

KERN COUNTY WATER AGENCY

WATER SUPPLY REPORT
2000

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In-lieu Recharge - The process of recharging groundwater supplies by substituting surface water for groundwater that would otherwise be pumped.

Irrigation Efficiency - The amount of irrigation water stored within the crop root zone in relation to the total amount applied, expressed as a percent.

Metric Conversions

Acre-feet (x) 1233.5 = cubic meters

Acre-feet (x) 0.0012335 = cubic hectometers

Feet (x) 0.0348 = meters

Inches (x) 2.54 = centimeters

Million gallons per day (x) 0.043813 = cubic meters per second

Acres (x) .4047 = hectares

Overdraft - A long-term condition in which groundwater recovery of a basin exceeds groundwater recharge in that basin.

Sacramento River Index - An index used by the California Department of Water Resources to forecast available water supplies and State Water Project delivery capabilities. The index consists of the forecasted or computed unimpaired flows of the Sacramento River near Red Bluff, Feather River at Oroville Reservoir, Yuba River at Smartville and American River at Folsom Reservoir.

SWP The State Water Project - In Kern County, its major feature is the Edmund G. Brown California Aqueduct.

TDS - Total dissolved solids. A measurement of the dissolved solids in water, consisting mainly of inorganic salts and small amounts of organic matter and gases. Usually measured in parts per million (ppm).

Unconfined Aquifer - A groundwater bearing stratum that is not constrained at its upper surface by an impervious or semi-impervious unit, such as a regional clay.

USBR United States Bureau of Reclamation - Constructed the federal Central Valley Project, which is now operated by the Friant Water Users Authority.

2000 – A year of change

Although water year 2000 started with a dry November and December, the initial allocation for the SWP water was 50 percent of contracted supplies. With December 1999 as the eighth driest December on record, dry conditions continued through early January. However, by the end of January 2000, a turnaround occurred for Northern California hydrology. The month concluded with the SWP share of San Luis Reservoir (San Luis) at 870,000 acre-feet and Lake Oroville (Oroville) at 2.3 million acre-feet (maf). This was in spite of fishery concerns earlier in 1999 that reduced SWP pumping in the Sacramento-San Joaquin Delta (Delta). Due to delta smelt concerns, DWR estimated that the export reductions in the summer of 1999, resulting from high salvage of delta smelt at the SWP export facility, reduced the amount of water the SWP had moved to San Luis Reservoir by about 286,000 acre-feet. This lowered the initial allocation to the Contractors by about five percent. The storage impact also delayed the availability of Article 21 water to the Contractors and resulted in about 70 thousand acre-feet (taf) less of Article 21 being delivered later in 2000.

The Northern Sierra Eight Station Index (Eight Station Index) is an indicator of the average water supply conditions in Northern California. By January 26, 2000 the Eight Station Index was at 23.6 inches of cumulative rainfall since the start of the water year, or 94 percent of average. By February 22, that value jumped to 36.8 inches for the year, or 112 percent of average.

In February, the Central Valley Project (CVP) share of San Luis was about 695,000 af and filling at an average rate of 4,500 af per day. The United States Bureau of Reclamation's (USBR) initial water allocation for deliveries of south-of- Delta agricultural contractors was 50 percent of contracted supplies. Friant CVP contractors received an initial allocation of 60 percent for Class I supplies and no Class II water.

By March 2000, water supply conditions improved significantly and DWR increased the SWP allocation to 100% of the SWP contractors' (Contractors) request (3.62 maf). The Eight-Station Index reached 123 percent of average by late March, and the Northern Sierra snowpack was at 130 percent of normal as of March 20. Approved deliveries for south of Delta ag contractors on the federal projects was at 60 percent of contracted supplies on March 20, 2000. Friant CVP contractors were approved for 100 percent of Class I supplies and 100 percent of Class II supplies. Storage in Lake Isabella was at 190,016 af on March 21, making it 104 percent of normal. Storage in Lake Isabella was forecast to peak between 360,000 and 400,000 af during June.

