	307	3,952	0	0	0	3,952
Groundwater inflow	1,000	2,000	500	2,000	1,000	1,000	7,500	7,000	0	0	14,500
Total	3,600	2,804	7,855	7,516	5,397	5,328	32,500	10,919	4,413	1,290	49,123
Outflows											
Wells											
Agricultural	2,149	2,179	6,641	1,564	1,574	1,150	15,256	12,235	5,413	1,743	34,647
Domestic and municipal and industrial (4)	173	14	930	5,013	1,014	2,844	9,988	0	0	47	10,035
Groundwater outflow	2,000	500	2,000	2,000	1,000	2,000	9,500	0	500	500	10,500
Total	4,322	2,693	9,571	8,577	3,588	5,994	34,744	12,235	5,913	2,290	55,182
Storage change											
Inflows - outflows	(722)	110	(1,715)	(1,061)	1,810	(665)	(2,243)	(1,316)	(1,500)	(1,000)	(6,059)
Water level change	(301)	566	(1,158)	(938)	802	(1,541)	(2,571)	379	n.m.	n.m.	(2,192)

Notes:

Entries are accurate to one or two significant digits. However, all digits are shown to avoid rounding small amounts to zero and to preserve correct column totals.

- 1 Natural stream recharge in the Pacheco subbasin and the Paicines and Tres Pinos Creek Valley basins is limited to the amount of available storage capacity, which is calculated as (well pumping + groundwater outflow) - (deep percolation through soils) +/- net annual storage change.
- 2 Deep percolation of rainfall is calculated using a soil moisture budget model with the same crop-soil zones used in the calibrated groundwater model developed by Yates and Zhang (2001). Rainfall percolation equals total simulated percolation minus percolation of irrigation water.
- 3 Deep percolation of irrigation water is assumed to equal 10% of applied irrigation water.
- 4 Use of domestic and municipal and industrial groundwater in the Bolsa and Paicines subbasins was not estimated; it was actually greater than zero but much less than agricultural use. Municipal groundwater use in the Tres Pinos Creek Valley basin was estimated from data for water year 2000.

The total water budget for Zone 6 is much more accurate than the water budgets for the individual subbasins within it, because of uncertainty in allocating stream recharge among the subbasins and in estimating groundwater flow between subbasins. However, differences among subbasin water level trends described in the previous section help substantiate the breakdown of the overall water budget into budgets for individual subbasins.

The annual water budgets for Zone 6 and each subbasin for water year 2002 are shown in Table 6. The assumptions and procedures used to derive the estimates of each budget item are described in detail in Appendix H, and the results are summarized here. Most budget items are accurate to approximately two significant digits, except the estimates of groundwater flow between subbasins, which are probably not accurate to more than one significant digit. All entries in Table 6 are shown to the nearest acre-foot to avoid rounding small numbers to zero, to preserve correct column totals, and to maintain as much accuracy as possible in subsequent calculations.

The general approach used to develop the water budgets was to independently tabulate or estimate each of the inflow and outflow items, and then calculate the change in storage as the difference between total inflows and total outflows. A second estimate of storage change was obtained by multiplying the water level change by subbasin area and aquifer storativity (an empirical measure of the amount of water stored or released per foot of water-level change). Discrepancies between the two estimates were used to detect errors in the data, adjust assumptions in the calculations, and quantify the effects of climate conditions and water use patterns during the year.

Groundwater recharge from percolation of natural streamflow was below average during water year 2002 because of below-average runoff. The amount of percolation has been difficult to estimate in recent years because high groundwater levels have caused some of the potential recharge to be rejected. This phenomenon appeared to still be present during 2002, although to a lesser extent. Streamflow was sufficient to refill the Paicines and Tres Pinos Creek Valley basins, and average water levels in the Tres Pinos, Hollister West, and San Juan subbasins also recovered to nearly the same levels as the prior winter. The lower reach of Pacheco Creek (below Highway 156) gained flow from groundwater discharge throughout the year, leaving only the upstream reach available for potential percolation recharge. A flow-partitioning analysis was used to divide gaged daily flows in the San Benito River into natural flow and flow derived from Hernandez Reservoir releases. Percolation quantities were allocated to those sources in the same proportion (see Appendix H). To roughly match the two estimates of storage change, it was necessary to assume that approximately one-third of the potential percolation recharge in those subbasins was rejected, the same percentage as last year. Recharge from stream percolation is included in the Bolsa subbasin budget for the first time this year. In recent years, the estimated water budgets for this subbasin have consistently been too negative, and the error was particularly noticeable this year. Measurements of San Felipe Lake outflow into Millers Canal during 2002 revealed a perennial baseflow ranging from 1.4–10 cubic feet per second (cfs). The Calaveras Fault forces groundwater into Pacheco Creek and Tequisquita Slough as a means of exiting the Pacheco subbasin. Groundwater levels are much lower across the fault in the Bolsa subbasin, and some of this flow probably percolates back into the ground. The estimated percolation amount of 1,000 af represents an average percolation rate of 1.4 cfs.

Recharge from deep percolation of rainfall and applied irrigation water was calculated using a daily soil moisture budget model that was revised and recalibrated in 2001 during the development of a basinwide groundwater model (Yates and Zhang 2001). Deep percolation of irrigation water is presumed to equal 10% of the applied water, reflecting an assumed 90% irrigation efficiency. The remaining simulated deep percolation derived from rainfall, and the amount was similar to the amounts during 1999–2001 which also were years of average rainfall.

The wastewater percolation amounts equal the amounts shown in Table 4. This year, 25% of the percolation from the Hollister DWTP ponds was assumed to accrue to the Hollister West subbasin, consistent with slightly lower water levels in that subbasin, a long no-flow season in the river, and imbalances in the initial water budget estimates.

Groundwater withdrawals are the metered amounts shown in Table 1. Wells are not metered in the Bolsa subbasin, and the estimation method was revised this year to reflect cropping patterns mapped by DWR in 1997 (the most recent data available). This unexpectedly increased the estimate of groundwater pumping and worsened the imbalance in the initial water budget for that subbasin. This was partially corrected by adjustments to the estimates of stream percolation and groundwater inflow.

Groundwater flow between subbasins is not expected to change substantially from year to year. Because water levels during water year 2002 were so similar to those during 2001, none of the flow values were changed except the estimated amount of inflow from the Gilroy area. The inclusion of water level data from that area in developing water level contour maps (Figure 5, for example) demonstrates that groundwater in southern Santa Clara County mostly flows under the Pajaro River into San Benito County rather than discharge into the river. It was deemed reasonable to increase the estimate of this inflow by 2,000 af.

The calculation of storage changes from water-level changes was also revised this year to incorporate storativity values derived from calibration of the groundwater model developed in 2001. The methodology remained otherwise the same. Net storage changes during water year 2002 were quite small in all subbasins, consistent with the small changes in average water levels. Modest decreases occurred in the subbasins along the San Benito River (Tres Pinos, Hollister West, and San Juan), and the decreases appeared to stem more from relatively low river percolation recharge than from changes in other budget items. Storage increased or decreased by 300–800 af in the other subbasins. The overall storage change for Zone 6 was a decrease of 2,571 af, and the estimate based on the difference between inflows and outflows was within a few hundred acre-feet of this amount.

None of the subbasins is in a state of overdraft. Groundwater levels have recovered over the past 15 years to the point that high water levels cause some potential stream recharge to be rejected, and groundwater now discharges into the lower ends of several creeks in the basin. The relatively small storage changes associated with near-normal climatic conditions during 1999–2002 are also good evidence that the basin is not in a long-term state of overdraft. The original purpose of constructing the San Felipe project in the mid-1980s was to halt and reverse decades of groundwater overdraft, and the early years of project operation were directed toward that objective, with great success. In recent years it has become clear that

project operation needs to balance multiple issues and objectives and be adjusted flexibly from year to year to reflect changing basin conditions. Current issues, for example, include soil drainage problems associated with high groundwater levels, rejection of potential stream recharge, and minimizing long-term salt build-up in the basin.

GROUNDWATER QUALITY

The description of groundwater quality during water year 2002 is divided into three topics. The first two topics, Status of Groundwater Contamination Sites and General Water Quality Patterns and Trends summarize data that are routinely collected by local and state agencies. The third topic, Groundwater Salt Budget, involves considerable theoretical development and data from other sources. The details of that analysis are documented in a separate report, and only a summary of the results is presented here.

Status of Groundwater Contamination Sites

No new groundwater contamination sites were discovered in San Benito County during water year 2002. Existing groundwater contamination sites that have been undergoing investigation and remediation for several years include five leaking, underground gasoline tanks in Hollister; the Quantic Industries (formerly Whittaker) facility on San Juan Road near Union Road; and the county landfill on John Smith Road. Cleanup of the sites is overseen by the California Regional Water Quality Control Board, and progress during 2002 included monitoring, testing of new remediation methods, continuation of existing treatment methods, and regulatory review. Cleanup is progressing slowly in some cases. For example, the highest MTBE concentration ever recorded at one site was for a sample collected in 2002, even though a pump-and-treat system has been in operation since 1996. MTBE concentrations at two sites are still about 150 times greater than the maximum contaminant level for drinking water (5 parts per billion). Fortunately, no municipal water supply wells have been affected by MTBE. Detailed information for each of the contamination sites is presented in Appendix I.

General Water Quality Patterns and Trends

Groundwater quality in northern San Benito County has been studied several times over the past 80 years (Clarke 1924, Eaton et al. 1941, Kilburn 1972, Jones & Stokes Associates, Inc., and CH2M-Hill 1998), but information is sparse because water quality is routinely measured only at public water supply wells. The studies involving a larger number of wells have included only a few constituents, such as specific conductance, nitrate, and boron. Although limited in scope, these studies revealed clear differences in water quality among the subbasins, at least with respect to salinity. A survey of specific conductance by the District in 1997 showed that the Pacheco and Tres Pinos subbasins had the lowest median values of electrical conductivity (601 and 707 microsiemens per centimeter (µS/cm), respectively). These subbasins also receive the most amount of recharge from streams, as a percentage of total subbasin recharge. The San Juan, Hollister East, and Hollister West subbasins were considerably saltier, with median values of 1,108–1,239 µS/cm. The Bolsa Southeast subbasin had the highest median value (1,679 µS/cm), possibly as a result of low groundwater levels in that area and internal recirculation of salts that are concentrated by

evaporation when groundwater is applied for irrigation. The number of wells sampled in the Bolsa subbasin was too small to draw any conclusions for that subbasin.

Concentrations of nitrate were more variable within each subbasin, and there did not appear to be significant differences among the subbasins. The lowest median value was 4.4 milligrams per liter (mg/l) of nitrate (as NO₃) in the San Juan subbasin, and the highest median value was 9.7 mg/l in the Bolsa Southeast subbasin. None of the 70 samples (from 66 wells) exceeded the maximum contaminant level (MCL) for drinking water of 45 mg/l. However, 10 public water supply wells—which are monitored more frequently—had nitrate concentrations exceeding the MCL at least once during 1994–1999 (Berg pers. comm.).

California state drinking water standards have established MCLs for 84 organic and inorganic constituents. Constituents in groundwater other than nitrate that have occasionally exceeded primary drinking water standards in public supply wells include antimony, thallium, gross alpha radiation, and total trihalomethanes. Primary drinking water standards are designed to protect public health. The antimony, thallium, and all but one of the radiation exceedances were at on-site wells serving the former Whittaker ordnance manufacturing facility and could be the result of industrial contamination. Arsenic and hexavalent chromium have received particular attention recently because of recent or proposed changes in their MCLs. The MCL for arsenic was decreased from 50 to 10 micrograms per liter (µg/l, or part per billion) in 2001. Arsenic is usually measured every three years in municipal supply wells, and recent samples have all been less than or equal to 5 µg/l. Thus, it does not appear that compliance with the new standard is generally a problem in northern San Benito County. Hexavalent chromium was historically thought to comprise only a small percentage of total chromium in most natural waters, until recent statewide monitoring proved otherwise. Total chromium concentrations in municipal supply wells in recent years have all been in the 0–23 µg/l range, or less than half of the MCL (50 µg/l). However, more detailed sampling at the City of Hollister wells revealed that hexavalent chromium concentrations were in the 8–17 µg/l range. At the one well with a paired measurement, hexavalent chromium made up 59% of the total chromium. A specific MCL for hexavalent chromium is under consideration by state and federal regulatory agencies.

Constituents that have occasionally exceeded secondary drinking water standards—which deal with aesthetic quality of the water—include specific conductance, total dissolved solids, chloride, iron, manganese, and turbidity. Exceedances occurred at 25 public supply wells during 1994–1999, and in some cases multiple constituents exceeded their respective standards in the same sample. Almost all groundwater in the basin has a very high hardness. Hardness is not regulated under drinking water standards but impairs the efficacy of soap and causes it to form scum.

Few data are available for evaluating water-quality trends because the District has not historically had a water quality monitoring program. The only wells that are routinely monitored are municipal water supply wells, and many constituents are sampled only once every three years.

To meet the obvious need for periodic, systematic water quality measurements, the District obtained a grant from the state AB303 program to implement a groundwater quality monitoring program. Those activities will commence in 2003 and will provide a clearer picture of general water quality patterns and trends for future annual reports.

Groundwater Salt Budget

Almost all agricultural, domestic, and M&I uses of water tend to increase water salinity, as measured by specific conductance or the total concentration of dissolved solids in the water. In the case of agriculture, soluble fertilizers are added to the soil and evapotranspiration removes pure water, leaving the salts behind to be dissolved into the remaining moisture in the soil. Urban uses add soluble compounds from food preparation, cleaning agents, excreta, and industrial processes, as well as irrigation of golf courses, cemeteries, playing fields and residential landscaping. As groundwater is used and reused in the basin, there is risk that its salinity will increase. This tendency may be offset by groundwater outflow, which exports salts from the basins. After functioning for decades as a closed system, water levels in recent years have risen high enough to reinitiate groundwater outflow to the San Benito River and several creeks in the eastern part of the basin.

The District first began investigating the salt balance of the groundwater basin in 2001 and continued to improve the analysis in 2002. The estimated salt budget for the groundwater basin in northern San Benito County during water year 2002 is shown in Table 7. The budget includes the Paicines and Tres Pinos Creek Valley basins and is a lumped budget for the soil and groundwater parts of the system. The three columns in the table show the flow of water associated with each salt load, the average concentration, and the salt load, which equals the flow times the concentration (converted to units of tons). The concentrations shown for municipal wastewater, septic systems, agricultural soil amendments and fertilizers, urban fertilizers and chemicals, and atmospheric deposition are the incremental concentrations associated with the salt load. The total salt concentration for those flows equals the original salinity of the source water plus the incremental concentration. Thus, for the same applications of gypsum or fertilizer, the total salt concentration of water infiltrating into the soil would be higher for a field irrigated with groundwater than for a field irrigated with San Felipe water. For the remaining budget items (San Felipe water, stream percolation, and groundwater inflow), the concentration shown is the total concentration for the flow.

Each of the estimated budget items is highly uncertain because of inadequate data, and the table should be used only to indicate the general magnitude of the budget items and their relative importance.

The most obvious features of the salt budget are that many of the inputs contribute significantly to the overall salt load and that total inputs are approximately six times greater than total outputs. To put the net salt loading in context, it can be expressed in terms of an annual increase in average groundwater salinity throughout the basin. If the salt load is assumed to mix uniformly throughout the upper 400 feet of the groundwater basin, groundwater salinity would increase by an average of 2.2 mg/l.per year.

The gradual increase in groundwater salinity that results from agricultural and municipal land uses in the basin is not an immediate crisis but can become a significant long-term problem. A considerable amount of the salt load is from natural sources and would be difficult if not impossible to alter. Although a significant amount of salt enters the basin in San Felipe water, its concentration is low. Thus, the effect of San Felipe water on basin salinity is beneficial relative to using an equivalent amount of local water. Salt inputs to municipal wastewater can be managed to some extent, particularly the inputs from water softeners and

Table 7. Salt Input and Removal for the San Benito County Part of the Gilroy-Hollister Groundwater Basin and Paicines and Tres Pinos Creek Valley Groundwater Basins

	Annual Flow (acre-feet)	Incremental Salt Concentration (mg/l)	Annual Salt Load (tons)
SALT INPUT			
Municipal wastewater			
Hollister DWTP	2,100	463	1,322
Hollister IWTP	1,636	594	1,321
Ridgemark	300	1,143	466
San Juan Bautista	224	272	83
Tres Pinos	28	400	15
Subtotal			<u>3,207</u>
Rural domestic septic systems	168	600	137
San Felipe water used for all purposes	22,883	280	8,711
Agricultural soil amendments (gypsum)	120,386	121	19,749
Agricultural fertilizers (N-P-K)			
Applied amount	120,386	94	15,370
Losses to volatilization			243
Harvested in crop			10,446
Net input	17,324	199	<u>4,680</u>
Urban fertilizers and chemicals	11,056	67	1,008
Percolation from creeks and rivers			
San Benito River + lower Tres Pinos Creek	8,193	806	8,983
Pacheco Creek			0
Other east side creeks	2,528	881	3,029
San Juan Creek			0
Subtotal			<u>12,012</u>
Atmospheric deposition	66,641	2	183
Groundwater inflow			
Paicines + Tres Pinos Creek valleys	1,000	596	810
Pacheco Creek valley	1,000	596	810
Santa Clara County (Gilroy area)	5,000	596	4,051
Subtotal			<u>5,672</u>
Total inputs			<u><u>35,290</u></u>
SALT REMOVAL			
Local rainfall runoff	3,347	380	1,728
Groundwater discharge to creeks and rivers			
San Juan Creek	1,304	1,894	3,357
San Benito River	724	1,750	1,723
San Felipe Lake outflow to Pajaro River	1,000	668	908
Subtotal			<u>5,988</u>
Total removal			<u><u>7,715</u></u>

possibly the inputs from industrial users. Agricultural inputs could potentially be managed more precisely, or the economic gain in yield could be balanced against the present and future costs—both economic and environmental—of increased groundwater salinity. Salt can be removed from water, but the process is energy-intensive and therefore expensive, and it can be difficult or expensive to dispose of the concentrated brine that results from the desalination process.

Distribution of Salt Inputs

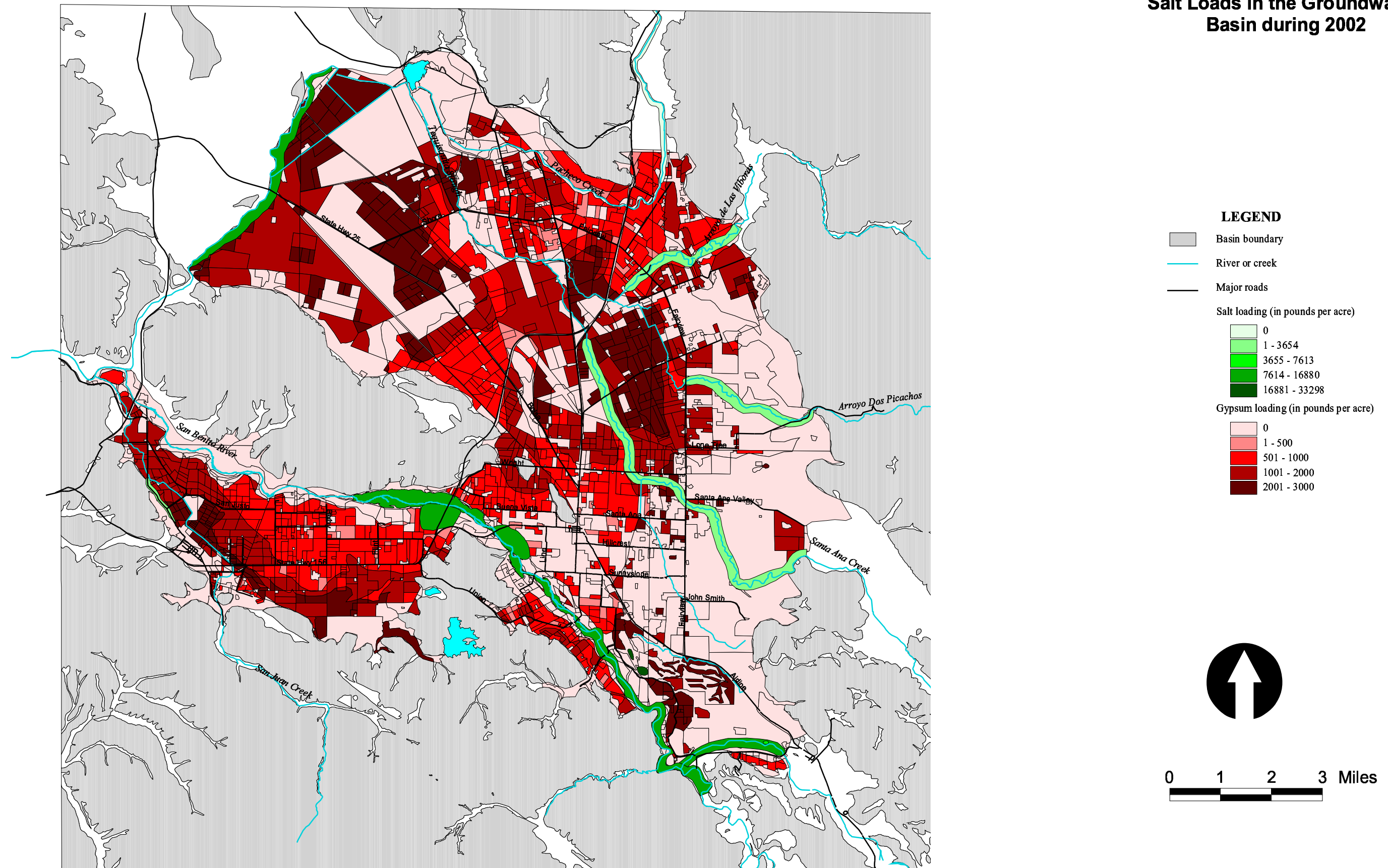
The salt inputs listed in Table 7 are not all distributed uniformly throughout the basin, which raises the possibility that impacts to groundwater quality could be more serious near locations with heavy salt loading. Inputs from atmospheric deposition, rural septic systems, and San Felipe water are widely dispersed. Applications of fertilizers and soil amendments are also broadly dispersed throughout the basin, but selected crops and soil types receive higher applications than others. This is illustrated in Figure 8, which shows the geographic distribution of several large or locally concentrated salt inputs, in pounds per acre per year (lb/ac/yr). Gypsum application rates are a function of soil type and crop type, with heavier clay soils and vegetable crops typically receiving higher application rates than lighter soils or other crops. The heaviest applications (approximately 3,000 lb/ac/yr) occur in the central part of the Bolsa subbasin, the area between San Felipe Road and Fairview Road north of McCloskey Road, and the southern fringe of the San Juan Valley. Gypsum is applied in dry form, and its impact on groundwater quality depends on the percentage of the applied amount that is flushed through the soil profile by amount of rainwater and irrigation water. If all of the applied gypsum (or equivalent salts released by cation exchange) is assumed to become concentrated into the amount of water that percolates below the soil zone, the salinity of the deep percolation would increase by an average of 841 mg/l basinwide or 2,125 mg/l for a truck crop on clay soil.