In April 2000, the Contractors received bad news from DWR. March precipitation was about half of normal. Coupled with higher than expected demands for SWP water south of the Delta and greater Delta water quality requirements, DWR became concerned about being able to meet the 100 percent SWP allocation. Water supply studies, updated in the middle of April, were indicating a reduction in the water delivery capability of the SWP as well as lower San Luis storage in relation to the studies prepared in March that supported the 100 percent allocation. On April 20, DWR announced a 10 percent reduction in the SWP allocation from

- The Lower Kern River Program was established. In December 2000, the Agency entered an agreement for the purchase of Lower Kern River Rights from Nickel LLC. Funding was largely supplied from the Proposition 13 grant monies. The Agency purchased a package of rights, which included storage in Lake Isabella, rights to high flows on the Kern River (estimated at a long term average of 50,000 af per year) and other associated rights. The price included a payment of \$7.4 million from bond funds and provision of 10,000 af per year of Agency supplies.

Water Supplies

State Water Project

Although the initial hydrology for 2000 was dry, the initial allocation for State Water Project contractors was 50 percent. An improvement in hydrology prompted an increase up to 100 percent, but by April the outlook for SWP operations changed and DWR was forced to drop the allocation to 90 percent.

The chronology of 2000 allocations follows:

November 30, 1999	50% allocation
February 25, 2000	70% allocation
March 10, 2000	100% allocation
April 20, 2000	90% allocation

Member Units' contract entitlements since 1990 are shown on Table 2. The table also shows entitlement between municipal and industrial (M&I) and agricultural uses. The Agency is the third largest M&I SWP contractor, and is the largest agricultural SWP contractor.

The SWP provided a total of 1,399,674 af to the Agency, including 1,087,730 af of SWP Table A, 58,241 af of Article 21 Water, 45,360 af of DWR Turnback Pool Purchase and 208,343 af of SWP water transferred into Kern County by other entities. A total of 1,386,481 af of SWP water were actually delivered during 2000. Since the first deliveries in 1968, nearly 25 million af of SWP water have been brought into Kern County. A graph of historic SWP deliveries is provided in Figure 3. Table 3 shows a history of SWP deliveries, with annual and cumulative deliveries and imports. Table 4 shows 2000 SWP deliveries by contract type.

Kern River

For 2000, the Kern River natural flows were two-thirds of its average rate. This was a result of dry conditions since the end of 1999. Concerns of another below normal year surfaced during February with a Kern River forecast of only 40 percent of average. In March the southern Sierra begin to turn around and registered 105 percent of normal runoff, which translated into a forecasted runoff for the Kern River of 85 percent of normal. The Kern River flows that were maintained above average until the end of December 1998 were replaced by a April-July unimpaired runoff at 70 percent of average and Lake Isabella storage was at 247,590 af, about 44 percent of total capacity in June.

Table 7 shows deliveries of CVP water by entity for 2000. As shown, 270,578 af of Class I entitlement and 184,924 af of Class II water was delivered. A total of 39,542 af of "Section 215" water was delivered in 2000, most of which was delivered to Southern San Joaquin Municipal Utility District. MUD. Also, 202,067 af of other water were delivered, to Arvin-Edison Water District under its banking program with Metropolitan Water District of Southern California. This water is not included in the total CVP deliveries to the county.

Table 8 displays annual and cumulative deliveries of CVP water since 1950, when water was first imported to Kern County. Figure 5 shows CVP deliveries since 1970. From 1950 to 2000, almost 15.8 million af of CVP water were imported into Kern County.

Minor Streams

Local minor stream watersheds are the second largest local source of surface water, after the Kern River. Streams which yield measurable runoff are grouped into four watershed areas: the Poso group (including Poso Creek), the Caliente group (including Caliente and Tehachapi Creeks), the El Paso group (including El Paso Creek), and the San Emigdio group (including San Emigdio Creek). Grouping of minor streams is based upon hydrologic similarity of the watersheds and representative gauging records. Minor stream flows can be substantial during above-average precipitation years, such as 1982, 1983 and 1986.

Runoff for ungauged streams is estimated by statistical methods based on historic relationships of the watershed area, precipitation and runoff for similar gauged streams. Gauges are in place on Poso and Tehachapi Creeks, and therefore actual measurements can usually be used for these watersheds. The Agency, in cooperation with local water districts, monitors stream flows on Poso and Tehachapi Creeks. However, in very dry years the flow on Tehachapi Creek is too small for the gauge to record. In this report, flows are assumed to occur at the foothill line before they disappear into the valley alluvium. Total minor stream volumes in 2000 were estimated to be about 25,700 af as follows:

<u>Stream Group</u>	<u>Acre-feet</u>
Poso	14,400
Caliente	5,000
El Paso	2,700
San Emigdio	3,600
Total	25,700

Some minor stream water is used for irrigation by farmers in the North Kern Water Storage District and Semitropic Water Storage District. Much of the remaining water percolates to the underlying aquifer. Some of this recharge probably contributes to the shallow groundwater in the Kern Lake Bed area and near the Kern National Wildlife Refuge. The Agency estimated that about 24,500 af of the minor stream flows during 2000 contributed to groundwater recharge. Table 9 shows annual minor stream runoff, along with cumulative runoff since 1970. The variability of minor stream flows is shown by the accompanying statistics, and shown graphically in Figure 6. Figures 7a and 7c show the hydrograph for Tehachapi and Poso in 2000. Figures 7b and 7d show cumulative runoff for Tehachapi and Poso for the year.

Figure 8 shows annual rainfall recorded at three selected climatic stations in Kern County. Rainfall in the Wheeler Ridge area is normally higher than on the valley floor. Orographic uplift associated with the mountains at the southern end of the San Joaquin valley account for the higher rainfall in this area. Table 11 lists the annual amounts of effective precipitation, expressed as total af and inches per acre, along with cumulative amounts and descriptive statistics. Figure 9 is a graphic depiction of the same information.

Recycled Water

The reuse of municipal and industrial waste water provides an irrigation water source for Kern County agriculture. There are 14 active waste water recycling treatment plants in the San Joaquin Valley portion of Kern County. Recycling processes are classified as follows. "Primary" treatment removes most suspended matter from the sewage (usually via settling ponds), but removes little or no colloidal or dissolved matter. "Secondary" treatment provides some biological action or filtration to remove any remaining colloidal or dissolved substances from the sewage (nearly all recycling treatment facilities in Kern County provide secondary treatment of sewage). "Tertiary" treatment involves further filtration and disinfections to inactivate pathogens.

Most of the effluent from treatment plants in Kern County is recycled and used to irrigate salt-tolerant crops on bordering lands, such as cotton, pasture and some grains. A small amount percolates directly to the groundwater basin. The remainder evaporates. In 2000 about 49,970 af of waste water were recycled (Table 12). The Agency estimated that about 45,300 af were used by agriculture, 90 af evaporated and 4,580 percolated to the underlying aquifer. Table 13 shows historic amounts of recycled water. Figure 10 shows the same information as a graph.

Another source of reusable waste water results from agricultural tail water return systems. Many farming operations have installed these systems to intercept water that would normally run off the field during irrigation. This recovered water is either transported back to the main irrigation system or is applied on an adjacent field (from the foot of one field to head of another). Tail water return systems are widely used on fields that are furrow or border irrigated. Their efficiency lies in the saving of energy required to recover the water from wells, or by reducing the need to import additional surface supplies. From a basin balance standpoint, these two water reuse activities are internal and do not add to the hydrologic system.