The distribution of salt loading from fertilizer applications is related principally to crop type. As with gypsum, the variability in application rates occurs throughout the basin on a field-by-field basis. The effects of fertilizers on the salinity of deep percolation are more difficult to estimate, however, because of the additional processes of chemical transformation, volatilization, and uptake by crops. An average salinity increase for deep percolation throughout the basin can be estimated by dividing the total estimated salt load from fertilizers (4,680 tons, from Table 7) by the total deep percolation (17,324 af). The resulting estimate is that fertilizers increase the salinity of the deep percolation by 200 mg/l.

The only data available to characterize the net effect of gypsum and fertilizer applications on groundwater quality are the periodic measurements of salinity at a half-dozen agricultural drains in the San Juan Valley collected during 2001 and 2002. Drains intercept soil water that would otherwise become deep percolation. The salinity of the drain water was usually between 2,000 and 2,700 mg/l, whereas the median salinity of groundwater at 19 wells in that area measured in 1997 was approximately 755 mg/l. The elevated salinity of the drain water results not only from gypsum and fertilizer applications but also in large part from evaporative concentration of irrigation water. The combined effect of these agricultural factors is to create a significant salt load, but one that is widely distributed throughout the basin.

Salt loading from stream percolation, wastewater percolation and groundwater inflow is relatively localized, and the distribution of these loads is shown in Figure 8. The area of groundwater affected during one year

Figure 8. Distribution of Selected Salt Loads in the Groundwater Basin during 2002



was estimated from groundwater gradients and transmissivity to extend about 400 feet downgradient of the footprint of the percolation area. This is not a large distance in the context of the entire basin, but the load continues to spread downgradient in subsequent years (e.g., 4,000 feet in 10 years). Only the area affected during the current year is shown in the figure, consistent with the annualized salt budget calculations. The most striking aspect of the salt loading from the localized sources is that they are generally an order of magnitude larger than the loading from the dispersed sources in terms of pounds per acre. However, the amount of water accompanying the localized sources is also much larger on a per-acre basis, so that the concentrations are smaller than the concentrations in deep percolation beneath field soils. In the case of streams, the concentration of the percolation equals the concentration in the stream (a time-averaged concentration of about 596 mg/l during water year 2002). The incremental concentration of percolated municipal wastewater ranged from 272–1,143 mg/l during water year 2002.

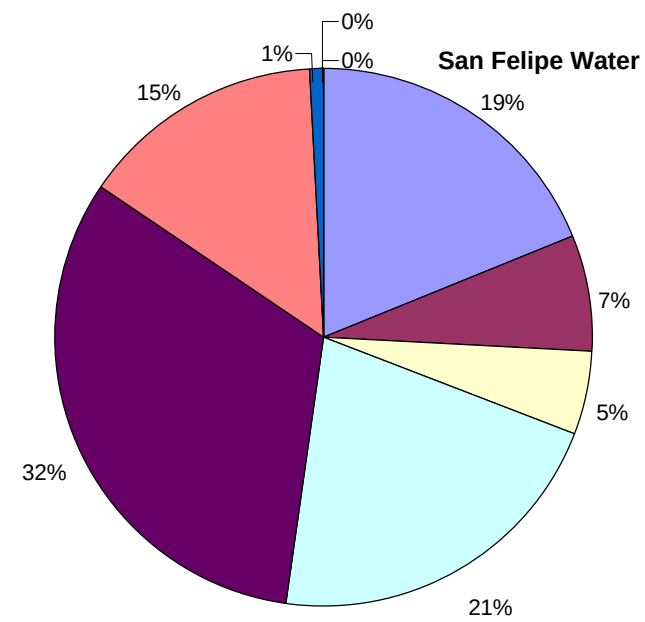
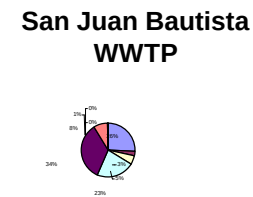
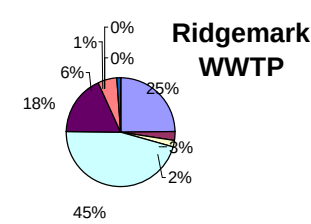
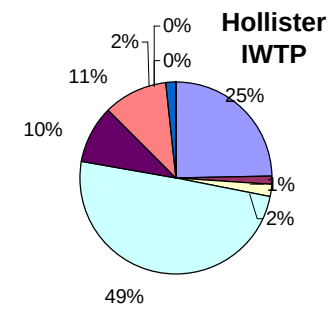
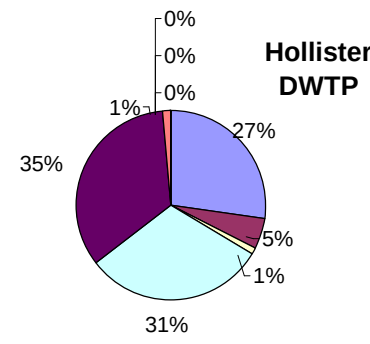
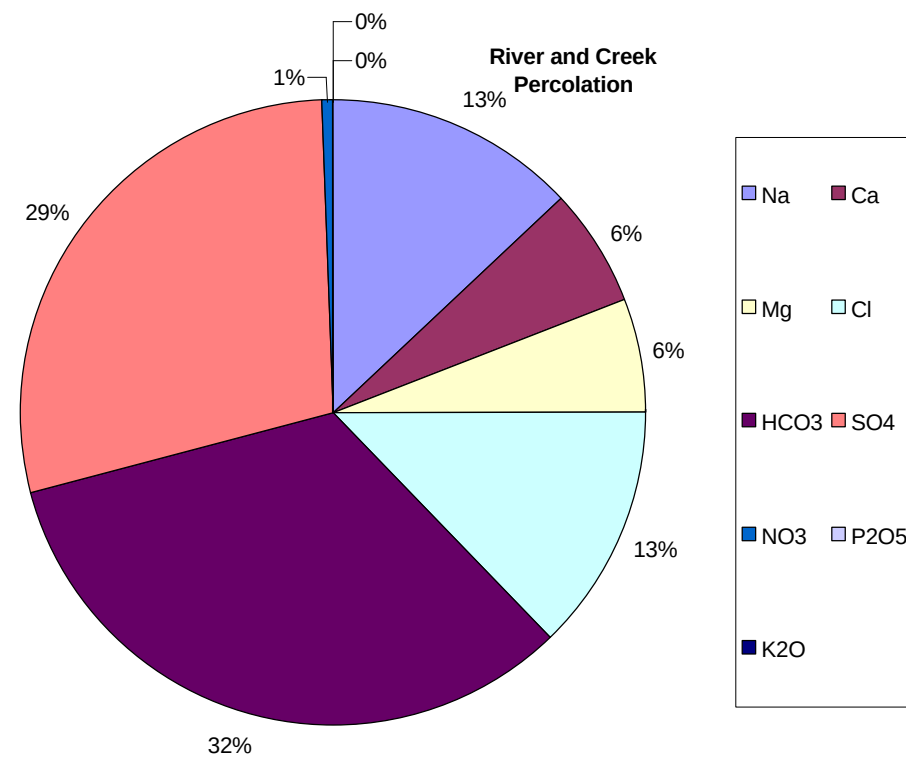
Chemical Composition of Salt Inputs

The chemical composition of salt inputs affects their potential impacts on beneficial uses. The major ions in the salt loads are sodium (Na), potassium (K or K₂O), calcium (Ca), magnesium (Mg), bicarbonate (HCO₃), sulfate (SO₄), chloride (Cl), phosphate (P₂O₅), and nitrate (NO₃). The first seven of these are classified as "major ions" in the study of natural waters and are included in standard general mineral analyses. Unfortunately, general mineral samples are not routinely collected for all of the salt inputs, and some values had to be estimated indirectly.

Figure 9 shows pie diagrams of the estimated major-ion composition of all of the significant sources of salt input to the groundwater basin. The area of each pie is proportional to the salt load in tons, and the pie wedges indicate the percentage of each ion on a weight basis.

In terms of relative proportions of constituent ions, the salt loads can be grouped into four categories. The compositions of river and creek percolation, San Felipe water and groundwater inflow are all fairly similar, although San Felipe water has slightly higher percentages of bicarbonate and chloride, and a lower percentage of sulfate relative to the local waters. The wastewater flows also have similar compositions, although there is considerable variation in percent chloride. This presumably reflects differences among the municipal supply waters and variations in the amount of water softener use in the respective service areas. The ionic composition of fertilizers inputs is unique because they are formulated to contain specific ions that are absent or negligible in natural waters. The principal soil amendment is gypsum (CaSO₄). In this case, the constituent ions are also found in the water and wastewater samples, but in smaller percentages.

The proportions of ions in deep percolation beneath field soils can be quite different from the proportions of the salts applied to the soil surface because of chemical transformations, cation exchange, precipitation, uptake by crops and other chemical processes that occur within the soil zone. Additional analyses of drain water and shallow groundwater are needed to document the net effect of these processes in northern San Benito County.



1%

Groundwater Inflow

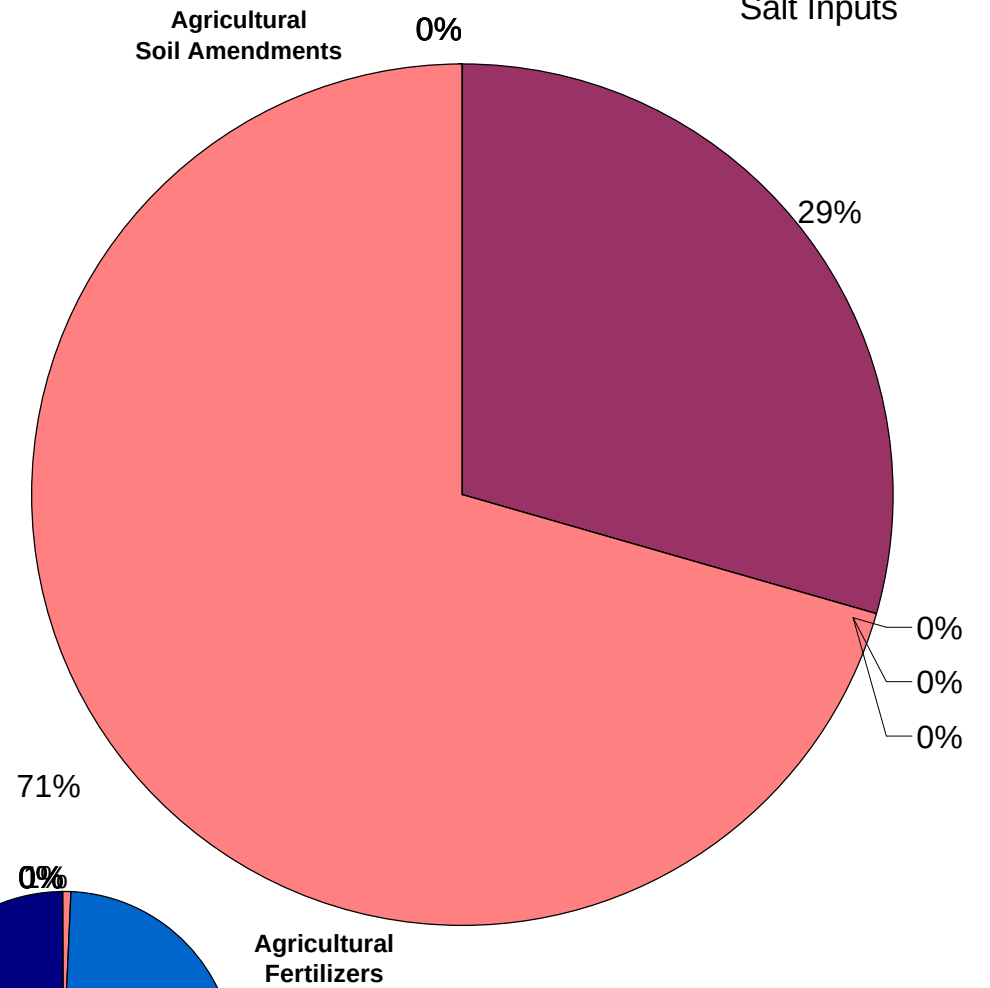
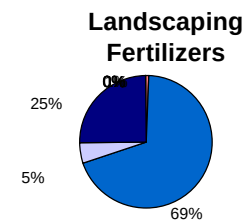
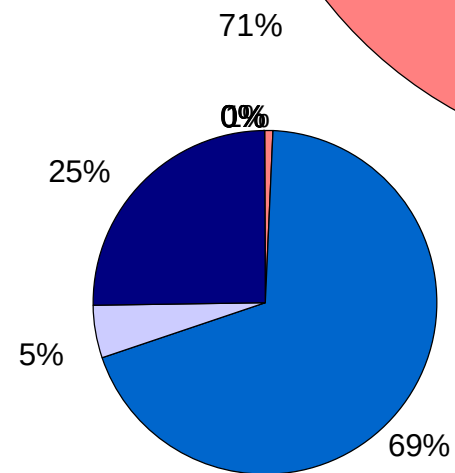


Figure 9.
Chemical
Composition of
Salt Inputs

SOIL DRAINAGE

When the water table approaches or reaches the land surface, it creates saturated soil conditions that can impair crop growth, weaken the foundations of structures, and cause nuisance seeps and boggy areas. In the case of orchards, even water tables within about 8 feet of the land surface can adversely affect some tree types. Water levels in most parts of Zone 6 rose rapidly during the mid-1990s and have approached or reached the level of the ground surface or creekbeds in some areas. Flowing artesian wells have been present in winter since 1999 near Prescott Road in the western San Juan Valley and near Lovers Lane in the western part of the Pacheco subbasin, both of which are locations where flowing wells were present under predevelopment conditions in 1913 (Clarke 1924).

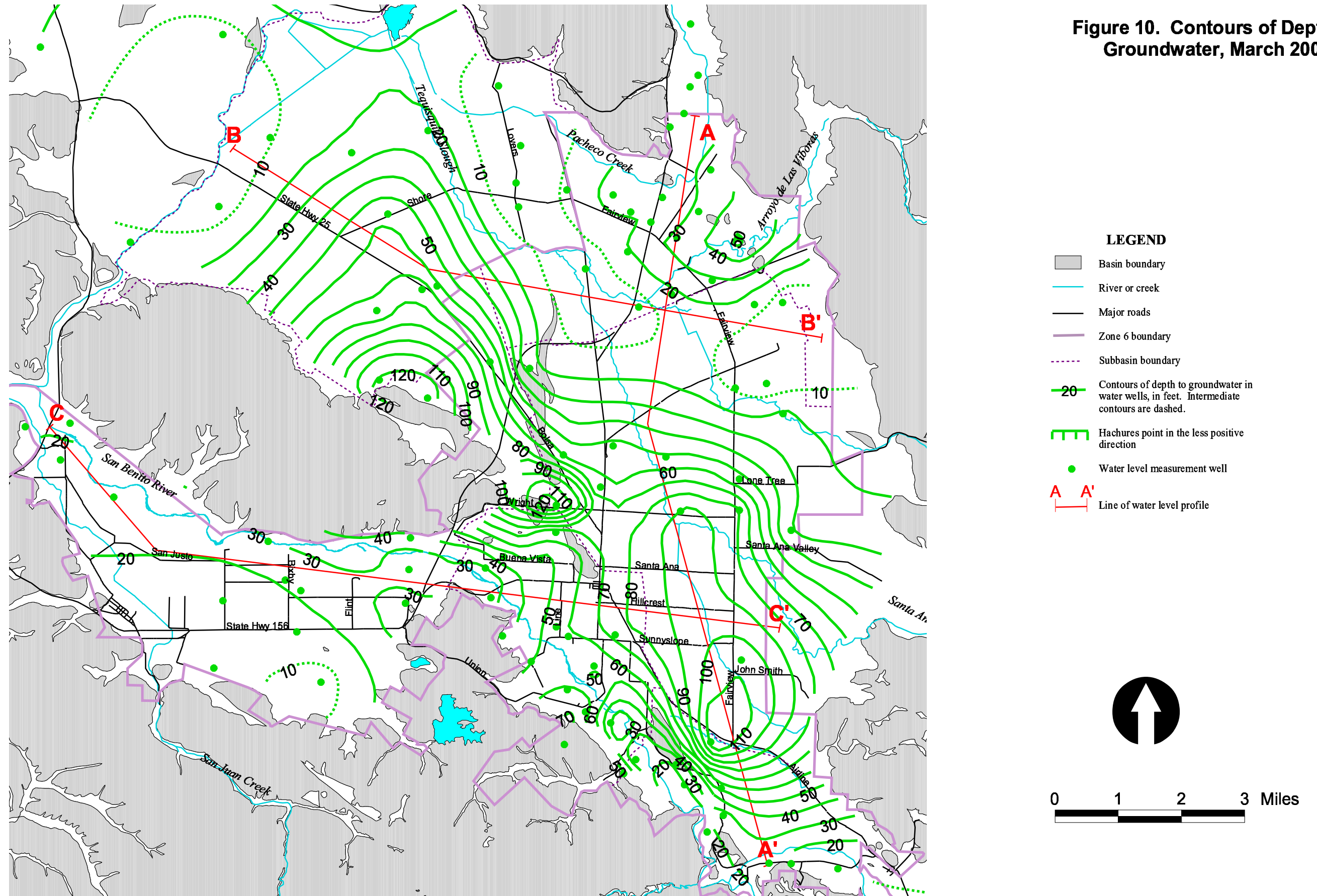
Contours of the depth of water in wells monitored by the District in March 2002 are shown in green on Figure 10. The general pattern is the same as in previous years. The areas where groundwater is relatively shallow are the southern and western part of the San Juan Valley, a broad arc extending from San Felipe Lake southeast to Spring Grove Road, and the area along the Pajaro River. The contours based on water levels in the wells routinely monitored by the District underestimate the extent and severity of the shallow groundwater problem. This is partly because data are sparse in some of the problem areas, especially the western half of the San Juan Valley. None of the flowing wells in that area are included in the monitoring network. Also, all of the wells in the network are water wells of considerable depth that do not reflect conditions in aquifers near the land surface. Because most recharge occurs at the top of the groundwater basin while water wells extract water at depth, there commonly is a downward water level gradient within the basin. Data from shallow monitoring wells confirm that water levels in shallow aquifers are higher than those in deeper aquifers.

Groundwater levels in most parts of the basin rose rapidly during the mid-1990s. In the Pacheco and San Juan subbasins, water levels reached the streambed elevation of nearby creeks or the San Benito River and ceased rising. Further additions of groundwater recharge simply caused groundwater to discharge to the surface waterways rather than increase storage and raise water levels. This has also been the usual condition in the Tres Pinos subbasin, where water levels have dipped significantly below their normal level only during sequences of dry years. In that subbasin, however, the maximum groundwater elevations are sufficiently far below the surrounding ground surface to avoid soil drainage problems.

GROUNDWATER STORAGE ACCOUNTING

Reliable methods of calculating the net groundwater recharge benefits of releasing stored water from Hernandez Reservoir and importing San Felipe water are desirable to help manage those two water supplies and to facilitate water exchanges and transfers. Methods were developed and described in detail in the annual groundwater report for water year 2000, and the same methods were used here.