Oil Field Produced Water

Another source of waste water is as a byproduct of oil production. Unlike treated municipal effluent or tail water, oilfield-produced waters are a true addition to the hydrologic system, being drawn from deep, connate waters that are intermixed with oil deposits. In the Kern Front oil field, which lies astride the Kern River, northeast of Bakersfield, substantial quantities of water are removed with each barrel of oil. The chemical quality of this water is generally within acceptable limits for agriculture. Thus, much of this water is discharged into irrigation canals.

Water Requirements

Agricultural

Gross irrigated acreage in the San Joaquin Valley portion of Kern County was about 884,105 in 2000. Since 8,761 acres were double-cropped, total net acreage in 2000 was 875,344. Approximately 750,755 acres were irrigated over the usable groundwater basin, and 133,350 acres were irrigated on lands outside the usable groundwater basin.

A summary of irrigated acreage is provided in Table 16, along with descriptive statistics. Figure 13 shows irrigated acreage plotted as a bar graph. Figure 14 categorizes irrigated acreage by crop. Permanent crops (trees and vines) make up 43 percent of Kern County's total acreage. Cotton remained an important crop to Kern County's economy despite falling prices and comprises 21 percent of the county's total acreage. Alfalfa and other green feeds accounted for about 7 percent of Kern County's agricultural total acreage, and are grown to support the dairy and cattle industries (Milk and cream production are now California's number one crop), as well as for pleasure horses. Vegetables represent another 10 percent of Kern County's agricultural acreage.

Crops grown in Kern County are consumed throughout the United States and are exported to countries around the world. The top ten export crops are almonds, carrots, cotton, grapes, nursery stock, oranges, pistachios, plums and potatoes. Countries receiving products from Kern County include Canada, Mexico, countries in Central and South America, Africa, Europe, the Middle East, Japan, China, Southeast Asia, and Australia.

The Kern County Agricultural Commissioner's annual crop report for 2000 shows that all Kern agricultural products had a combined market value of \$2,209,573,000. This is a four percent increase from 1999. Total harvested acres were down by less than 1 percent and fruit and nut harvested acres rose 11 percent.

	1999	2000	Change
Fruit and nut crops	975,316,000	1,082,175,000	+\$106,859,000
Field crops & rangeland	418,658,000	415,053,000	-3,605,000
Vegetable crops	326,061,400	334,186,000	+8,124,600
Nursery crops	99,129,000	106,246,000	+7,117,000
Seed crops	10,180,000	7,246,000	-2,934,000
Other*	300,279,000	264,667,000	-35,612,000
Total	\$2,129,623,400	2,209,573,000	79,949,600

*Includes industrial and wood crops, livestock and poultry, livestock and poultry products and apiary products.

Trees and vines account for almost half of Kern County's gross agricultural value, reflecting the importance of these crops to the local economy.

Gross agricultural requirements in 2000 were estimated to be about 3,071,500 af with 2,727,900 af occurring over the usable groundwater basin. Net agricultural requirements in 2000 were about 2,511,700 af with about 2,230,700 af occurring over the groundwater basin. Agricultural return flows to groundwater are estimated as the difference between gross and net water requirements over the basin. Not all return flows return to usable groundwater. Some water is lost to saline sinks such as shallow groundwater areas. In moisture deficient soils, return flows are absorbed by the soils and are irrecoverable. About 617,400 af of agricultural water applied in 2000 returned to usable groundwater storage.

Applied water data has been collected over the years by many entities. Table 19 provides a basin-wide average applied water requirement for some major crops grown in Kern County.

Municipal and Industrial (M&I)

Gross M&I requirements in 2000 were estimated to be about 228,400 af, with about 206,800 af required over the usable groundwater basin. Of this total, 28,200 af were supplied by the Agency's Henry C. Garnett Water Purification Plant. Olcese Water District served the Rio Bravo area with 991 af of treated Kern River water. East Niles Community Services District used about 1,255 af of CVP water obtained from Arvin-Edison Water Storage District. The remainder of M&I needs over the groundwater basin, 132,500 af, was supplied by groundwater. Table 20 gives a breakdown of urban water deliveries by water purveyor service area. The total production of the purveyors as shown on Table 20 is less than gross M&I requirements. This is because many rural families and businesses maintain their own water systems (wells), and their production volumes are not recorded. Gross M&I requirements include an estimate of the needs of these rural areas.