Figure 10. Contours of Depth to Groundwater, March 2002



Hernandez Reservoir Operations and Zone 3 Benefit

Groundwater storage benefits resulting from Hernandez Reservoir releases do not simply equal the amount of water released from the reservoir because the releases commingle with natural runoff and base flow along the 66 miles of river channel between the reservoir and the downstream end of the groundwater basin where the river joins the Pajaro River. Under low- to moderate-flow conditions, the groundwater recharge benefit attributable to the project equals total recharge minus recharge that would have occurred without the reservoir. Under high-flow conditions when natural runoff creates continuous outflow to the Pajaro River, releases provide no recharge benefit because the natural flow already exceeds the percolation capacity of the river channel. Furthermore, some of the released water is lost to seepage and evapotranspiration between the reservoir and the Paicines basin, and the lost water does not contribute any benefit to Zone 3 water users.

A daily flow accounting procedure was developed to calculate the additional San Benito River percolation that occurs from Hernandez Reservoir releases. The procedure partitions flow below Willow Creek School into a component derived from Hernandez releases and a component derived from natural runoff. Net flow losses between the Willow Creek School and old Highway 156 stream gages are similarly allocated to Hernandez and natural sources. Percolation below old Highway 156 is limited to a maximum rate based on historical measurements is similarly apportioned.

The accounting procedure was applied to daily flows during water years 1995–2002, resulting in the estimates of annual Zone 3 recharge attributable to Hernandez operations shown in Table 8. The estimated amount of Hernandez recharge during water year 2002 was 5,000 af, which was about average for the 7 years simulated. The decrease from recent years can be attributed to the smaller amount of water released from the reservoir. The per-acre benefit during water year 2002, if recharge in that year were divided evenly throughout the 27,000 acres in Zone 3, was 0.17 af per acre.

San Felipe Project Operations and Zone 6 Benefit

Each acre-foot of San Felipe water used—whether for percolation in streams, direct agricultural use, or direct municipal use—theoretically increases groundwater storage by 1 af compared to supplying the same uses by groundwater. The actual benefit is decreased by evaporation losses from San Justo Reservoir and from streams used for percolation. The resulting estimate of groundwater storage benefit from San Felipe imports in 2002 is 21,915 af, and estimates for each of the last 7 years are shown in Table 8. A rough estimate of the amount of San Felipe imports needed to balance the groundwater budget can be obtained by subtracting the net change in groundwater storage from the San Felipe groundwater recharge benefit in each year. This estimate is shown for each year in the right-hand column in Table 8. As expected, the amount of San Felipe water needed to balance the groundwater budget in relatively wet years, such as 1996–1998, is much smaller than in the subsequent drier years. In fact, conditions were wet enough in 1998 that no imports would have been needed at all to balance the budget. Hydrologic conditions in each of the

last 4 years (1999–2002) were close to average, and the average estimate of annual San Felipe import needed to balance the water budget during that period was 20,700 af.

This estimate probably overstates the amount of San Felipe imports needed to balance the water budget because of the complicating effects of rejected recharge. Groundwater levels were relatively high during 1999–2002, and some stream percolation that could have replenished the groundwater basin was rejected for lack of storage space. Had water levels been lower, natural recharge would have been greater, and the amount of San Felipe water needed to balance the water budget would have been smaller. The amount of rejected recharge appears to have been on the order of 2,000 af/yr in recent years. The same complication applies to groundwater outflow through seepage into the lower reaches of the San Benito River, Pacheco Creek, and Tequisquita Slough. If groundwater levels were lower, this outflow would cease, and less San Felipe water would be needed to maintain stable groundwater levels. The amount of groundwater outflow in recent years has been on the order of 3,000 af/yr. Unlike rejected recharge, groundwater outflow provides a clear benefit to groundwater users by exporting salt from the basin. Thus, importing sufficient San Felipe water to maintain a certain amount of groundwater outflow is a reasonable water management practice. Adjusting for the effects of rejected recharge and allowing for some amount of groundwater outflow, the amount of San Felipe import needed to maintain healthy groundwater conditions on a long-term average-annual basis is probably 17,000–20,000 af/yr.

Table 8. Groundwater Recharge Benefits in Zones 3 and 6

Water Year	Hernandez Reservoir Recharge Benefit In Zone 3 (acre-feet)	San Felipe Recharge Benefit in Zone 6		
		Net Change in Groundwater Storage (acre-feet)	San Felipe Groundwater Recharge Benefit (acre-feet)	San Felipe Benefit Needed to Balance Groundwater Budget (acre-feet)
1995	+5,322	n.e.	n.e.	n.e.
1996	+11,956	+21,559	29,395	7,836
1997	+1,362	+26,989	33,252	6,263
1998	+1,830	+19,336	15,740	-3,596
1999	+4,462	+2,663	19,779	17,116
2000	+6,943	-734	20,845	21,579
2001	+8,600	+2,457	22,050	19,593
2002	+5,000	-2571	21,915	24,486

n.e. = not estimated

The long-term average amount of San Felipe water needed to balance the groundwater budget is meaningful only as a reference point for water management planning. To facilitate conjunctive use of surface and groundwater and to avoid potential adverse impacts associated with excessively high or low groundwater levels, it is desirable to adjust the amount of San Felipe imports to meet current conditions.

CONDITIONS EXPECTED FOR WATER YEAR 2003

The overall water balance outlook for water year 2003 depends on current local reservoir storage, expected San Felipe deliveries, and expected seasonal rainfall. Reclamation announces the allocation of water for CVP contractors in February but prepares 12-month forecasts of reservoir operations that are updated monthly. Present storage in Shasta, Trinity, and San Luis Reservoirs is close to average, in spite of below-average runoff in the Sacramento River basin last year. With average storage levels and neither exceptionally low or high precipitation expected during winter 2003, the average allocations of water for south-of-Delta contractors during the past 5 years is a reasonable estimate of allocations for the contract year beginning in March 2003. Those averages are 75% of the contract amount for agricultural users and 91% for M&I users, which correspond to 26,662 af and 7,507 af for those two user categories in the District, respectively. Both amounts exceed recent historical usage.

Rainfall in Hollister during October and November 2002 totaled 1.66 inches, which is 81% of the 128-year average. A moderate El Niño pattern is present in the equatorial Pacific Ocean, but this condition is not strongly associated with above- or below-average seasonal precipitation in central and northern California. Hernandez Reservoir was essentially empty (300 af of storage) at the end of November, this low level having been maintained to facilitate modification of the outlet works in November. San Justo Reservoir was 94% full, however. The combined storage of all three local Hernandez, Paicines, and San Justo Reservoirs was 10,987 af at the end of November. A reasonable estimate of surface water supplies available during water year 2003 can be obtained by adding the 75% exceedance probability estimate of agricultural CVP water (26,662 af), the minimum required purchase of M&I CVP water (6,300 af), and current reservoir storage (10,987 af), which yields a total of 43,949 af. Approximately 21,000 af of groundwater would need to be pumped to meet expected demand in Zones 3 and 6. This is approximately half the amount of groundwater pumped during water year 2002. Even under a more pessimistic scenario of 50% deliveries of San Felipe agricultural water, zero yield from Hernandez and Paicines Reservoirs and a 10% increase in water demand compared to 2002, the amount of groundwater pumping needed to meet demand (41,600 af) is slightly less than the amount pumped in 2002. Thus, even under adverse conditions, it appears that water needs within the District during 2003 can be met without excessive groundwater pumping.

RECOMMENDATIONS

This annual report is required under Section 70-7.6 of the State Water Code to include information and recommendations regarding overdraft, groundwater production, San Felipe imports, and water charges. These are described below, followed by a separate section containing a variety of other recommendations for studies, monitoring programs, and water management policies and projects. Some of the latter recommendations—or similar ones—were also made in previous years, and the present recommendation includes a brief status report on previous progress.

Required Recommendations

Overdraft and Groundwater Production

The net groundwater storage change in Zone 6 during water year 2002 was a fairly small decrease of 2,571 af. There was a negligible net increase in storage in the Bolsa subbasin. Annual changes in groundwater storage have been relatively small during the past 4 years of near-normal climatic conditions. Furthermore, groundwater levels have been high enough and water budgets positive enough to support groundwater discharge to creeks and rivers in the Pacheco and San Juan subbasins. Areas of low water levels in the Bolsa, Bolsa Southeast, and Hollister East subbasins caused by historical overdraft are gradually disappearing. These patterns indicate that recent annual San Felipe imports have equaled or exceeded the amount needed to achieve balanced water budgets during that period. This demonstrates that importation of San Felipe water is capable of eliminating historical overdraft and providing a means to recover from future drought periods.

Total groundwater production in zone 6 during water year 2002 was approximately 25,240 af. The recommended amount of groundwater production for 2003 is the amount that, in conjunction with San Felipe water, meets agricultural, municipal, industrial, and domestic water needs with efficient water management practices. Substantially higher groundwater production could be sustained for several consecutive years during droughts as part of a planned conjunctive use program.

San Felipe Imports and Hernandez Releases

During the past several years, the District has implemented policies and initiated projects designed to prevent excessively high or shallow groundwater levels. These policies and projects were in response to rapid increases in groundwater levels during the mid-1990s and the awareness of potential adverse impacts associated with shallow groundwater levels. These include potential additional costs for installation and operation of soil drainage systems; malfunctioning septic system leach fields; a risk of potential regulation of drain discharges by agencies responsible for water quality; a potential increase in flood risk or flood erosion along the San Benito River and some reaches of other streams as a result of increased vegetation growth associated with shallow groundwater; and a potentially greater risk of damage to structures during earthquakes due to soil liquefaction, which is more likely to occur with shallow groundwater levels. Policies and projects that have been implemented or initiated include:

- Limiting percolation of San Felipe water to the southern part of the Hollister East subbasin and areas upstream of Cienega Road in the Hollister West and Tres Pinos subbasins.
- Limiting percolation of Hernandez Reservoir water to areas upstream of Cienega Road.
- Restricting the transfer of San Felipe water among District customers if the transfer is into a subbasin with high groundwater levels (presently the Pacheco, Hollister West, and San Juan subbasins).
- Designing a District wellfield in the Hollister West subbasin that would pump local groundwater and blend it into the San Felipe supply, thereby partially offsetting the decrease in municipal pumping that is expected to occur after part of the municipal supply is converted to treated San Felipe water.

In conjunction with average to below-average runoff in the past few years, these measures have successfully stabilized groundwater levels in most parts of the basin. However, problems and the potential for problems associated with high groundwater levels continue to be present. For example, water use in the San Juan subbasin has continued to shift from groundwater to San Felipe water. Also, a new field drainage system was installed near San Justo and Prescott Roads, possibly reflecting an expansion of the area adversely impacted by shallow groundwater.

For water year 2003, it is recommended that these programs be continued. It is appropriate to continue providing San Felipe water requested by customers up to the base allocation and to apply restrictive measures only to additional amounts.

The District should limit percolation of San Felipe water to sites close to municipal wells. Percolation of San Felipe water is not necessary to prevent overdraft at the present time. In fact, most parts of the basin are experiencing the opposite problem: high or rising groundwater levels. However, it would be reasonable to continue percolation near municipal pumping centers because the San Felipe water might slightly improve local groundwater quality and because it provides an additional means of meeting the minimum purchase requirement for San Felipe M&I water. The Airline Highway and Tres Pinos Creek sites are examples of sites that are near municipal wells and not likely to develop problems with shallow groundwater conditions. Whether to continue using the percolation pond next to the San Benito River near Cienega Road depends on how the City of Hollister redistributes its groundwater pumping in response to the decreased groundwater demand caused by the new “Lessalt” water treatment plant. If pumping rates are maintained

at municipal wells in the Hollister West basin and decreased at wells in the Hollister East subbasin, it would be reasonable to continue percolation activities at Cienega Road. If the opposite is true, percolation should be curtailed to avoid excessively high groundwater levels in the Hollister West subbasin. The District should work with the City to coordinate the new pumping and percolation regimes.

To maximize the flexibility of percolation operations, the District should consider uncoupling the groundwater charge from the percolation activities. This issue is discussed below under "Groundwater Charges." Decreasing the amount of percolated San Felipe water might force the District to find an alternative means of paying for the minimum purchase requirement of San Felipe M&I water. The minimum purchase requirement is 4,200 af for the contract year ending in February 2003, and 4,300 af for the following year. Actual use during water year 2002 was only about 2,154 af (1,312 af used directly and approximately 840 af percolated). The District simply paid the revenue shortfall for the minimum purchase using other funds.

Groundwater Charges

When the San Felipe Project first began operating in the late 1980s, there was a great need to actively percolate San Felipe water in local creekbeds to reverse historical overdraft as rapidly as possible. Because the recharge directly benefited groundwater users, the District has routinely leveed a groundwater charge. The charge was ordinarily set to cover approximately half of the cost of San Felipe water used for percolation in streams, with the remaining cost paid using other revenues. More recently, percolation has been used as a means of increasing local use of San Felipe M&I water. The minimum amount of M&I water the District is required to purchase gradually increases every year or two according to a schedule set by Reclamation. Direct use of M&I water has developed more slowly than was originally expected, creating a shortfall between the actual use and the minimum purchase requirement. The District has partially compensated for the shortfall by increasing the percentage of percolated San Felipe water allocated to the M&I category. Unfortunately, this arrangement puts financial pressure on the District to continue percolating San Felipe water even if the percolation is likely to contribute to shallow groundwater problems. This situation is likely to continue even with the new "Lessalt" water treatment plant because the plant's capacity will fall short of the minimum purchase requirement. The full capacity of the plant is 3 MGD (3,360 af/yr), which together with the approximately 1,300 af/yr of other direct uses of San Felipe M&I water still falls short of the current minimum purchase requirement (6,300 af/yr).

Until actual M&I use of San Felipe water reaches the minimum purchase requirement, it is recommended that the District not rely on percolation as a means of making up the revenue deficit. The San Felipe Project has a sufficient track record at this point to demonstrate beyond any doubt that all groundwater users have benefited from the project in terms of increased supply and decreased pumping costs. It is therefore reasonable to continue the groundwater charge as one of the District's sources of revenue. However, any alternative method of formulating the charge should fairly reflect the fact that municipal water users are ultimately responsible for meeting the minimum purchase requirement for M&I water. Water Code Section 70-7.8 (the legislation that created the District, and subsequent amendments) specifies that the water charges "shall not exceed the costs reasonably borne by the District in the period of the charge in providing the water supply service" More of the benefit to the groundwater balance over the past 15 years has

derived from "in-lieu" recharge than from direct percolation of San Felipe water. In-lieu recharge is the decrease in groundwater pumping that occurs when a well owner switches to San Felipe water. Thus, the costs borne by the District in providing the improved groundwater supply are actually all of the costs associated with operating the San Felipe project, not just the costs associated with percolation of San Felipe water. This would appear to give the District considerable latitude in developing an alternative basis for formulating the groundwater charge.

For the agricultural sector, the challenge is the opposite of the challenge for the M&I sector: San Felipe use has been increasing, and there is a need to encourage increased use of groundwater in many parts of the basin. Provided that an overall revenue shortfall is not created, the District may wish to consider eliminating the agricultural groundwater charge entirely. The present charge of \$1.50 per acre-foot is already only one-fiftieth (1/50) of the San Felipe agricultural water rate, so the change might not significantly shift usage patterns. Nevertheless, it would create a small incentive to shift water usage in the right direction.

Other Recommendations

Previous Recommendations

Recommendation: Investigate Shallow Groundwater Conditions in the Tres Pinos and Hollister West Subbasins, and Use the Groundwater Model to Explore Conjunctive Use Possibilities

Progress. The issue has become more urgent now that the “Lessalt” water treatment plant is on line and associated decreases in municipal pumping are expected to raise water levels in the Hollister West subbasin even farther. In response to this situation, the District has designed a project to blend groundwater from the Hollister West subbasin into the San Felipe supply. The District has also developed a groundwater flow model capable of simulating some of the effects of these changes in pumping. New shallow monitoring wells have been installed in the Hollister West subbasin by the City of Hollister and the District, and data from these wells provide further insight into the three-dimensional patterns of groundwater flow in that subbasin.

Updated recommendation. The District should use the groundwater model (or a local model excerpted from it) to investigate the effects of imminent or potential actions that could affect water levels in the Hollister West subbasin (see the following, related recommendation).

Recommendation: Enhance and Apply the Groundwater Model

Progress. The District, in cooperation with San Benito County, developed a new regional groundwater flow and quality model in 2001 (Yates and Zhang 2001). A few improvements have been made since then to simplify the procedures for preparing model input and evaluating output. A user manual for the model—reflecting the streamlined procedures—is in progress.

Updated recommendation. Several enhancements of the model would be worthwhile to address specific issues and applications of near-term interest, including adding a module to calculate subbasin water budgets, adding one or more layers to improve simulation of three-dimensional gradients in the Holliser West subbasin, and possibly expanding the modeled area to include the Paicines and Tres Pinos Creek Valley subbasins.

Recommendation: Review and Improve Elements of Basic-Data Program

Progress. The District expanded its routine monitoring of flow, and salinity of creeks and agricultural drains to include nine locations on Pacheco Creek, Arroyo de las Viboras, Arroyo Dos Picachos, Santa Ana Creek, Tequisquita Slough, and Millers Canal, and increased the monitoring frequency to approximately bimonthly. Eleven shallow monitoring wells were installed between Hollister and San Juan Bautista to improve the detection of shallow groundwater conditions. Monitoring of groundwater levels in the Paicines and Tres Pinos Creek Valley basins has become routine during the past 2 years.

Updated recommendation. The monitoring of streamflow and water quality should continue, with periodic evaluation of monitoring results to determine whether changes in monitoring frequency are warranted. The entire groundwater monitoring program needs to be reviewed and updated to include more wells with geologic logs and to replace wells that have nonrepresentative water levels or that have been abandoned since the last comprehensive network review (Farrar 1981). The 11 new shallow wells constructed by the District need to be included in the program, and many of them were intentionally located close to deep wells with drillers' logs. Those wells should also be included. To address current water management issues, the reference point elevations for the wells must be accurately surveyed.

The water level database also needs to be updated to include new wells, reflect current subbasin designations, store additional information about the wells, and improve output format for data analysis.

Recommendation: Investigate Sources of Nitrate Contamination

Progress. A focused investigation of nitrate contamination has been deferred while the District completes a more comprehensive water quality survey and makes improvements to its water quality monitoring program.

Updated recommendation. Following completion of the current water quality project, the District should reevaluate the need for a nitrate contamination study.

Recommendation: Well Discharge Measurement Procedures

Progress. It was recommended that a program be implemented to ensure that San Felipe water and groundwater use is measured to within plus or minus 5%, which is the level of accuracy recommended by Reclamation. The District formulated a field verification method involving in-line flow meters on lengths of portable irrigation pipe that could be rotated among the 20 to 30 most heavily used wells. This program was not implemented in 2002, however.

Updated recommendation. The District hopes to test this verification method in the near future.

Recommendation: Simplify and Reformat Annual Groundwater Report so Content is More Understandable for Lay Readers

Several individuals and agencies commented last year that the annual groundwater report had become too technical and was difficult to understand. They recommended that the organization and format of the report be changed to make the information more understandable.

Progress. The present annual report incorporates numerous changes designed to improve the readability of the report. In general, the changes involved shifting technical material to appendices or separate reports, simplifying the language used in the report, and using color to clarify selected figures.

Updated recommendation. The District may wish to consider additional changes to the report next year, depending on feedback it receives on the present report.

Recommendation: Implement Selected Field Studies and Data Management Improvements to Increase the Accuracy of the Groundwater Model and Annual Groundwater Reports

Progress. The District successfully implemented recommendations to monitor flow and salinity in the east side creeks and to continue monitoring flow and salinity in agricultural drains, San Juan Creek, and the San Benito River. These programs were described in the above recommendation related to the basic data program. No action was taken on the following two specific recommendations. Hernandez Reservoir was at too low a level to conduct a seepage and evaporation study, and the proposed field-scale study of salt balance proved to have conceptual problems.

- Improve the methods used to estimate seepage and evaporation from San Justo, Paicines, and Hernandez Reservoirs, and revise the reservoir water budgets to list those items separately.
- Install gages and data loggers to record runoff quantity and salinity for two small (500–1,000 acre) agricultural drainage areas on the valley floor. These data would be very helpful in calibrating the rainfall-runoff component of the soil moisture budget model and in estimating salt removal in rainfall runoff.

Updated recommendation. The District should complete the seepage and evaporation study for Hernandez and San Justo Reservoirs when Hernandez storage returns to a more normal level. A revised

study design for investigating salinity partitioning between runoff and deep percolation should be developed that complements recent improvements in the salt budget analysis and water quality monitoring program.

New Recommendations

Recommendation: Obtain Complete General Mineral Samples of Creeks, and Wastewater and Agricultural Drain Discharges

The salt balance calculations for the present annual report were hindered by lack of complete general mineral analyses of creeks, and wastewater and agricultural drain discharges. In many cases, data are available for specific conductance and one or two of the major ions (typically chloride and sodium), but not all of the major ions. Without these data, it is difficult to characterize salt loading in the basin and quantify effects of cation exchange such as occurs with water softening and application of gypsum to field soils.

Recommendation: Continue to Improve the District's Geographic Information System to Support Water Management Activities

In 2001, the District hired a contractor to prepare a digital database and map of assessor's parcels in northern San Benito County as the first major element of a Geographic Information System (GIS) for local land and water use analysis. A number of additions and improvements to the GIS were implemented in the course of completing this year's annual groundwater report. This process revealed a number of minor tasks the District should complete to improve the usefulness of its GIS for analysis and figure preparation.

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Personal Communications

- Holdren, Glen. Senior engineer. Bracewell Engineering, Inc., Oakland, CA. October 31, 2002—telephone conversation with Gus Yates.

Merritt, Mark. Groundwater hydrologist. Santa Clara Valley Water District, San Jose, CA. November 6, 2002—E-mail transmittal of water level data to Gus Yates.

Appendix A

APPENDIX A. REPORTING REQUIREMENTS AND PREVIOUS ANNUAL REPORTS

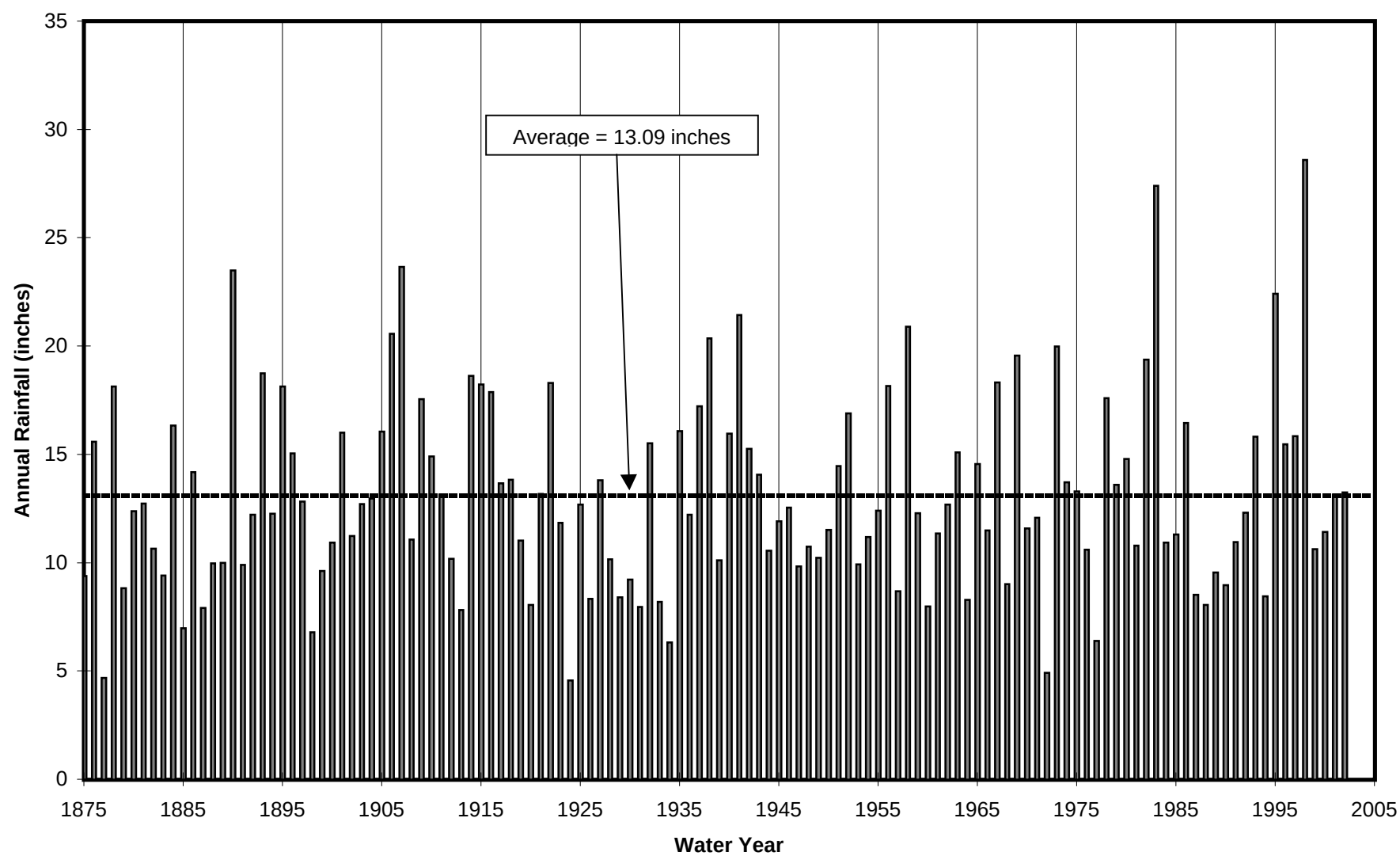
Water Code Section 70 is the codified form of the San Benito County Water District Act, first passed in 1953. Section 70-7.6 authorizes the District Board of Directors to require that the District prepare an annual groundwater report. The Board has consistently ordered that annual reports be prepared. Section 70-7.6 includes a lengthy list of items to be included in the report. Generally, this information relates to

- groundwater production and overdraft during the reporting year,
- estimated production and overdraft during the current and ensuing years,
- recommendations regarding the amount of water to import from the U.S. Bureau of Reclamation (Reclamation) Central Valley Project (CVP), and
- recommendations regarding water charges for groundwater and San Felipe water.

Section 70 was amended in 1998 to specify that the water year for reporting purposes shall be from October 1 of the prior calendar year through September 30 of the current calendar year, which is the water year used by the U.S. Geological Survey and is consistent with data tabulations in previous annual reports.

Each annual report since water year 1996 has included in-depth analysis of selected topics, in addition to the required elements and basic data on hydrology, water levels, water use, and water quality. The 1996 annual report enhanced the basic data analysis by expanding the geographic scope to cover the Paicines and Tres Pinos Creek basins and by developing separate water budgets for each subbasin. The 1997 annual report included an in-depth analysis of seasonal water use patterns, irrigation water duties, and long-term water quality trends. The 1998 annual report included additional analysis of irrigation water duties, descriptions of known groundwater contamination sites, and a summary of conclusions and recommendations presented in the interagency groundwater management plan completed in April of that year. The 1999 report provided detailed documentation of wastewater dischargers in the basin and formulated strategies for managing subbasin water budgets. The 2000 report introduced methods for calculating the net water supply benefits of Zone 3 (Hernandez and Paicines Reservoirs) and Zone 6 (San Felipe) operations, and it initiated a systematic discussion of required, prior, and new recommendations. The water quality chapter was expanded for the 2001 report to include a detailed preliminary salt balance for the groundwater basin. Key information from some of the in-depth analyses in prior years is included for reference in appendices of the 2002 report.

Appendix B



Data: Hollister gage (1875-1995); CIMIS station at SBCWD offices (1996-2002)

Figure B-1. Annual Precipitation in Hollister during Water Years 1875-2002

Table B-1. Monthly Reference Evapotranspiration and Precipitation in Inches at the SBCWD District Office (CIMIS Station)

Reference Evapotranspiration (ET_o) (inches)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1995	3.55	1.56	0.97	1.00	1.45	2.57	3.87	4.57	6.19	7.07	6.50	4.85	44.15
1996	3.70	1.99	0.92	1.12	1.58	3.37	4.88	5.91	6.56	7.18	6.44	4.53	48.18
1997	3.72	1.62	1.16	1.15	2.28	4.11	5.70	7.39	7.02	7.06	6.62	5.59	53.42
1998	3.71	1.68	1.27	1.01	1.18	2.56	4.08	4.39	5.16	6.75	6.64	4.59	43.02
1999	3.36	1.47	1.24	1.32	1.61	2.82	4.56	5.60	6.47	6.76	5.74	4.47	45.42
2000	3.84	1.70	1.71	0.99	1.39	3.49	4.97	5.86	6.57	6.59	6.09	4.64	47.84
2001	2.75	1.48	1.30	1.54	1.65	2.88	3.71	6.04	6.44	5.91	6.12	4.09	43.91
2002	3.50	1.86	1.27	1.55	2.27	3.63	4.20	6.36	7.03	7.27	6.16	5.37	50.47
Average	3.52	1.64	1.22	1.16	1.59	3.11	4.54	5.68	6.34	6.76	6.31	4.68	47.05

Precipitation (inches)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1995	3.26	5.35	1.96	9.42	0.72	5.69	1.85	0.58	0.41	0.02	0.00	0.00	29.26
1996	0.11	0.00	2.19	4.35	4.51	1.56	1.33	1.31	0.00	0.01	0.00	0.00	15.37
1997	0.97	3.16	4.27	6.81	0.21	0.09	0.18	0.02	0.10	0.00	0.00	0.02	15.83
1998	0.16	3.77	2.59	4.92	9.56	2.70	2.30	2.39	0.10	0.02	0.00	0.08	28.59
1999	0.54	1.92	0.79	2.52	2.51	1.51	0.65	0.06	0.07	0.00	0.00	0.00	10.57
2000	0.14	0.97	0.12	4.04	4.51	0.68	0.39	0.44	0.10	0.00	0.00	0.02	11.41
2001	3.42	0.79	0.22	2.85	2.76	0.69	2.19	0.00	0.01	0.02	0.02	0.19	13.16
2002	0.70	5.13	3.40	0.66	1.15	1.56	0.36	0.28	0.00	0.00	0.00	0.00	13.24
Average	1.23	2.28	1.73	4.99	3.54	1.85	1.27	0.69	0.11	0.01	0.00	0.04	17.18

Table B-2. Daily Reference Evapotranspiration in Inches at the SBCWD Office (CIMIS Station) during Water Year 2002

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.14	0.09	0.02	0.04	0.07	0.12	0.15	0.14	0.19	0.26	0.22	0.24
2	0.15	0.09	0.04	0.01	0.08	0.13	0.05	0.19	0.20	0.23	0.15	0.25
3	0.14	0.09	0.06	0.06	0.07	0.13	0.04	0.16	0.20	0.23	0.06	0.20
4	0.12	0.11	0.06	0.05	0.09	0.13	0.04	0.18	0.27	0.24	0.21	0.19
5	0.12	0.10	0.02	0.05	0.08	0.11	0.13	0.18	0.29	0.23	0.24	0.16
6	0.06	0.02	0.05	0.02	0.08	0.05	0.11	0.21	0.28	0.25	0.24	0.19
7	0.12	0.08	0.07	0.03	0.04	0.04	0.14	0.20	0.24	0.26	0.25	0.18
8	0.09	0.11	0.06	0.05	0.07	0.11	0.09	0.23	0.27	0.28	0.28	0.20
9	0.15	0.09	0.02	0.02	0.09	0.09	0.07	0.22	0.31	0.32	0.28	0.22
10	0.16	0.07	0.07	0.05	0.10	0.07	0.16	0.20	0.28	0.29	0.27	0.23
11	0.13	0.09	0.05	0.06	0.09	0.13	0.17	0.23	0.24	0.23	0.25	0.20
12	0.15	0.01	0.06	0.05	0.08	0.13	0.20	0.24	0.22	0.25	0.23	0.17
13	0.17	0.07	0.05	0.06	0.03	0.13	0.21	0.23	0.17	0.25	0.21	0.16
14	0.17	0.08	0.05	0.02	0.04	0.14	0.21	0.22	0.23	0.23	0.20	0.18
15	0.15	0.07	0.06	0.06	0.04	0.08	0.16	0.19	0.25	0.21	0.20	0.17
16	0.08	0.05	0.05	0.05	0.06	0.12	0.14	0.23	0.26	0.21	0.15	0.16
17	0.10	0.08	0.01	0.06	0.03	0.03	0.10	0.22	0.25	0.21	0.18	0.17
18	0.12	0.07	0.04	0.06	0.07	0.13	0.16	0.22	0.25	0.21	0.17	0.18
19	0.08	0.05	0.05	0.07	0.03	0.14	0.20	0.12	0.25	0.22	0.16	0.20
20	0.12	0.04	0.03	0.07	0.09	0.16	0.17	0.13	0.20	0.19	0.20	0.19
21	0.08	0.02	0.03	0.05	0.11	0.13	0.20	0.16	0.20	0.20	0.19	0.18
22	0.11	0.04	0.01	0.07	0.12	0.07	0.23	0.21	0.18	0.24	0.17	0.18
23	0.10	0.05	0.05	0.06	0.10	0.10	0.21	0.24	0.23	0.25	0.14	0.21
24	0.12	0.04	0.05	0.07	0.10	0.14	0.20	0.27	0.23	0.25	0.18	0.20
25	0.12	0.03	0.05	0.07	0.13	0.12	0.13	0.19	0.22	0.25	0.19	0.16
26	0.09	0.06	0.04	0.01	0.12	0.14	0.05	0.18	0.17	0.23	0.21	0.12
27	0.07	0.06	0.03	0.06	0.13	0.17	0.14	0.22	0.21	0.19	0.23	0.07
28	0.09	0.02	0.01	0.04	0.13	0.13	0.19	0.23	0.21	0.20	0.18	0.13
29	0.07	0.02	0.02	0.05		0.15	0.08	0.26	0.25	0.21	0.16	0.15
30	0.05	0.06	0.01	0.06		0.14	0.07	0.26	0.28	0.23	0.16	0.13
31	0.08		0.05	0.07		0.17		0.20		0.22	0.20	
Total	3.50	1.86	1.27	1.55	2.27	3.63	4.20	6.36	7.03	7.27	6.16	5.37

Annual total: 50.47

Table B-3. Daily Precipitation in Inches at the SBCWD Office (CIMIS Station) during Water Year 2002

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0	0.02	0.26	0	0	0	0	0.02	0	0	0	0
2	0.02	0	0.96	0.32	0	0	0	0	0	0	0	0
3	0	0.02	0.12	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0.26	0	0	0	0	0	0
7	0	0	0	0	0.39	0.15	0	0	0	0	0	0
8	0	0	0	0	0.02	0	0	0	0	0	0	0
9	0	0	0.03	0	0	0	0	0	0	0	0	0
10	0	0.19	0	0	0	0.02	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	1.2	0	0	0	0	0	0	0	0	0	0
13	0	0.14	0	0	0	0	0	0	0	0	0	0
14	0	0	0.42	0	0	0	0	0	0	0	0	0
15	0	0.02	0	0	0	0.32	0	0	0	0	0	0
16	0	0.05	0	0	0.19	0	0.02	0	0	0	0	0
17	0	0.02	0.09	0	0.5	0.41	0.14	0	0	0	0	0
18	0	0.02	0	0	0	0.01	0	0	0	0	0	0
19	0	0	0.04	0	0.04	0	0	0.05	0	0	0	0
20	0	0	0.36	0	0.01	0	0	0.15	0	0	0	0
21	0	0.02	0.33	0.04	0	0	0	0.06	0	0	0	0
22	0	0.09	0.13	0	0	0.36	0	0	0	0	0	0
23	0	0	0.03	0	0	0.03	0	0	0	0	0	0
24	0	0.91	0	0	0	0	0	0	0	0	0	0
25	0	0.94	0	0	0	0	0	0	0	0	0	0
26	0	0.23	0	0.19	0	0	0.12	0	0	0	0	0
27	0	0	0.03	0	0	0	0	0	0	0	0	0
28	0	0.35	0.21	0.11	0	0	0	0	0	0	0	0
29	0	0.91	0.32	0		0	0.05	0	0	0	0	0
30	0.68	0	0.05	0		0	0.03	0	0	0	0	0
31	0		0.02	0		0		0		0	0	
Total	0.70	5.13	3.40	0.66	1.15	1.56	0.36	0.28	0.00	0.00	0.00	0.00

Annual total: 13.24

Appendix C

Table C-1. Daily Flows in the San Benito River at the Willow Creek School Gage during Water Year 2002

Station Name: San Benito River near Willow Creek School, California

Station Number: 11156500

Latitude: 363634

Longitude: 1211207

Daily Mean Discharge (cfs)
Water Year October 2001-September 2002

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	10	12	10	22	7.4	4.4	2.8	2.7	1.9	24	2.3	0.71
2	9.7	12	16	24	7.1	4.4	2.9	2.6	1.9	22	2.1	0.64
3	9.6	11	27	33	7.1	4.4	2.9	2.4	2	23	1.8	0.64
4	9.7	8.6	20	30	7	4.2	3	2.3	3	22	1.9	0.64
5	10	7.7	18	26	6.7	4.2	3.1	2.2	4	22	1.7	0.64
6	11	7.2	15	21	6.3	4.2	3	2.1	5	22	1.4	0.75
7	11	7	13	22	6.4	4.6	3	2	6	21	1.1	0.81
8	11	6.8	12	20	7	4.4	3	2	7	23	0.99	0.8
9	11	6.5	13	21	6.5	4.2	3.1	2	8	23	0.86	0.77
10	11	6.4	12	19	6.3	4.2	2.9	2	9	24	0.79	0.7
11	10	7.5	11	18	6.1	4.2	3	2	10	22	0.75	0.64
12	10	9.3	11	17	5.9	4	2.9	1.9	11	25	0.67	8.2
13	10	13	9.9	16	5.6	3.9	2.6	1.9	11	24	0.64	18
14	10	10	12	20	5.4	3.8	2.4	1.9	16	20	0.64	23
15	9.7	8.6	10	17	5.3	3.8	2.4	1.9	19	20	0.64	27
16	9.5	7.9	9.2	19	5.3	3.7	2.7	1.9	21	17	0.64	30
17	9.8	7.4	8.7	19	6.2	4.4	2.5	1.9	22	10	0.8	28
18	10	7.1	8.3	17	6.2	4.4	2.6	1.9	24	7.2	0.81	24
19	10	7	9	16	5.5	3.6	2.5	1.9	25	5.9	0.89	24
20	11	7	10	17	5.1	3.5	2.5	2.4	30	5.4	0.85	26
21	11	6.9	22	24	5	3.3	2.3	2.4	37	4.3	0.77	31
22	11	6.7	16	28	4.9	3.1	2.2	2.3	48	4.5	0.87	30
23	11	6.5	16	19	4.8	3.6	2.1	2.1	55	4.6	0.91	30
24	11	9.1	16	17	4.7	3.6	2.1	2	55	2.9	0.89	32
25	11	13	16	16	4.7	3.3	2.1	1.9	45	2.6	0.85	33
26	11	11	18	21	4.7	3.2	2.4	1.9	33	2.6	0.8	20
27	11	9.8	18	20	4.6	3.1	2.5	1.9	29	2.6	0.75	21
28	11	9.6	20	21	4.4	2.9	2.5	1.9	28	2.9	0.68	12
29	11	11	20	15		2.8	2.6	1.9	28	2.8	0.76	9.5
30	12	11	23	11		2.7	2.8	1.9	25	2.4	0.85	7.8
31	12		24	7.8		2.9		1.9		2.2	0.79	
Minimum	9.5	6.4	8.3	7.8	4.4	2.7	2.1	1.9	1.9	2.2	0.6	0.6
Median	11	8	15	19	6	4	3	2	20	17	1	15
Average	11	9	15	20	6	4	3	2	21	13	1	15
Maximum	12	13	27	33	7	5	3	3	55	25	2	33
Total	327	265	464	614	162	117	79	64	620	417	31	442
Acre-feet	648	525	920	1,217	322	232	157	127	1,229	827	62	877

Notes:

cfs = cubic feet per second.

Bold = missing record replaced with estimated values for annual report calculations.

Table C-2. Daily Flows in the San Benito River at old Highway 156 during Water Year 2002

Station Name: San Benito River at Highway 156 near Hollister, California
Station Number: 11158600 **Latitude:** 365107 **Longitude:** 1212544

Daily Mean Discharge (cfs)
 Water Year October 2001-September 2002

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0	0	0	4	3.9	1.1	0	0	0	0	0	0
2	0	0	0	6	4.2	0.83	0	0	0	0	0	0
3	0	0	0	8	3.7	0.48	0	0	0	0	0	0
4	0	0	0	7	3.5	0.62	0	0	0	0	0	0
5	0	0	0	6	3.6	0.12	0	0	0	0	0	0
6	0	0	0	4	3.8	1.8	0	18	0	0	0	0
7	0	0	0	2	6.5	5.3	0	0	0	0	0	0
8	0	0	0	1.2	16	2.2	0	0	0	0	0	0
9	0	0	0	0	7.7	1.5	0	0	0	0	0	0
10	0	0	0	0	3.8	1	0	0	0	0	0	0
11	0	0	0	0	2.9	0.84	0	0	0	0	0	0
12	0	0.5	0	0	2.9	0.31	0	0	0	0	0	0
13	0	0	0	0	2.2	0.16	0	0	0	0	0	0
14	0	0	0	0	2.4	0.18	0	0	0	0	0	0
15	0	0	0	0	2.4	18	0	0	0	0	0	0
16	0	0	0	0	4	3.8	0	0	0	0	0	0
17	0	0	0	0	21	23	0	0	0	0	0	0
18	0	0	0	0	6.9	6.1	0	0	0	0	0	0
19	0	0	0	0	4.1	2.5	0	0	0	0	0	0
20	0	0	0	0	3	0.35	0	0	0	0	0	0
21	0	0	0	0	2.3	0.22	0	0	0	0	0	0
22	0	0	0	0	2.4	12	0	0	0	0	0	0
23	0	0	0	0	2.3	4.7	0	0	0	0	0	0
24	0	0.79	0	1.5	2.1	0.4	0	0	0	0	0	0
25	0	0	0	3.1	2.1	0	0	0	0	0	0	0
26	0	0	0	4.5	2.2	0	0	0	0	0	0	0
27	0	0	0	3.8	1.6	0	0	0	0	0	0	0
28	0	0	0	9.4	1.3	0	0	0	0	0	0	0
29	0	0	0	4.5		0	0	0	0	0	0	0
30	0.28	0	0	4.2		0	0	0	0	0	0	0
31	0		2	4		0		0		0	0	
Minimum	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Median	0	0	0	1	3	1	0	0	0	0	0	0
Average	0	0	0	2	4	3	0	1	0	0	0	0
Maximum	0	1	2	9	21	23	0	18	0	0	0	0
Total	0	1	2	73	125	88	0	18	0	0	0	0
Acre-feet	1	3	4	145	247	174	0	36	0	0	0	0

Notes:

cfs = cubic feet per second.