Average municipal and industrial water use was 294 gallons per capita per day (gpcd), an decrease of 9 gpcd over the previous year. Residential water use was about 200 gpcd. Commercial, industrial and institutional use accounts for the difference. Residential water use by west side towns (Taft, Maricopa, Lost Hills) is quite low in comparison to residential use over the groundwater basin. The average domestic water use in these towns during 2000 was about 185 gpcd.

Net M&I consumptive use in 2000 was about 64,700 af over the groundwater basin. Gross return flows from M&I uses were about 156,900 af. About 50,000 af were treated in wastewater recycling facilities and evaporated, percolated or reused for agriculture. Most of the M&I water used outside the groundwater basin is for oil field operations (only about 30 percent is used for residential purposes), and is all consumptively used.

Exports

During periods of high runoff, such as occurred during 1998, some water may be introduced into the California Aqueduct via the Kern River-California Aqueduct Intertie and exported over the Tehachapi Mountains into southern California. Some water may spill into the Kern River flood channel, where it can flow north into Tulare Lake in Kings County. This type of water is not a usable supply. In 2000 no water was exported from Kern County in this manner.

Basin-Wide Water Use Efficiency

Water applied to a crop in excess of its evapotranspiration requirements percolates past the root zone and enters groundwater supplies, where it is available for reuse. Sometimes shallow clay layers in the soil can intercept this deep percolation, resulting in a condition called "shallow groundwater." In some areas deep percolation may mix with unusable saline groundwater. In the western portion of Kern County, most soils are moisture-deficient (the water held in the soil is less than the amount of water the soil would normally retain after drainage via gravity). Any deep percolation occurring in these moisture-deficient soils will be absorbed until the water-holding capacity of the soils is reached.

Over the entire San Joaquin Valley portion of Kern County, gross water uses were about 3,384,100 af during 2000 (3,071,500 for agriculture, 227,500 af of M&I use, 44,800 af of evaporation losses, 494,000 af of groundwater recharge, and 4,000 af of unrecoverable delivery system losses). Total consumption of water was about 2,721,700 af (2,525,000 af by agriculture, 71,500 af by M&I, and 45,000 af of evaporation losses). Effective precipitation was about 123,800 af. Agricultural irrigation efficiency was about 78 percent. A total of 50,000 af of M&I water was treated and reused, mostly by agriculture. The difference between gross and net requirements is an estimate of groundwater returns, which amounted to 617,400 af. However, about 84,000 af of deep percolation were lost by saline sinks. Therefore, net groundwater returns were 567,500 af in 2000.

Of the 3,843,100 af of gross water supply during 2000, 3,753,300 af were beneficially used or were available for reuse via net deep percolation. This means that 98 percent of the water used in 2000 was put to beneficial use or was available for reuse. This percentage is termed "basin-wide water use efficiency." Kern County is among the most water-efficient areas in the state.

Intertie Activity

The Kern River-California Aqueduct Intertie (Intertie) is a structure connecting the Kern River to the California Aqueduct near Tupman. Its basic purpose is to dispose of floodwater, preventing damages downstream of the Kern River flood plain. Flows into the California Aqueduct through the Intertie may contain water from the Kern, Kaweah, Kings, San Joaquin or Tule rivers, or a combination of these. Generally, Kern River flows must exceed about 200 percent of normal before the Intertie gates need to be opened. The structure has a capacity of 3,500 cfs. However, downstream SWP demands can become the limiting factor in wet years when demands are low. The Intertie did not operate in 2000.