Bold = missing record replaced with estimated values for annual report calculations.

Table C-3. Daily Flows in Tres Pinos Creek during Water Year 2002

Station Name: Tres Pinos Creek near Tres Pinos, California
Station Number: 11157500 **Latitude:** 364553 **Longitude:** 1211745

Daily Mean Discharge (cfs)
 Water Year October 2001-September 2002

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	7.3	1.6	1.5	5.6	1.4	1.2	1.2	0.8	0.38	0	0	0
2	7.7	1.1	1.5	4.7	1.4	1	1.1	0.82	0.41	0	0	0
3	15	1.1	1.4	17	1.4	1.2	0.96	0.85	0.4	0	0	0
4	17	1	1.4	18	1.4	1.2	0.98	0.9	0.29	0	0	0
5	17	1.1	1.3	10	1.2	1.2	0.94	0.84	0.24	0	0	0
6	13	1.3	1.2	6.1	1.2	1.3	0.88	0.88	0.22	0	0	0
7	8	1.2	1.2	4.5	1.3	1.5	0.82	0.77	0.29	0	0	0
8	8.2	1.2	1.2	4	1.4	1.4	0.84	0.68	0.22	0	0	0
9	6.1	1.3	1.2	3.8	1.3	1.3	0.83	0.67	0.19	0	0	0
10	3.9	1.3	1.1	3.5	1.3	1.2	0.78	0.7	0.14	0	0	0
11	3.4	1.3	1.1	3.4	1.3	1.2	0.78	0.66	0.11	0	0	0
12	3.3	1.4	1	3.3	1.3	1.2	0.69	0.57	0.1	0	0	0
13	3.1	1.4	1	3.1	1.3	1.2	0.52	0.57	0.09	0	0	0
14	2.6	1.4	1.1	2.9	1.3	1.2	0.51	0.57	0.07	0	0	0
15	0.96	1.4	1.2	3	1.3	1.3	0.6	0.59	0.07	0	0	0
16	0.63	1.3	1.3	2.8	1.2	1.2	0.65	0.56	0.07	0	0	0
17	0.56	1.3	1.3	2.6	1.3	1.5	0.68	0.56	0.06	0	0	0
18	0.43	1.3	1.2	2.5	1.2	1.3	0.68	0.5	0.01	0	0	0
19	0.32	1.3	1.2	2.5	1	1.3	0.67	0.61	0	0	0	0
20	0.27	1.3	1.2	2.4	1.2	1.4	0.65	0.72	0	0	0	0
21	0.26	1.3	1.3	2.4	1.2	1.3	0.67	0.76	0	0	0	0
22	0.28	1.4	1.3	2.1	1.2	1.3	0.7	0.68	0	0	0	0
23	0.29	1.5	1.2	2	1.2	1.3	0.68	0.66	0	0	0	0
24	0.2	1.5	1.2	2	1.2	1.4	0.62	0.61	0	0	0	0
25	0.63	1.5	1.2	1.9	1.3	1.5	0.71	1.6	0	0	0	0
26	0.42	1.5	1.1	1.9	1.2	1.5	0.69	0.55	0	0	0	0
27	0.34	1.5	1.2	1.7	1.1	1.5	0.68	0.53	0	0	0	0
28	0.32	1.5	1.2	1.7	1.1	1.4	0.67	0.44	0	0	0	0
29	0.36	1.5	1.6	1.5		1.4	0.77	0.42	0	0	0	0
30	0.99	1.5	5.6	1.4		1.2	0.73	0.34	0	0	0	0
31	1.1		3.4	1.4		0.97		0.35		0	0	
Minimum	2.0	0.3	1.9	2.2	1.9	1.6	1.4	0.9	2.6	7.9	8.6	7.7
Median	3	2	2	2	3	2	2	6	11	10	10	9
Average	3	1	2	2	4	4	2	7	12	11	10	9
Maximum	6	3	2	3	12	32	2	17	15	16	11	10
Total	97	44	65	76	99	125	53	210	347	338	307	274
Acre-feet	192	88	129	152	196	248	106	416	689	671	608	543

Notes:

cfs = cubic feet per second.

--- = missing record.

Table C-4. Miscellaneous Streamflow Measurements during Water Year 2002

Map Label	Streamflow Measurement Site	Streamflow Measurement Date					
		10/07/2002	08/18/2002	05/29/2002	03/19/2002	12/19/2001	10/04/2001
1	Tres Pinos Creek - Southside Road Bridge (West)	0	0	0	0		
2	San Benito River - Thomas Road (KT Road Bridge)	0	0	0.277	9 est	5.194	
3	San Benito River - Downstream of Berm 11 at Hospital Road	0	0			2.961	
4	San Benito River - Upstream of Berm 3 (Yuki) at Cienega/Union Road	0					
5	San Benito River - Downstream of Berm 10 at Nash Road	0	0				
6	San Benito River - Old Highway 156 Bridge	0	0	0	0.5 est	0.02	
7	San Benito River - near Mitchell Road					0	
8	San Benito River - near Flint Road			0	0	0	
9	San Benito River - near Bixby Road		0	0.01		0.38	
10	San Benito River - Y Road	0.118	0.106	0.531	3.164	2	0.12
11	San Juan Creek - San Juan-Hollister Road		0	0			
12	San Juan Creek - Highway 156		0.113	1.108	0.145	0.113	1.09
13	San Juan Creek - Anzar Road	1.298	1.138	2.235	2.933	3.328	1.24
14	San Juan Creek - 2000 ft downstream of Hwy 101 (Vermilyer)	1.497		2.137			
15	Pacheco Creek at Walnut Ave.	0	5.136	0	0	0	
16	Pacheco Creek at Highway 156	0.01					
17	Pacheco Creek at Lovers Lane	0.23	0.07	0.6	3.37		
18	Arroyo de las Viboras at Hawkins Ranch driveway				0.2		
19	Arroyo de las Viboras at Fairview Road		0		0		
20	Arroyo Dos Picachos at Fallon Road	0	0	0	0		
21	Arroyo Dos Picachos at Aquistapace Road	0.01	.02 est	.02 est	0.02 est		
22	Santa Ana Creek at Fairview Road		0		0		
23	Santa Ana Creek at Fallon Road	0	0	0	0		
24	Teausquita Slough at San Felipe Road	0.446	0.967	0.25 est	.05 est		
25	Millers Canal 2000 ft downstream of San Felipe Lk (pipeline xing)	1.43	1.36	4.52	10.63		

Notes:

See Figure 2 for numbered site locations

est = streamflow estimated by eye or by relatively inaccurate methods (e.g. width x depth x eyeballed centerline surface velocity)

Some sites were measured on the day before or after the indicated date. However, all sites along any individual creek or river were measured on the same day.

Appendix D

Table D-1. Historical Percolation of San Felipe Water

Annual Percolation of San Felipe Water during Water Years 1994-1998 (acre-feet)

Water Year	Pacheco Creek	Arroyo de las Víboras			Arroyo Dos Picachos		Santa Ana Creek			Airline Highway	Ridge-mark	Tres Pinos Creek	San Benito River	Total
		Road	Creek 1	Creek 2	Fallon Road	Jarvis Lane	Creek	John Smith Road	Maranatha Road					
1994	232	136	515	0	0	550	209	0	0	0	0	85	158	1,885
1995	444	238	770	2	0	654	622	73	0	0	0	809	2,734	6,345
1996	0	494	989	832	67	235	708	531	197	134	25	21	6,097	10,330
1997	0	447	601	1,981	77	0	200	17	353	286	29	1,477	5,619	11,087
1998	0	132	109	403	0	0	0	65	0	158	74	518	1,084	2,543

Monthly Percolation of San Felipe Water during Water Year 1999 (acre-feet)

	Pacheco Creek	Arroyo de las Víboras			Arroyo Dos Picachos		Santa Ana Creek			Airline Highway	Ridge-mark	Tres Pinos Creek	San Benito River	Total
		Road	Creek 1	Creek 2	Fallon Road	Jarvis Lane	Creek	John Smith Road	Maranatha Road					
Oct.	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Nov.	0	0	0	0	0	0	1	0	27	6	0	27	0	61
Dec.	0	0	0	0	0	0	1	0	2	16	0	65	0	84
Jan.	0	0	0	0	0	0	1	81	10	0	2	0	0	94
Feb.	0	0	0	0	0	0	0	34	0	11	0	0	0	44
March	0	0	0	0	0	0	0	45	3	13	0	0	0	60
April	0	0	0	0	0	0	0	22	0	23	0	0	0	45
May	0	0	0	0	0	0	0	29	6	30	0	34	0	99
June	0	0	0	0	0	0	0	31	0	36	0	208	155	430
July	0	0	0	0	0	0	0	0	0	0	0	73	127	201
Aug.	0	0	0	0	0	0	0	0	0	0	9	0	121	129
Sept.	0	0	0	0	0	0	1	14	0	7	0	44	9	74
Total	0	0	0	0	0	0	4	256	48	141	10	452	413	1322

Tble D-1. Continued.

Monthly Percolation of San Felipe Water during Water Year 2000 (acre-feet)

	Pacheco Creek	Arroyo de las Viboras			Arroyo Dos Picachos		Santa Ana Creek			Airline Highway	Ridge-mark	Tres Pinos Creek	San Benito River	Total
		Road	Creek 1	Creek 2	Fallon Road	Jarvis Lane	Creek	John Smith Road	Maranatha Road					
Oct.	0	0	0	0	0	0	3	85	10	68	0	194	84	443
Nov.	0	0	0	0	0	0	0	31	0	31	9	91	136	298
Dec.	0	0	0	0	0	0	0	0	0	0	0	0	173	173
Jan.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	1	0	0	0	0	0	0	7	0	10	0	0	80	98
April	0	0	0	6	0	0	0	47	0	48	1	0	184	286
May	0	0	0	0	0	0	0	24	0	35	0	0	146	205
June	0	0	0	0	0	0	0	30	0	35	1	0	95	161
July	0	0	0	0	0	0	0	12	0	12	0	0	37	60
Aug.	0	0	0	0	0	0	0	0	8	0	0	0	0	8
Sept.	0	0	0	0	0	0	0	0	4	0	1	0	4	8
Total	1	0	0	6	0	0	3	236	21	240	12	285	938	1,740

Monthly Percolation of San Felipe Water during Water Year 2001 (acre-feet)

	Pacheco Creek	Arroyo de las Viboras			Arroyo Dos Picachos		Santa Ana Creek			Airline Highway	Ridge-mark	Tres Pinos Creek	San Benito River	Total
		Road	Creek 1	Creek 2	Fallon Road	Jarvis Lane	Creek	John Smith Road	Maranatha Road					
Oct.	0	0	0	0	0	0	0	0	4	45	1	94	6	149
Nov.	0	0	0	0	0	0	0	61	5	52	0	206	222	546
Dec.	0	0	0	0	0	0	0	51	5	42	0	179	157	434
Jan.	0	0	0	0	0	0	0	42	4	40	0	180	158	425
Feb.	0	0	0	0	0	0	0	6	0	8	0	45	192	251
March	0	0	0	0	0	0	0	0	0	0	0	0	120	120
April	0	0	0	0	0	0	0	0	0	0	0	0	136	136
May	0	0	0	0	0	0	0	0	0	0	0	0	51	51
June	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sept.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	161	17	186	1	703	1,041	2,110

Appendix E

SAN BENITO COUNTY WATER DISTRICT
Actual Revenue and expenditures for Zones 3 and 6
Fiscal Years 1996-2002

**Table E-1. Revenues and Expenditures for San Benito County Water District
Zones 3 and 6 Fiscal Years 1997-2002**

	Zone 3						Zone 6					
	06/30/1997	06/30/1998	06/30/99	06/30/00	06/30/2001	06/30/2002	06/30/1997	06/30/1998	06/30/99	06/30/00	06/30/2001	06/30/2002
OPERATING REVENUES												
Sale of Water to Sunnyslope	\$5,399	\$4,790	\$4,348	\$4,385	\$4,183	\$5,001						
Sale of San Felipe Water - AM							\$1,711,041	\$1,085,512	\$1,489,701	\$1,460,867	\$1,612,296	\$1,572,123
Sale of San Felipe Water - DM							163,701	111,739	136,095	152,065	140,124	116,618
Pump Charges - AW							31,153	23,166	20,439	27,533	23,149	33,932
Pump Charges - DW							319,638	287,288	220,133	207,755	88,193	309,076
Pumping Power Exchange - Zone 6					36,132	0						131,916
Water Transfers & Exchanges					127,714	0				519,320		
Sale of Meters & Valves							14,326	8,857	8,949	5,547	8,679	7,157
Stream Clean-up Reimbursement							133,741	31,834	0	0		0
Prior Year Adjustment										(69,457)		0
Miscellaneous Income			50	2,390		331	5,548	32,292	20,346	70,557	3,516	3,898
Total Operating Revenues	\$5,399	\$4,790	\$4,398	\$6,775	\$168,029	\$5,332	\$2,379,148	\$1,580,688	\$1,895,662	\$2,374,187	\$1,875,958	\$2,174,721
OPERATING EXPENDITURES												
Salaries and Employee Benefits	\$93,935	\$140,011	\$113,356	\$107,654	\$79,108	\$87,805	\$712,963	\$742,271	\$680,438	\$737,123	\$788,488	\$838,797
Purchase of San Felipe Water - AG							775,731	487,093	797,074	548,343	344,097	688,665
Purchase of San Felipe Water - M&I							344,470	591,616	113,197	649,422	339,233	436,948
PL 102-575 AG							181,262	243,757	136,033	196,151	104,596	71,915
PL 102-575 M&I							49,612	52,115	14,158	73,725	41,783	105,371
SLDMWA - CVP O & M										225,021		170,063
SCVWD - San Felipe O & M											208,892	227,068
Operating Deficit M & I											404,600	318,024
Water Transfers & Exchanges											136,204	125,951
Maintenance and Repairs	22,221	87,981	34,107	15,250	23,696	7,306	166,354	405,118	356,226	392,676	365,870	149,325
Professional and Special Services	54,073	98,635	60,023	47,841	140,481	61,357	154,215	155,104	166,214	171,546	396,465	460,755
Office Expense	1,956	4,589	4,420	2,643	3,814	3,853	15,312	41,500	46,998	31,253	31,198	25,531
Insurance	6,974	10,116	7,780	4,238	4,327	4,461	31,596	50,435	38,900	22,056	22,673	23,134
Special Programs	3,488	5,105	4	31,880	2,890	171	8,726	13,440	2,937	88,484	10,225	11,300
Transportation and Travel	121	970	821	1,706	1,433	814	5,505	15,110	12,904	13,559	13,699	8,781
Dues, Fees and Publication	231	879	498	7,726	5,498	5,212	22,485	18,272	25,101	53,217	40,918	44,040
Utilities	2,618	2,236	2,661	2,479	2,725	2,999	75,595	97,517	80,517	106,288	126,513	118,478
Miscellaneous Expense	8,355	225	1,307	31	206	102	334,575	14,050	7,811	890	12,131	1,611
Total Operating Expenses	\$193,972	\$350,747	\$224,977	\$221,449	\$264,178	\$174,082	\$2,878,401	\$2,927,398	\$2,478,508	\$3,309,754	\$3,387,586	\$3,825,757
NET OPERATING INCOME (LOSS)	(\$188,573)	(\$345,957)	(\$220,579)	(\$214,674)	(\$96,149)	(\$168,750)	(\$499,253)	(\$1,346,710)	(\$582,845)	(\$935,567)	(\$1,511,628)	(\$1,651,036)
NONOPERATING REVENUES												
Property Taxes	185,971	193,182	227,986	236,239	266,160	323,051	2,805,162	2,640,308	3,009,493	3,384,986	3,523,000	3,884,756
Grants					0	0					33,010	-
Interest	32,431	37,337	41,809	64,046	32,694	30,451	707,194	701,966	807,369	879,761	1,145,904	751,945
Gain (Loss) Sale of Investment						0	13,226	(5,744)	(51,813)	0	66,745	35,508
FEMA Reimbursement	343,917	0	13,249	0	0	0	132,501	0	196,085	913,006	0	0
Total Nonoperating Revenues	\$562,319	\$230,519	\$283,044	\$300,285	\$298,854	\$353,502	\$3,658,083	\$3,336,530	\$3,961,135	\$5,177,753	\$4,768,659	\$4,672,209
NONOPERATING EXPENSES												
Operating Transfers - Out					4278						1,558,569	
Debt Service - Principal Reduction							225,000	300,000	350,000	375,000	400,000	425,000
Debt Service - Interest Reduction							406,538	387,488	363,558	336,575	307,313	275,750
Capital Outlay	12,789	58,818	17,043	4,578	41,706	30,742	1,300,169	363,826	1,493,141	597,999	265,175	480,922
Total Nonoperating Expenses	\$12,789	\$58,818	\$17,043	\$4,578	\$45,984	\$30,742	\$1,931,707	\$1,051,314	\$2,206,699	\$1,309,574	\$2,531,057	\$1,181,672
NET OTHER INCOME (LOSS)	\$549,530	\$171,701	\$266,001	\$295,707	\$252,870	\$322,760	\$1,726,376	\$2,285,216	\$1,754,436	\$3,868,179	\$2,237,602	\$3,490,537
Excess (Deficit) of Total Revenues over Total Expenditures	\$360,957	(\$174,256)	\$45,422	\$81,033	\$156,721	\$154,010	\$1,227,123	\$938,506	\$1,171,590	\$2,932,612	\$725,974	\$1,839,501

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Table E-2. Historical and Current San Benito County Water District Water Charges

Year	Standby & Availability Charge (dollars/acre)	San Felipe Project (Blue Valve) Water Rates (dollars/af)						Groundwater Charge (dollars/af)	
		Water Charge		Power Charge					
		Agricultural	Municipal & Industrial	Distribution Subsystem				Agricultural	Municipal & Industrial
				6H	9H	9L	Others		
1987	\$8.00	\$34.00	n.c.					\$5.00 (2)	\$25.00 (2)
1988	\$2.00	\$34.00	n.c.					\$5.00 (2)	\$25.00 (2)
1989	\$2.00	\$34.00	\$90.00					\$0.00	\$0.00
1990	\$4.00	\$34.00	\$90.00					\$6.25	\$22.00
1991	\$4.00	\$38.00	\$113.00					\$6.25	\$22.00
1992	\$4.00	\$45.00	\$120.00					\$2.00	\$10.00
1993	\$4.50	\$45.00	\$120.00					\$1.00	\$15.00 (3)
		\$55.00 (1)	\$146.00 (1)					\$1.00	\$5.00
1994	\$4.50	\$77.61	\$168.92					\$1.00	\$5.00
1995	\$4.50	\$77.61	\$168.92					\$1.00	\$15.75 First 100 af \$36.70 Next 500 af \$54.60 Over 600 af
1996	\$6.00	\$75.00	\$150.00					\$1.50	\$33.00
1997	\$6.00	\$75.00	\$157.00					\$1.50	\$33.00
1998	\$6.00	\$75.00	\$155.00					\$1.50	\$33.00
1999	\$6.00	\$75.00	\$155.00					\$1.50	\$33.00
2000	\$6.00	\$75.00	\$155.00					\$1.50	\$11.50
2001	\$6.00	\$75.00	\$155.00					\$1.50	\$25.00
2002	\$6.00	\$75.00	\$150.00	\$40.00	\$50.00	\$30.00	\$15.00 (4)	\$1.50	\$25.00

Notes:

af = acre-feet.

n.c. = no classification.

All rates effective March 1 through following February.

(1) Revised August 1993.

(2) Never implemented.

(3) Amended -- never implemented.

(4) First implemented in 2002

Table E-3. U.S. Bureau of Reclamation Charges per Acre-Foot for San Felipe Water, 1996 - 2002

User Category and Cost Item	1996	1997	1998	1999	2000	2001	2002
Irrigation (1)							
Cost of service (2)	\$65.63	\$69.57	\$61.58	\$64.52	\$64.24	\$69.50	\$75.00
Restoration fund (3)	6.53	6.70	6.88	6.98	7.10	7.28	7.54
SLDMWA (4)	n.a.	n.a.	5.00	2.73	6.43	2.65	6.61
Total	<u>72.16</u>	<u>76.27</u>	<u>73.46</u>	<u>74.23</u>	<u>77.77</u>	<u>79.43</u>	<u>89.15</u>
Contract rate (5)	\$27.46	\$27.46	\$27.46	\$27.46	\$27.46	\$27.46	\$27.46
Municipal & Industrial							
Cost of service (2)	\$125.40	\$143.27	\$130.88	\$131.51	\$129.62	\$111.86	\$140.83
Restoration fund (3)	13.06	13.39	13.76	13.96	14.20	14.56	15.08
SLDMWA (4)	n.a.	n.a.	5.00	2.73	6.43	4.15	6.61
Total	<u>138.46</u>	<u>156.66</u>	<u>149.64</u>	<u>148.20</u>	<u>150.25</u>	<u>130.57</u>	<u>162.52</u>
Contract rate (5)	\$85.86	\$85.86	\$85.86	\$85.86	\$85.86	\$85.86	\$85.86

Notes:

- (1) The irrigation rates shown here are for non-full-cost users, which include almost all agricultural users in Zone 6.
- (2) Cost-of-service for agricultural and municipal and industrial users includes a capital amortization fee and an operation and maintenance fee. For municipal and industrial customers, cost-of-service also includes a deficit charge, interest payments on Central Valley Project construction costs, and an out-of-basin charge. Cost-of-service rates apply March 1 through the end of the following February.
- (3) Restoration fund charges apply October 1 through September 30.
- (4) Beginning in 1998, the San Luis-Delta Mendota Water Authority instituted this charge to "self fund" costs associated with maintaining the Delta-Mendota Canal and certain other facilities, which were formerly funded directly by the Bureau of Reclamation.
- (5) The contract rate is shown for comparison. It is the minimum rate users are allowed to pay. To the extent that the contract rate does not cover interest plus actual operation and maintenance costs, the deficit is accumulated as a "capital and interest" debt that is charged interest at the current-year treasury borrowing rate.

Table E-4. Zone 6 Groundwater Percolation Revenue Requirements and Charges in 2002

Revenue Requirements				Revenue Sources	
Reclamation Charge Component	Reclamation Charge Rate (\$/af)	Percolated Amount (1) (af)	Reclamation Charge (\$)	Groundwater Use (2) (af)	Rate Needed to Cover Costs(3) (\$/af)
Agricultural					
Operation & maintenance	\$24.35	500	\$12,175	15,750	\$0.77
Capital	\$50.65	500	\$25,325	15,750	\$1.61
Deficit	\$0.00	500	\$0	15,750	\$0.00
Interest	\$0.00	500	\$0	15,750	\$0.00
Restoration	\$7.54	500	\$3,770	15,750	\$0.24
SLDMWA O&M	\$6.61	500	\$3,305	15,750	\$0.21
Total agricultural	\$89.15	500	\$44,575	15,750	\$2.83
Current groundwater charge (4)					\$1.50
Revenue generated					\$23,625
Revenue required from other sources (5)					\$20,950
Municipal and Industrial (M&I)					
Operation & maintenance	\$26.12	1,500	\$39,180	9,500	\$4.12
Capital	\$104.82	1,500	\$157,230	9,500	\$16.55
Deficit	\$19.19	1,500	\$28,785	9,500	\$3.03
Interest	\$136.32	1,500	\$204,480	9,500	\$21.52
Restoration	\$15.08	1,500	\$22,620	9,500	\$2.38
SLDMWA O&M	\$6.61	1,500	\$9,915	9,500	\$1.04
Total M&I	\$308.14	1,500	\$462,210	9,500	48.65
Current M&I charge (4)					\$25.00
Revenue generated					\$237,500
Revenue required from other sources (5)					\$224,710

Notes:

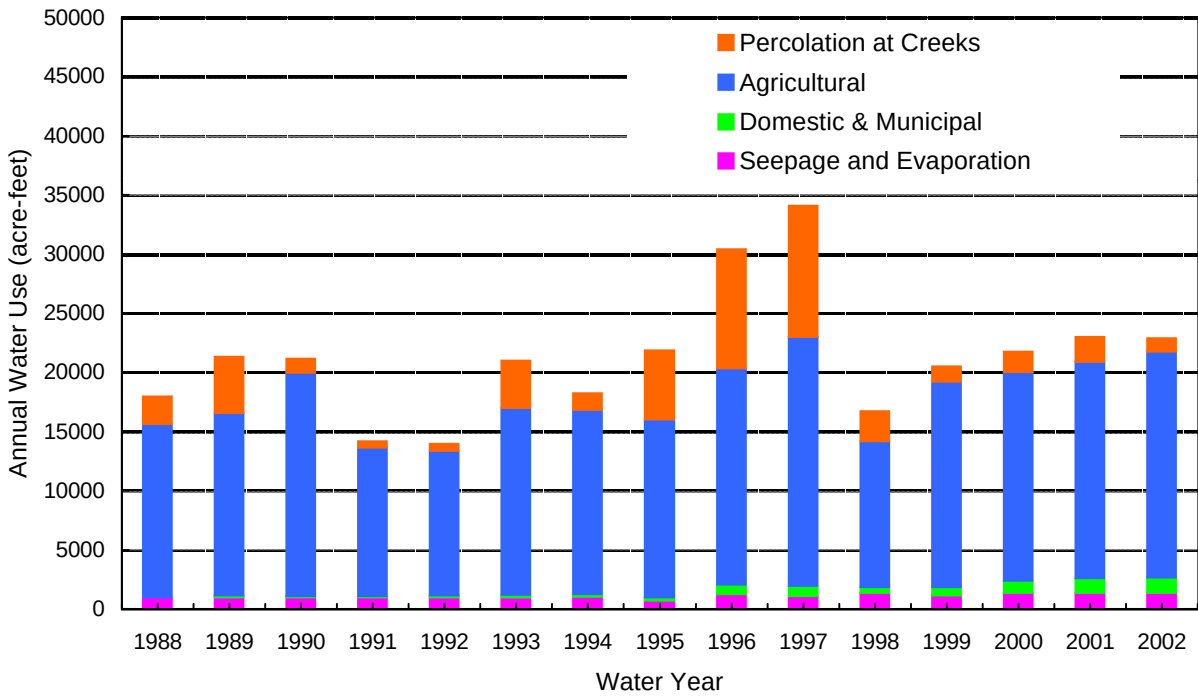
- 1 Percolated amounts are estimates for March 2002 through February 2003 developed in January 2002, with 75% of the percolation amount designated as municipal and industrial water.
- 2 Groundwater use by agricultural and municipal and industrial users are estimates for March 2002 through February 2003 developed in January 2002.
- 3 The rate needed to cover costs equals the total reclamation charge divided by the amount of groundwater use.
- 4 The District's current groundwater charge rates for agricultural and municipal and industrial users are substantially less than the rates needed to fully cover the cost of the percolated water. The difference is funded by revenue from other sources, principally taxes.
- 5 The amount of revenue required from other sources equals the total reclamation charge minus the amount of revenue raised by groundwater charges at the District's current groundwater charge rates.

Appendix F

APPENDIX F. WATER USE PATTERNS

Figure F-1 combines information from Figures 3 and 4 and shows the types of use for San Felipe water and groundwater in Zone 6 for each year during 1988–2002. It confirms that most components of water use were close to average in 2002. Other noticeable patterns include the gradual increase in domestic and municipal use of San Felipe water, the shift to smaller amounts of San Felipe percolation beginning in 1998, the steady increase in domestic and M&I use of groundwater associated with population growth, and a gradual but erratic shift toward increased use of San Felipe water and decreased use of groundwater for agricultural purposes.

San Felipe Water



Groundwater

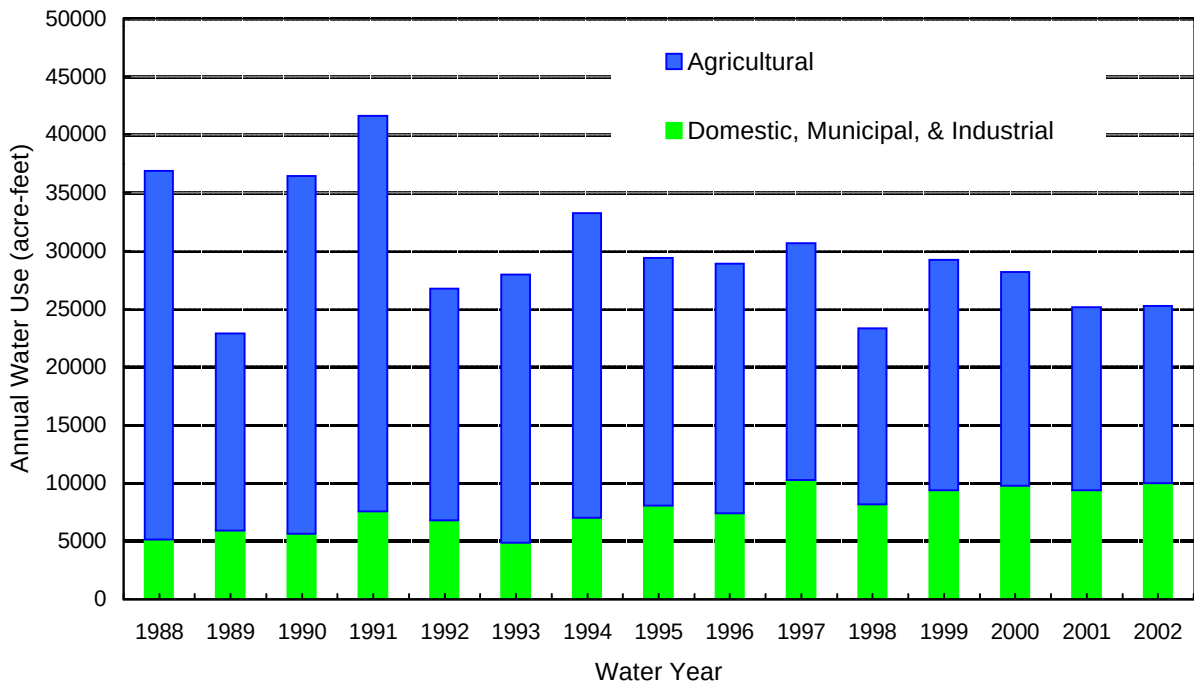
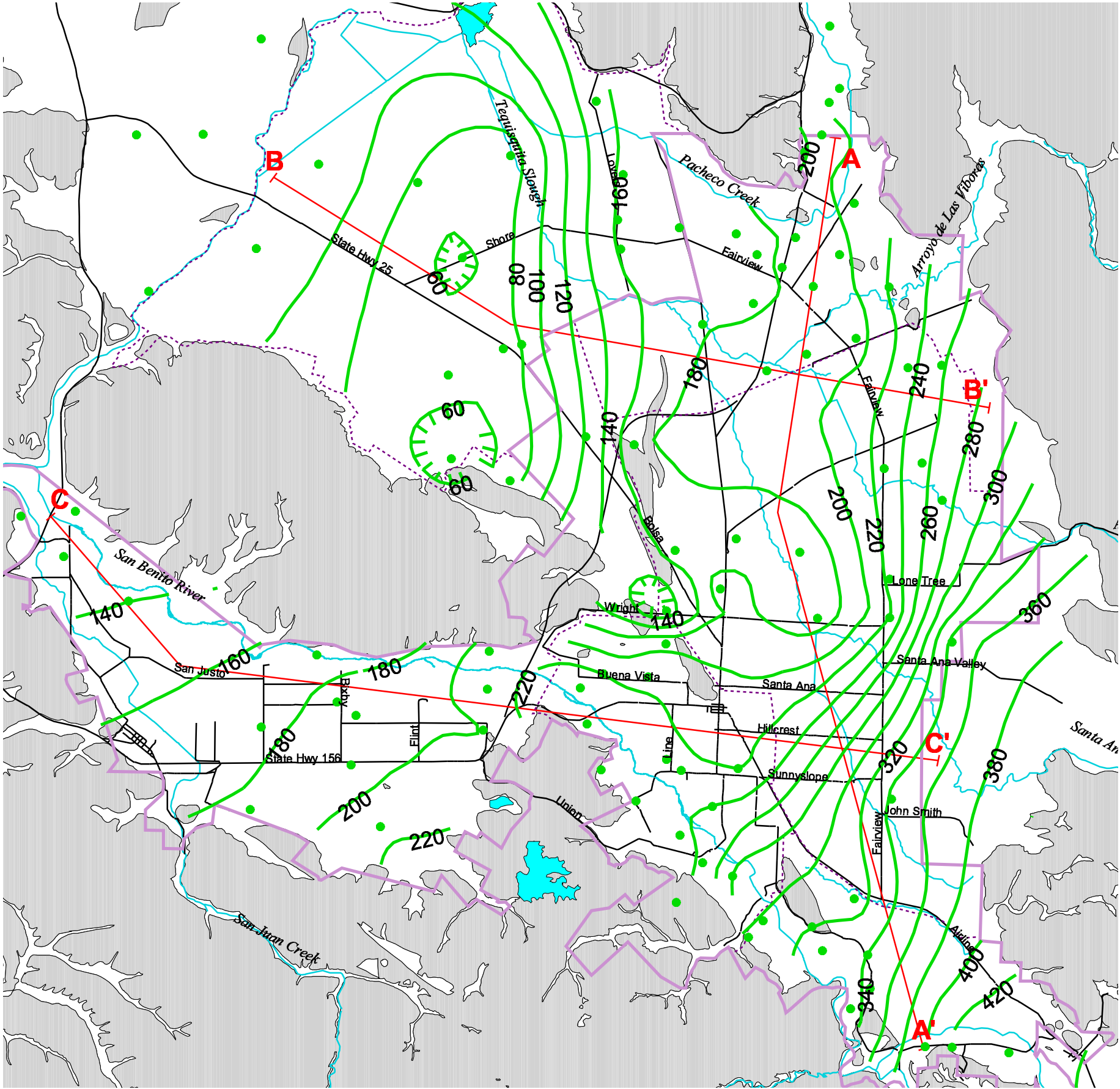


Figure F-1. Annual Use of San Felipe Water and Groundwater in Zone 6 by Type of Use during Water Years 1988-2002

Appendix G

Figure G-1. Contours of Groundwater Elevation, October 2001

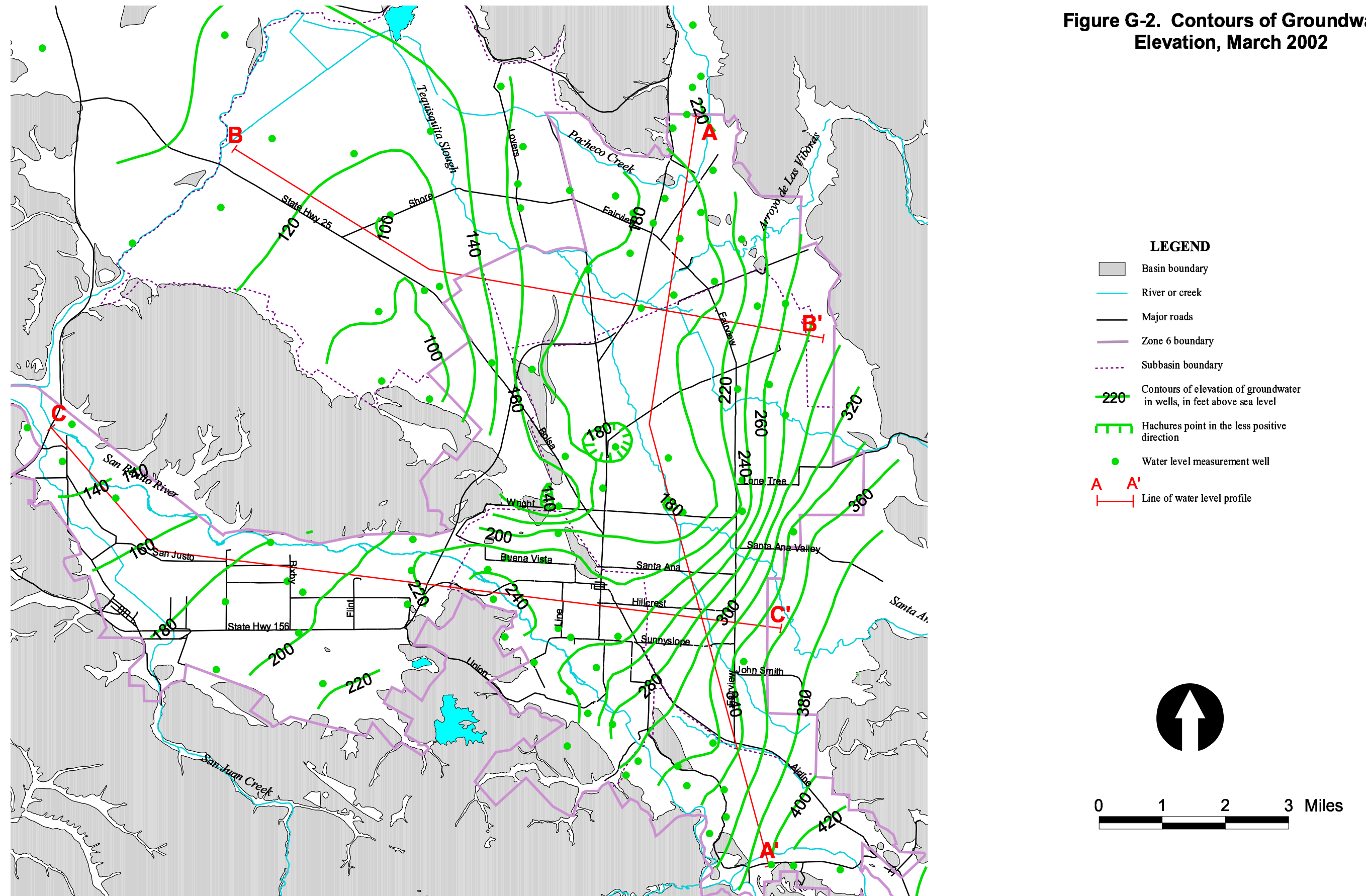


LEGEND

- Basin boundary
- River or creek
- Major roads
- Zone 6 boundary
- Subbasin boundary
- Contours of elevation of groundwater in wells, in feet above sea level
- Hachures point in the less positive direction
- Water level measurement well
- A A' Line of water level profile

0 1 2 3 Miles

Figure G-2. Contours of Groundwater Elevation, March 2002



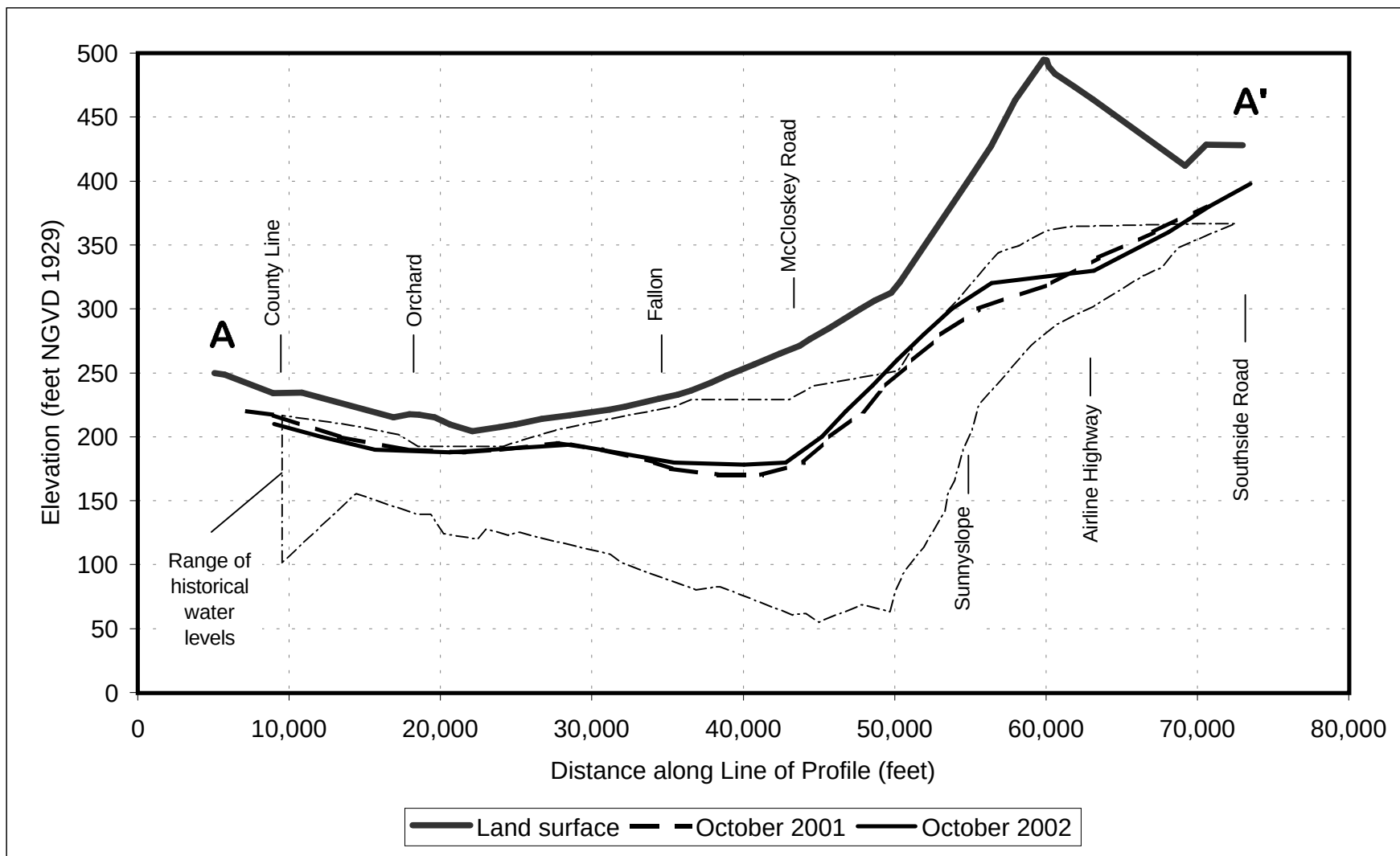


Figure G-3. Profile of Historical Groundwater Levels along Profile Line A-A'