Groundwater Conditions

Groundwater Recharge

Many entities in Kern County are engaged in groundwater replenishment. Semitropic Water Storage District (WSD), Rosedale-Rio Bravo WSD, North Kern WSD, Arvin-Edison WSD, the City of Bakersfield, Kern Water Bank Authority and the Agency all operate recharge facilities. Kern River water is recharged by a combination of deliberate spreading in recharge areas, by losses in unlined canals, or by percolation in the Kern River's channel. Central Valley Project water is recharged in spreading ponds operated by Arvin-Edison WSD or in

Groundwater Banking

Groundwater banking is a water management tool that has increased in use in recent years. Since groundwater storage is now more environmentally acceptable and economically feasible, the Agency and local water districts are expanding development of several water banking programs. The purpose of banking programs is to store surface water underground when it is available and recover it in times when it is not available. Available surface water supplies are used in conjunction with groundwater.

The largest of these programs is the Kern Water Bank, created in 1996. The Kern Water Bank has a storage capacity of nearly one million af and in 2000, recharged a total of 40,323 af. Another local project, the City of Bakersfield 2800 Acre recharge facility, has been maintained as a banking and recovery facility for many years. During 2000 no water was recharged in the 2800 Acres.

In 1992 the Agency purchased 2,253 acres of land to develop additional water recharge and banking facilities, referred to as the Pioneer Properties. The Pioneer Properties consists of two parcels on either side of the Kern River southwest of Bakersfield. The Agency manages the properties, referred to as the Pioneer Project, to recharge water to, and recover water from the groundwater basin. The Pioneer Project has an annual groundwater recharge capacity of about 146,000 af. During 2000, 15,049 af were recharged on the Pioneer Project.

The Agency also operates the Berrenda Mesa banking project, located along the south side of the Kern River just upstream of the Pioneer Properties. The project consists of 369 acres with an annual recharge capacity of 58,000 af and an annual recovery capacity of 46,000 af.

Table 24 shows banking account balances for those entities involved as banking partners in various banking programs. It displays in detail the banking portion of the information on Table 23 and includes recharge, extractions and transfers/sales of banking accounts. Recharge and recovery balances shown have not been reduced to reflect evaporation or other losses. Figure 19 graphically shows groundwater recharge sites and amounts for 2000.

Shallow Groundwater

When the downward movement of water in the soil column is interrupted by shallow clay or other strata of low permeability, shallow groundwater accumulations result. This condition is generally undesirable for farming operations because the water remains relatively close to the crop root zone. Poor crop yield, soil salt buildup and poorly drained fields are symptoms of shallow groundwater problems.

Kern County areas suffering from shallow groundwater tend to follow the historic lower-elevation trace of the Kern River channel. Increases in the shallow groundwater area appear after years of high Kern River runoff. Conversely, the shallow groundwater area shrinks during years when runoff is low. Thus, shallow groundwater appears to be a natural phenomenon. Table 25 summarizes the historic shallow groundwater areas, categorized into five-foot increments, along with the number of monitoring wells measured. While the number of data points (monitoring wells) has changed over time, the current data set incorporates 232 wells, covering the historic drainage of the Kern River.

Higher salt contents are prevalent on the west side of the southern San Joaquin Valley and in an area west of Delano.

Plate 4 is a compilation of data from water wells producing from the confined (lower) aquifer system. This lower system is partially protected from surface contaminants by the Corcoran Clay. Contours on this map show the groundwater quality of the lower aquifer to be superior to that of the unconfined zone.

Agricultural water well drilling increased slightly during 2000 compared to 1999. The Kern County Environmental Health Services Department issued 54 agricultural water well permits in 2000, compared to 28 permits issued during 1999. An additional 116 domestic wells were permitted and drilled during 2000, along with 568 wells for non-agricultural and non-domestic purposes (e.g., monitoring and cathodic protection wells). A total of 170 new agricultural and domestic water wells were drilled during 2000. Annular seals were required on four of the new wells to prevent degradation of lower groundwater zones. (Annular seals are plugs of concrete between the well casing and the drilled hole near a regional stratum of low permeability to prevent movement of water between two aquifer systems.)