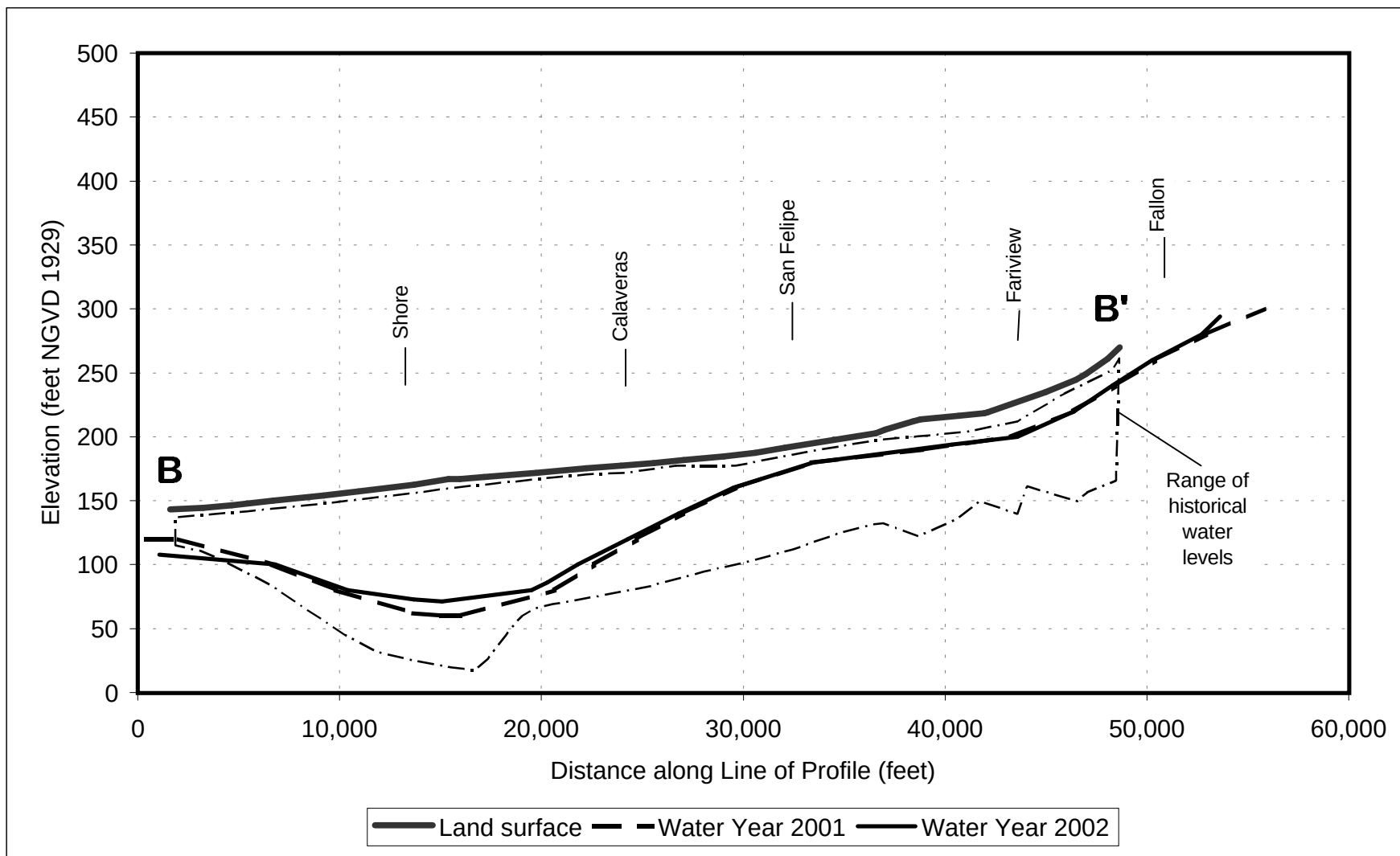


Figure G-4. Profile of Historical Groundwater Levels along Profile Line B-B'

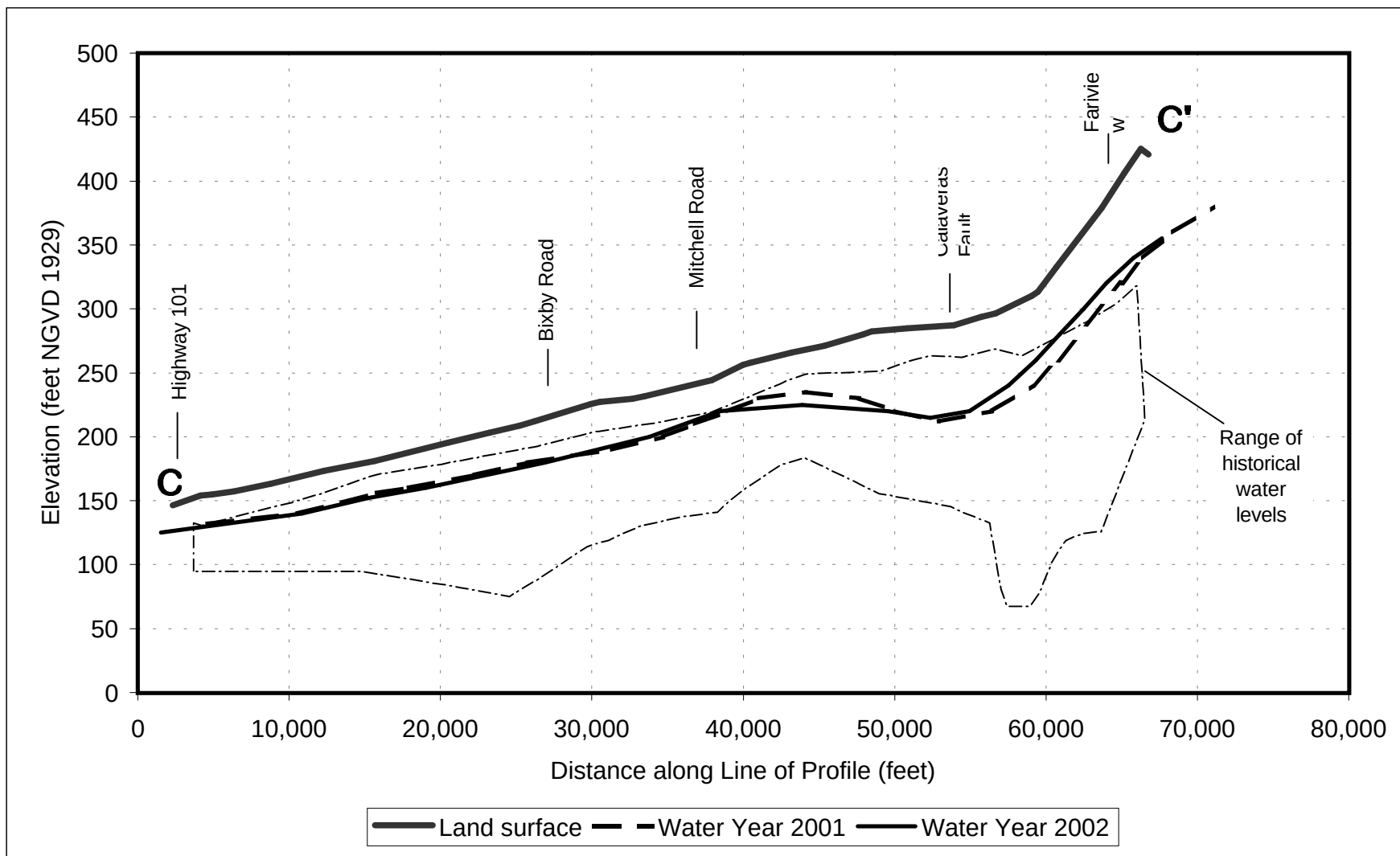


Figure G-5. Profile of Historical Groundwater Levels along Profile Line C-C'

Appendix H

APPENDIX H. WATER BUDGET CALCULATIONS

Groundwater budgets for each of the subbasins in Zone 6, the Bolsa subbasin, and the Paicines and Tres Pinos Creek Valley basins are shown in Table 6 in the main text. Methods used to estimate the subbasin groundwater budgets have gradually evolved over the past six annual reports as new information and tools became available and new circumstances arose. As explained in the main text, each of the budget items is estimated independently, and two methods of calculating change in groundwater storage are compared to shed light on any errors or inconsistencies in the item estimates. Data, assumptions, and calculation algorithms are then reviewed, and reasonable adjustments are made to eliminate large errors. Calculations and interpretations for each of the budget items are presented below.

With deep percolation and interbasin groundwater flow treated as known flows in the groundwater budget, stream percolation became the only reasonable variable to adjust to decrease the discrepancy between the two estimates of net annual storage change (see Storage Changes and Overdraft below). This approach was further justified by the fact that the storage change estimates in subbasins that do not interact dynamically with streams (Bolsa Southeast and Hollister East) were already in close agreement and that the initial water balances in the other subbasins—assuming no rejection of stream recharge—had too much recharge.

Inflows

Stream Percolation

High groundwater levels in recent years have caused some potential recharge from stream percolation to be rejected for lack of available storage space in the aquifers adjacent to the streams. Rejected recharge reflects a complex and dynamic interaction between surface water and groundwater and is difficult to quantify without using groundwater flow and stream hydraulics models. Stream percolation has become one of the most uncertain terms in the groundwater budgets, particularly given the lack of change in groundwater flows between subbasins and decreased use of deep percolation through soils as a variable for balancing the budgets.

Daily flows from natural runoff in Pacheco Creek, Arroyo de las Viboras, Arroyo Dos Picachos, Santa Ana Creek, and San Juan Creek were estimated from daily unit runoff averaged for four gaged watersheds surrounding northern San Benito County. Details of the streamflow estimation method were presented in the annual groundwater report for water year 1997, and selected data for 2001 are shown in Table H-1. The percolation rate and the length of the percolation reach for Santa Ana Creek were assumed to be the same as for percolation of San Felipe water in summer. An investigation of shallow

groundwater conditions in the Pacheco and northern Hollister East subbasins in 2000 by the District revealed that rising groundwater levels have shortened the percolation reaches in Arroyo de las Viboras and Arroyo Dos Picachos and converted Pacheco Creek to a gaining stream along the entire reach that lies within San Benito County. Streamflow monitoring during water year 2002 confirmed that Pacheco Creek continued to gain flow within the San Benito County reach, at least during low-flow periods. The natural stream percolation shown in Table 6 for the Pacheco subbasin derived entirely from Arroyo de las Viboras.

An initial estimate of percolation of natural flow along the San Benito River and Tres Pinos Creek was developed from measured flow losses between the gages at Willow Creek School, the old Highway 156 bridge and Tres Pinos Creek near Tres Pinos. The method for attributing percolation losses to natural flow versus releases from Hernandez Reservoir is described in the section on "Groundwater Storage Accounting. Because of the limited storage capacity of the Paicines and Tres Pinos Creek Valley basins, stream percolation in those areas was limited to a maximum storage deficit estimated as the residual in the annual groundwater budget (groundwater pumping + groundwater outflow – rainfall and irrigation recharge).

Total percolation of streamflow in the Tres Pinos and Hollister West subbasins was decreased to 30% and 40% of the initial, unrestricted percolation estimates, respectively. This decrease represents the effects of rejected recharge, and the percentage decrease is similar to the percentage assumed last year. If a larger difference in recharge rejection between the two subbasins could be justified, the remaining water budget errors could be reduced even further. Percolation calculations for the San Juan subbasin assumed a maximum percolation rate of 8 cfs—consistent with observed flow losses in past years—with no corrections for rejected recharge.

Percolation of San Felipe water was assumed to equal 100 % of the metered releases (Table 3) because the releases are adjusted to maintain complete percolation.

Deep Percolation through Soils

Deep percolation of applied irrigation water and rainfall below the root zone was estimated by calculating the daily soil moisture balance for various combinations of soil type, slope, and crop type. The soil moisture budget model (SMB model) that had been used since the 1996 annual report was revised in 2001 as part of a groundwater modeling effort, and the revised version was used for the 2002 estimates. The model simulates 25 one-dimensional recharge rates for 25 combinations of soils, slopes, and crops, and the simulated recharge rates for each combination were assigned on an area-weighted basis to each of 15 recharge zones in the basin. Rainfall-runoff and crop coefficient parameters were adjusted to calibrate the SMB model as part of the overall calibration of the groundwater model. The general effect of the adjustments was to decrease simulated recharge, especially in wet years. For

annual reports prior to 2001, the number of acres in each recharge zone was adjusted to achieve a match between simulated and measured water use for irrigation. This ensured that the amount of deep percolation recharge simulated by the SMB model was consistent with metered irrigation use. Since 2001, irrigation water use listed in Table 6 equals the measured amount, deep percolation of irrigation water equals 10% of the irrigation use (reflecting an assumed 90% irrigation efficiency), and rainfall percolation equals the balance of the simulated total deep percolation. The characteristics and distribution of the soil categories are listed in Tables H-2 and H-3.

Daily rainfall and reference ET data for the soil balance calculations were obtained from the California Irrigation Management Information System (CIMIS) meteorological station at the District's office in Hollister. Annual rainfall during water year 2002 was 13.24 inches, which almost exactly equals the 128-year average (13.09 inches). Rainfall was notably above average in November and December and below average during the remainder of the wet season. Reference evapotranspiration—which is less variable than rainfall—was 8% above average during May–September and 7% above average for the entire year. Rainfall and reference evapotranspiration data are presented in Appendix B.

For individual crop-soil combinations, deep percolation of rainfall ranged from zero (for native vegetation on all soil types except the San Benito River gravels) to 49% of rainfall (for bare river gravels). Rainfall recharge on bare soils was 12–49% of rainfall, depending on soil type. Because many fields were bare during much of the rainy season, rainfall recharge was higher in agricultural recharge zones than would have been the case with cover crops. For example, there was negligible rainfall recharge on pasture because the evapotranspiration demand of the grass during winter was sufficient to prevent rainfall from completely filling the root zone moisture storage capacity.

Reclaimed Water Percolation

As described above in the section on Recharge of Reclaimed Water, total groundwater recharge from reclaimed water was approximately 3,953 af during water year 2002 (Table 4).

Groundwater Inflow and Outflow

Groundwater can flow across many internal and external subbasin boundaries. From a water supply standpoint, the net inflow or outflow to or from each subbasin is more important than the actual magnitudes of the inflow and outflow. In prior years, the estimates of flows across subbasin boundaries were based on the direction and slope of water-level gradients, relative boundary permeabilities, river thalweg elevations, conservation of mass, and the amount of imbalance in the subbasin water budgets. Because the estimates were highly uncertain, they were adjusted slightly each year to help balance the subbasin water budgets. Because the net change in groundwater level during water year 2002 was small in most parts of the basin, groundwater flows between subbasins were assumed to be the same as

during water year 2001, with one exception. Groundwater inflow to the Bolsa subbasin was increased by 2,000 af to reflect a chronic error in the water budget for that subbasin and to reflect the likelihood of percolation from the Pajaro River and Millers Canal. A more detailed discussion of each of the groundwater flow entries was presented in the annual groundwater report for water year 1999.

Outflows

Wells

Groundwater pumping in Zone 6 was compiled from the District's billing records. For large wells, the District calculates annual pumping by multiplying the number of hours of well operation by the well discharge rate. The total hours of operation are recorded twice a year, in February and September. The discharge rates of these wells are periodically measured. For pumping at municipal supply wells, monthly production records obtained from the three major municipal water suppliers were used in lieu of the District's semiannual meter readings. For wells with discharge pipes less than 3 inches in diameter, the District estimates the amount of groundwater produced based on the parcel size and water use factors reflecting the number of homes, residents, livestock, and square feet of irrigated land.

The billing records are by parcel and cover all parcels in zone 6, even those that do not have a connection for receiving San Felipe water. The municipal supply well for Tres Pinos is outside of Zone 6, and its production is included in the Tres Pinos Creek Valley basin groundwater budget.

Groundwater pumping for agricultural use in Zone 6 totaled 15,256 af during water year 2001. Domestic and M&I pumping totaled 9,988 af (see Table 1). The method for estimating agricultural groundwater pumping in the Bolsa subbasin was revised this year. Instead of applying the average per-acre water use for all of Zone 6 to all of the acres in the Bolsa subbasin, water use for irrigation was estimated for individual crops and applied to the areas of those crops surveyed by DWR in 1997. Somewhat surprisingly, the revised method resulted in a slightly larger estimate of irrigation water use. Domestic groundwater use for the small number of residences in the Bolsa basin was assumed to be negligible compared to groundwater use for irrigation. Average annual groundwater pumping in the Paicines and Tres Pinos Creek Valley basins was estimated by LSCE (1991) based on the 1989 irrigated acreage and typical water demand for the major crops in those areas. These average values were adjusted by the same percentage that Zone 6 agricultural pumping deviated from the long-term average value.

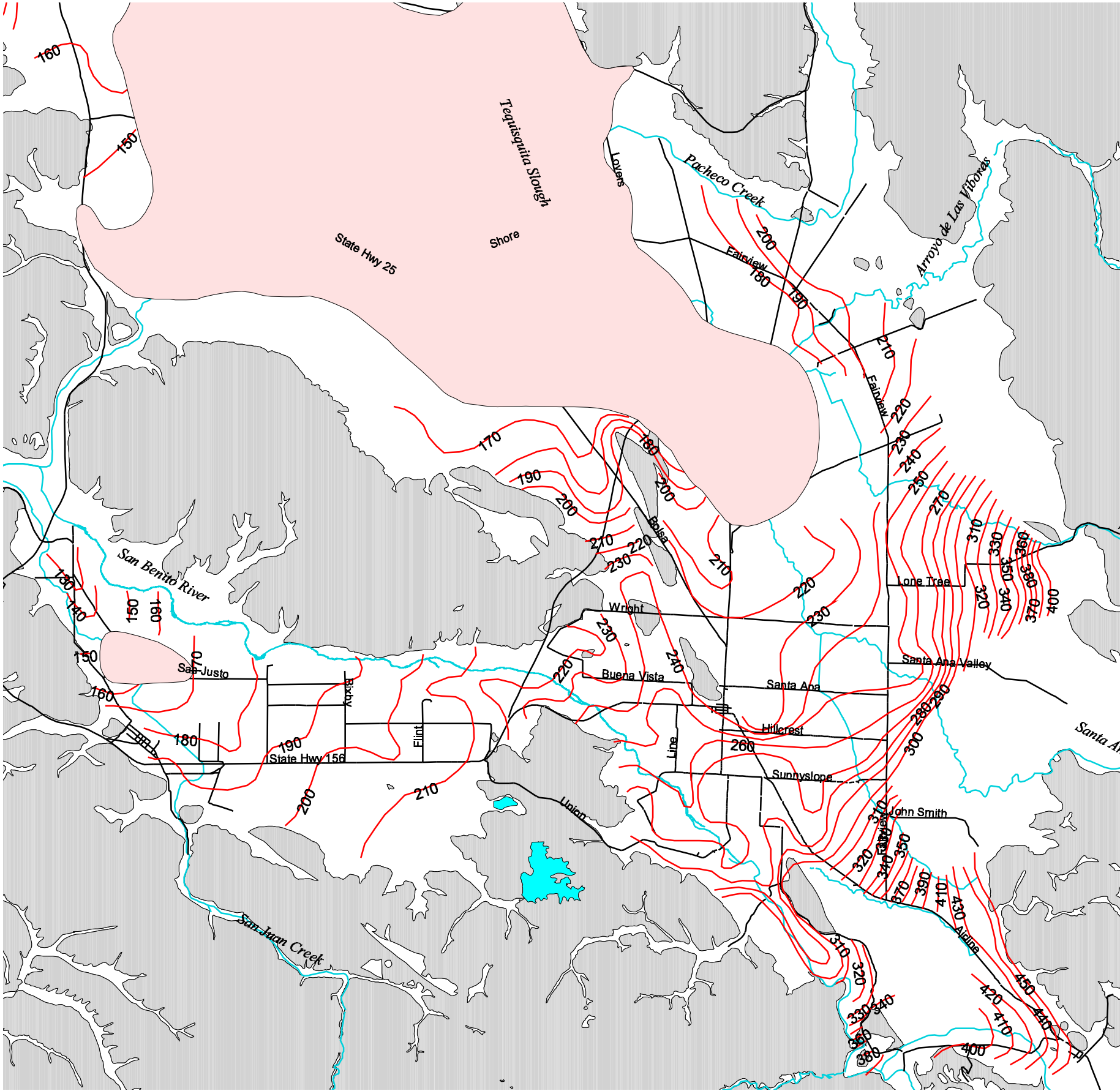
Storage Changes and Overdraft

Two methods were used to estimate net change in groundwater storage during water year 2002, and the methods were compared to identify discrepancies or inaccuracies in the water budgets. Storage changes were first estimated from net changes in water levels during the water year. For each subbasin, contoured groundwater elevations for October 2001 were subtracted from contoured elevations for October 2002, and the resulting change in water level (shown in Figure 6) was multiplied by the local groundwater storativity value. In past years, storativity values were area-weighted averages from the groundwater model developed by LSCE (1991). This year, they were replaced with area-weighted averages from the groundwater model completed in 2001 by the District and San Benito County (Yates and Zhang 2001). The storage coefficient and calculated storage change for each subbasin are shown in Table H-4, and the storage changes are also shown in the bottom row of Table 6 immediately beneath the line with the estimated storage change calculated by subtracting outflows from inflows.

The estimates of storage changes based on water-level changes indicate a net decrease in storage of 2,571 af in Zone 6 during water year 2002. Most of the decrease occurred in the Tres Pinos, Hollister West, and San Juan subbasins, where below-average stream recharge and percolation of Hernandez and San Felipe water contributed to small net declines in water levels. Storage increases in the Bolsa, Bolsa Southeast and Hollister East subbasins are a continuation of long-term process of refilling storage that was depleted by historical overdraft.

The remaining amount of historical overdraft of the groundwater basin since the beginning of substantial groundwater development was calculated from the change in water levels between 1913 and 2002. Figure H-1 shows contours of groundwater elevation in 1913 (Clarke 1924), which was before substantial use of groundwater resources. Artesian conditions (flowing wells) were present throughout much of the Bolsa subbasin and parts of the Pacheco, Hollister East, and San Juan subbasins. Some of the difference between 1913 water levels and 2002 water levels could result from differences in the time of year of the measurements (August versus October) and differences in average well depth (150–250 feet in 1913 versus about 400 feet in 2002). Pumping creates vertical water-level gradients within groundwater basins, and the minimum water level along a vertical profile of the aquifer system tends to be at the depth of the average well. Thus, the difference in well depths between 1913 and 2001 might not bias a water-level comparison because in both cases the water levels correspond to the average depth of the pumping stress. Figure H-2 shows the change in groundwater elevation from August 1913 to October 2002. Using the same methodology used to calculate storage changes from water level changes during 2002, the net change in storage during 1913–2002 was calculated for each subbasin. The results are shown in Table H-4. The net change was a decrease in storage of approximately 69,000 af in Zone 6 and 26,000 af in the Bolsa subbasin.

Figure H-1. Contours of Groundwater Elevation, August 1913



LEGEND

- Basin boundary
- River or creek
- Major roads
- Approximate area of flowing wells
- ~~220~~ Contours of elevation of groundwater in wells, in feet above sea level

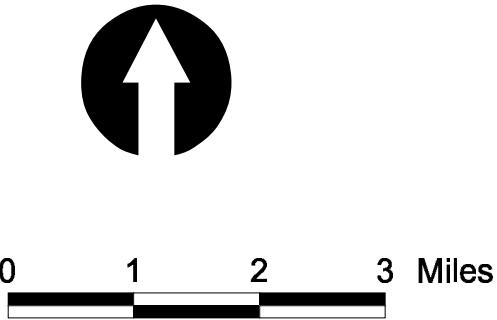
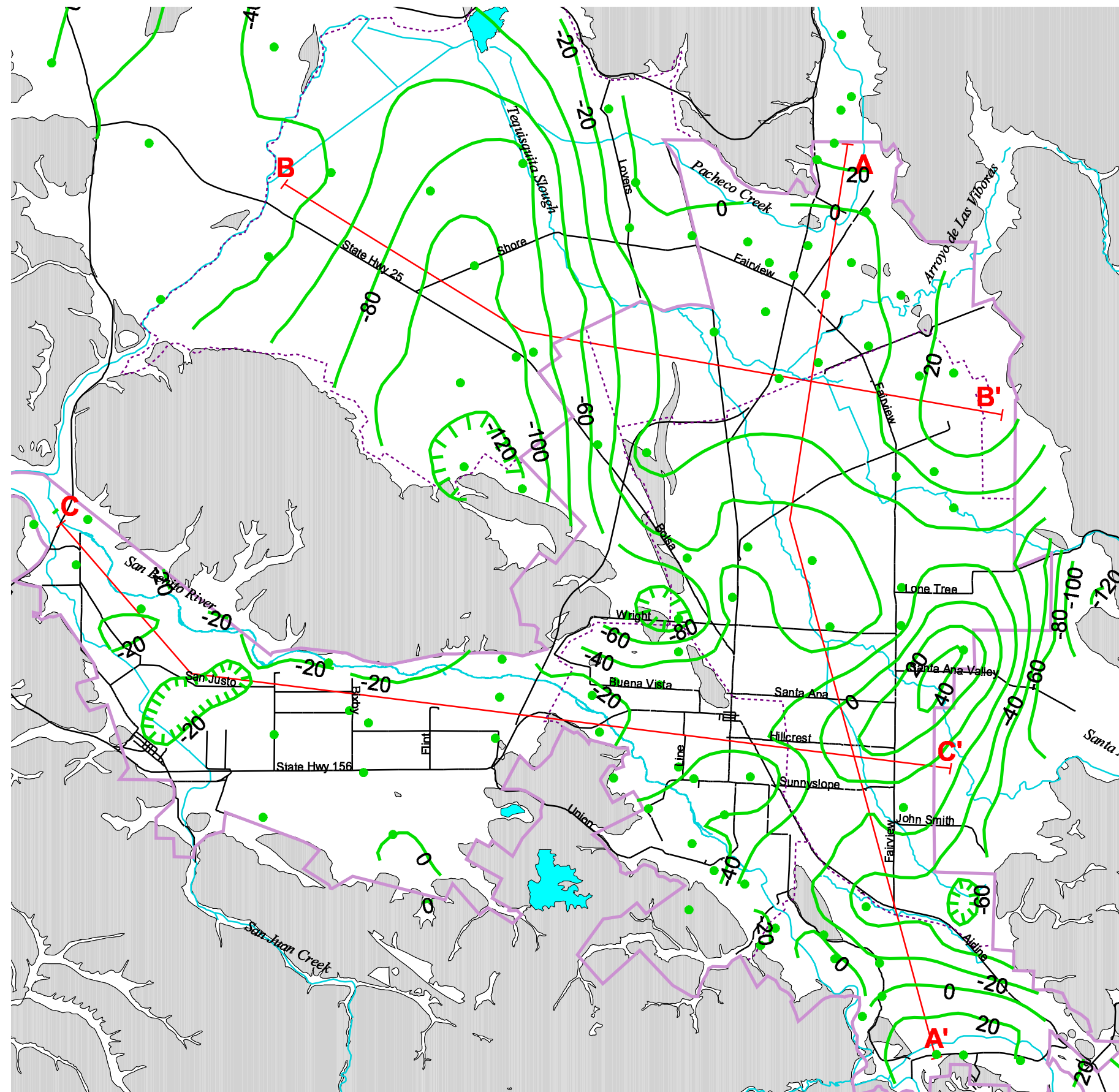
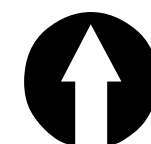


Figure H-2. Contours of Change in Groundwater Elevation, August 1913 to October 2002



- LEGEND**
- Basin boundary
 - River or creek
 - Major roads
 - Zone 6 boundary
 - Subbasin boundary
 - Contours of equal change in groundwater elevation, in feet
 - Hachures point in the less positive direction
 - Water level measurement well in 2002
 - Line of water level profile



0 1 2 3 Miles

Table H-1. Measured Percolation and Parameters for Estimating Natural Flow and Percolation in Local Streams

	Watershed Area (sq. miles)	Average Annual Rainfall (inches)	Measured Summer Percolation (1)			Channel Length for Natural Percolation (miles)	Reach Description
			Maximum Unit Percolation Rate (cfs/mile)	Channel Length (miles)	Maximum Percolation Rate (cfs)		
Reference Streams (2)							
Gabilan Creek	36.7	18	n.a.	n.a.	n.a.	n.a.	
Cantua Creek	46.4	11	n.a.	n.a.	n.a.	n.a.	
Los Gatos Ck	95.8	16	n.a.	n.a.	n.a.	n.a.	
Corralitos Ck	27.8	35	n.a.	n.a.	n.a.	n.a.	
Estimated Streams							
Pacheco Creek	145.0	18	2.67	0.00	0.00	0.00	Presently gaining flow along entire reach within San Benito County
Arroyo de las Viboras	22.1	22	2.76	2.28	6.29	2.28	Hawkins Ranch to approximately Fairview Road
Arroyo Dos Picachos	16.2	20	0.78	1.31	1.02	1.31	Jarvis Lane to 0.5 mile past Fallon Road
Santa Ana Creek	36.5	19	0.79	7.58	6.00	7.58	Maranatha Dr., John Smith Rd., and main channels to Fallon Rd. (edge of clay)
Bird Creek (3)	15.0	18	n.a.	n.a.	n.a.	n.a.	
Tres Pinos Creek							
Tres Pinos Creek Vly.	n.a.	n.a.	1.20	5.76	6.91	6.63	Los Muertos Cr. (natural) or Willow Grove School (summer) to Tres Pinos Creek stream gage
Zone 6	n.a.	n.a.	2.85	1.76	5.02	6.23	Tres Pinos Creek stream gage to San Benito River
Pescadero Creek (3)	38.3	18	n.a.	n.a.	n.a.	n.a.	
San Benito River (4)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	Percolation estimated directly from measured flow loss.

Notes:

cfs = cubic feet per second

n.a. = not applicable

- (1) Maximum summer percolation rates based on historical dry-season San Felipe releases required to wet the indicated reach.
For the San Benito River, the maximum unit percolation rate for the zone 6 reach was estimated from flow losses between Cienega Road and Flint Road while percolating San Felipe water on August 15, 1996. The maximum percolation rate for the Paicines basin reach equals the total percolation capacity between the Willow Creek School gage and the Highway 156 gage (50 cfs), minus the maximum percolation rate for the 8-mile reach from the Zone 6 boundary to Highway 156 (50 cfs - 8.0 mi x 3.17 cfs/mi = 24.64 cfs). High groundwater levels caused some recharge to be rejected in the Paicines, Tres Pinos, Hollister West and San Juan subbasins during 2001, resulting in rates smaller than the maximum percolation capacities shown here.
- (2) Reference streams are used to estimate streamflow only, not percolation.
- (3) Bird Creek and Pescadero Creek flows percolate through the San Benito River channel.
- (4) Percolation along the San Benito River in the Paicines basin and the Tres Pinos and Hollister West subbasins estimated separately from measured flow losses between the Willow Creek School and old Highway 156 gages. Seepage losses in the San Juan subbasin limited to the maximum observed rate of 8 cfs.

Table H-2. Soil and Vegetation Types Used to Characterize Groundwater Recharge Zones

Soil Types

Soil Type Category	NRCS Hydrologic Group ¹	Available Water Capacity (in/in)	Ground Slope (%)	Runoff Equation ²		Soil Series Included ³
				Intercept (in)	Slope (decimal)	
I	A	0.08	0 - 2	0.48	0.75	Riverwash, sandy alluvial soils, Metz
II	B	0.19	0 - 2	0.36	0.8	Sorrento, Reiff
III	C	0.18	0 - 2	0.32	0.85	Pacheco, Rincon, Salinas
IV	D	0.15	0 - 2	0.2	0.95	Willows, Clear Lake, Cropley, Antioch
V	D	0.15	>2	0.28	0.9	Diablo, San Benito, Linne, Soper

Notes:

¹ Natural Resources Conservation Service soil groups for calculating rainfall runoff using the curve number method. Textures range from Group A (sandy well-drained soils) to Group D (poorly-drained clay soils).

² Runoff = (rainfall - intercept) x slope. Rainfall and runoff are daily values in inches.

³ Soil series are formation names and are described in the county soil survey.

Crop Types

Vegetation Type	Root Depth (inches)	Irrigated (Yes/No)	Crop Coefficient Data Source ¹	Irrigation Efficiency (%)
Native vegetation	36-48 ²	N	= ET_0	n.a.
Fallow (bare)	30	N	10-40% of ET_0	n.a.
Pasture/turf/alfalfa	36	Y	= ET_0	90
Grains	30	Y,N ³	Bulletin 113	90
Field crops	30	Y,N ³	Bulletin 113	90
Truck crops	24	Y	R. Smith	90
Deciduous orchard	72	Y	R. Smith	90

Notes:

n.a. = not applicable

ET_0 = reference evapotranspiration

¹ Sources of crop coefficient data include California Department of Water Resources Bulletin 113 (1975 and 1986) and Cooperative Extension crop advisor Richard Smith (pers. comm.). The bare-soil crop coefficient ranges from 0.1 in summer to 0.4 in winter.

² The shallower root depths are assumed on grass-covered hillslopes surrounding the valley floor, and the larger root depths are assumed for riparian vegetation.

³ Grain crops are principally nonirrigated winter wheat and oats. The principal field crop is irrigated summer corn.

⁴ Based on harvested acreage, truck crops are lettuce (53%), peppers (11%), tomatoes (10%), cucumbers (10%), broccoli (7%), onions (7%) and other (2%).

⁵ For the purpose of assigning crop coefficients, half of the deciduous orchards are assumed to have cover crops and the other half not.

Table H-3 Soil Moisture Budget Recharge Zone Parameters and Simulated Flows during Water Year 2002

																Totals	
																All Zones	Except Zone 3
Recharge zone number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Recharge Zone Parameters																	
Number of groundwater model cells in zone	146	274	3546	25	180	91	369	370	81	142	57	232	196	423	45	n.a.	n.a.
Area of zone (acres)	3,352	6,290	81,405	574	4,132	2,089	8,471	8,494	1,860	3,260	1,309	5,326	4,500	9,711	1,033	141,804	60,399
Soil group	I	II	V	I	III	III	IV	IV	IV	III	III	II	III	II	II	n.a.	n.a.
Vegetation types (%)																	
Native vegetation	60	10	100	10	10	100	10	10	10	10		25	30	10	20	n.a.	n.a.
Fallow/bare	40	40-10		40-10	40-10		50-10		40-10	50-10				50-10		n.a.	n.a.
Pasture/turf/alfalfa									40			20	30			n.a.	n.a.
Irrigated grain/field										20				20		n.a.	n.a.
Nonirrigated grain/field							20	90			100					n.a.	n.a.
Truck		10-40		10-40	10-40		20-60		10-40	20-60				20-60		n.a.	n.a.
Deciduous orchard		40		40	40							20	30		80	n.a.	n.a.
Impervious												35	10			n.a.	n.a.
Simulated Annual Flows During Water Year 2002																	
Annual flow per unit area (inches)																	
Rain	13.24	13.24	13.24	13.24	13.24	13.24	13.24	13.24	13.24	13.24	13.24	13.24	13.24	13.24	13.24	n.a.	n.a.
Runoff	1.23	0.30	4.43	0.21	0.36	3.60	0.61	0.61	0.61	0.36	0.00	0.74	1.08	0.30	0.60	n.a.	n.a.
Irrigation	0.00	25.01	0.00	25.69	26.61	0.00	18.89	0.00	26.99	24.05	0.00	12.29	21.83	24.63	24.58	n.a.	n.a.
Evapotranspiration	7.76	29.31	8.99	29.78	29.93	9.87	22.75	7.30	29.94	27.71	9.36	17.76	26.28	28.01	31.36	n.a.	n.a.
Groundwater recharge	3.62	4.60	0.00	7.24	5.05	0.00	2.87	0.00	3.67	5.41	0.47	1.40	3.20	6.42	2.46	n.a.	n.a.
Annual flow volume (acre-feet)																	
Rain	3,698	6,940	89,817	633	4,559	2,305	9,346	9,372	2,052	3,597	1,444	5,876	4,964	10,714	1,140	156,458	66,641
Runoff	344	156	30,038	10	124	627	432	433	95	98	0	330	405	241	51	33,385	3,347
Irrigation	0	13,109	0	1,229	9,164	0	13,332	0	4,182	6,533	0	5,453	8,186	19,931	2,116	83,235	83,235
Evapotranspiration	2,168	15,365	60,973	1,424	10,306	1,718	16,061	5,169	4,640	7,529	1,021	7,882	9,854	22,670	2,700	169,478	108,505
Groundwater recharge	1,012	2,413	0	346	1,740	0	2,023	0	569	1,469	51	622	1,200	5,199	212	16,857	16,857
Subbasin Distribution of Recharge, by Zone (acre-feet)																	
Pacheco	0	1,229	0	0	232	0	0	0	146	302	34	0	0	0	0	1,943	1,943
Bolsa Southeast	0	0	0	0	143	0	0	0	0	0	0	0	0	661	0	804	804
San Juan	421	316	0	0	0	0	306	0	0	0	0	13	43	3,367	0	4,466	4,466
Hollister West	377	371	0	61	611	0	0	0	0	11	0	170	0	0	99	1,700	1,700
Hollister East	0	43	0	0	576	0	461	0	206	202	1	351	670	745	0	3,255	3,255
Tres Pinos	216	241	0	0	0	0	0	0	0	0	0	63	335	0	115	969	969
Subtotal zone 6	1,014	2,200	0	61	1,562	0	767	0	353	516	35	597	1,047	4,773	214	13,138	13,138
Bolsa	0	132	0	346	155	0	959	0	218	921	17	0	0	172	0	2,919	2,919
Paicines	0	0	0	0	0	0	0	0	0	0	0	0	0	1,092	0	1,092	1,092
Tres Pinos Cr. Valley	0	173	0	0	0	0	0	0	0	0	0	0	0	0	0	173	173
Total	1,014	2,504	0	407	1,716	0	1,726	0	570	1,436	52	597	1,047	6,037	214	17,322	17,322

Appendix I

APPENDIX I. GROUNDWATER CONTAMINATION SITES

No new groundwater contamination sites were discovered during water year 2002. Listed below are descriptions of known groundwater contamination sites in northern San Benito County that are undergoing active investigation and remediation supervised by the California Regional Water Quality Control Board (CRWQCB). The information was compiled from interviews with technical consultants for San Benito County Integrated Waste Management Department (Vercoutere pers. comm.), personnel at California Department of Health Services (Sweigert pers. comm.), and the CRWQCB (Hernandez pers. comms.), as well as from CRWQCB's Internet database of leaky underground storage tanks (California State Water Resources Control Board 2002). The list does not include several sites where only soil was contaminated or where cleanup activities have been completed. The sites are listed alphabetically by name.

E's Ranch Milk 105 San Felipe Road Hollister

Groundwater beneath the site has been contaminated with gasoline, including MTBE. The leak was first discovered in 1992 and cleanup activities, including soil vapor extraction and groundwater extraction and treatment, have been ongoing since 1996. Progress appears to be slow, however. The highest concentration of MTBE since sampling began in 1998 was measured in May 2002 (810 parts per billion [ppb]). There is no obvious declining trend in MTBE concentrations. An updated remediation plan and regulatory review were completed in 2002.

John Smith Landfill John Smith Road Hollister

A plume of volatile organic compounds was found in 1989 beneath this landfill east of Hollister and has been undergoing active remediation since. When it was first delineated, the plume extended onto an adjoining parcel. The plume is now stationary, and the four extraction wells used for groundwater treatment continued to operate throughout water year 2002. The treated water is discharged into the City of Hollister municipal sewer system. Concentrations of all but three of the contaminants (cis-1,2-dichloroethane, tetrachloroethane, and trichloroethane) have decreased to below their target levels for cleanup. A vapor extraction system installed in 2001 continued to accelerate the removal of volatile contaminants. Overall, however, concentrations have remained low and steady. The CRWQCB slightly modified the monitoring requirements to reflect previous sampling results.

Mel's Chevron Station
375 Fourth Street
Hollister

Gasoline contamination of groundwater is present at this site. Two additional monitoring wells installed in 2000 provided data suggesting that contamination may be coming from offsite. Treatment consists of soil vapor extraction. An MTBE concentration of 700 ppb was measured in July 2002, and cleanup activities underwent a recent regulatory review this year.

Quantic Industries (former Whittaker ordnance facility)
2751 San Juan Road
Hollister

The site is former munitions and explosives manufacturing facility. Remediation of groundwater contamination has been in progress since the mid-1990s. Pilot studies were completed in 2002 to test three remedial technologies, and all of them were fairly successful. Two of the methods involved injection of compounds (lactic acid or molasses) for in-situ biodegradation of volatile organics, hexavalent chromium, Freon 113, and perchlorate. The third method used a pump-and-treat process involving carbon and an ion exchange system. Concentrations of the contaminants are still quite high, and all work is proceeding under close supervision of the CRWQCB.

Toro Petroleum Company
1285 Prospect Avenue
Hollister

A gasoline leak was discovered in 2001 when an underground tank was removed. A site assessment workplan has been submitted. No sampling results or CRWQCB activity were reported in 2002.

Tosco 76 Products Facility
102 San Benito Road
Hollister

Gasoline contamination beneath the site was discovered in 1999, and the extent of contamination is under investigation. No sampling results or CRWQCB activity were reported in 2002.

**Victory Gas & Food
1615 San Juan Road
Hollister**

A leaking underground storage tank was discovered in 2001. The extent of gasoline contamination is under investigation. No sampling results or CRWQCB activity were reported in 2002.