Groundwater Levels

Because water moves through the soil column at a slow rate, it is necessary to analyze lagged data for the following year (in this case the spring of 2001) to determine the impacts associated with groundwater management and hydrology from the previous year (in this case water year 2000). Plate 5, "Depth to Groundwater, Spring 2001", was prepared using over 1,400 well measurements taken by Agency staff and others. Water depths are plotted and contoured to aid in the evaluation of groundwater trends. Control wells include unconfined and select composite aquifer wells throughout most of the basin. In areas north of Wasco, water levels in confined wells are used for contouring because they best represent the most utilized aquifer. The "Depth to Groundwater" map shows the distance in feet from the ground surface to the groundwater surface. This surface is the water table for those areas representing the unconfined aquifer; it is the potentiometric surface for those areas representing the confined aquifer.

Plate 6, "Groundwater Surface Elevation, Spring 2001", was prepared based on the same measured wells as Plate 5. Plate 6 shows the horizontal movement of groundwater from higher to lower elevations. The major direction of groundwater movement is away from sources of recharge. Plate 6 also shows what appear to be steep gradients between Semitropic Water Storage District (WSD) and neighboring Buena WSD. These apparent steep gradients reflect the transition from an unconfined aquifer system beneath Buena Vista WSD to a confined aquifer system beneath Semitropic WSD.

Historically, the Kern River has been the major groundwater recharge source in the basin. Mounding of groundwater occurs along the river channel, and groundwater moves away from this area. The rate of horizontal flow in the upper portions of the aquifer is estimated to range from 70 to 500 feet per year. Also, some mounding is attributed to various water districts' local recharge efforts.

the southeastern terminus of the Corcoran Clay. Present groundwater level data suggest that no confined aquifer exists east and south of this location. Deep wells in these areas show annual groundwater levels and fluctuations that are consistent with the shallow wells. Confined and unconfined aquifers usually exhibit characteristic differences in seasonal groundwater level changes.

The southwest Bakersfield hydrographs show continual declines until 1978. The wet period 1978-86 appears as a rise in groundwater level. The 1987-92 drought shows another period of decline. Water levels have declined since the beginning of 1999 due to dry conditions. In the past, these two wells (T30S/R26E-22P1 and T30S/R26E-22P3) were classified as unconfined and confined, respectively. However, similar groundwater levels in both wells over a long period of time suggest that a confined aquifer may not exist in this area.

The Arvin-Edison WSD area wells are designated as shallow (T32S/R29E-04P1) and deep (T32S/R29E-03Q1). The Arvin-Edison deep well may be in a confined aquifer, since it has shown annual variability in groundwater levels more consistent with the behavior of a confined aquifer. The large difference in groundwater levels between the two wells also suggests that two or more aquifers may exist in this area. The delivery of CVP water to Arvin-Edison WSD in the mid-1960s caused groundwater levels to rise, as seen in the shallow well hydrograph. During the 1976-77 and 1978-86 droughts, groundwater levels declined. During the 1978-86 and current wet years, water levels rose. This well shows a slight downward trend since 1998.

Indian Wells Valley

Indian Wells Valley is located in the northeast corner of Kern County. The extended valley floor encompasses about 450 square miles. It is bounded by the Sierra Nevada Mountains on the west, the Coso Range on the north, the Argus Mountains on the east, the Rademacher Hills on the southeast and the El Paso Mountains on the south. Elevations on the valley floor range from 2,300 to 3,000 feet above sea level while the surrounding mountains reach 9,000 feet. The largest community in the valley is the city of Ridgecrest, with a population of over 29,000. The valley is an arid high desert, with rainfall averaging only 3-4 inches per year. Little rainfall reaches the groundwater table; it is rapidly evaporated by high winds and temperatures or transpired by desert plants. The only source of potable water is groundwater, much of which is of good to excellent quality, and is provided by recharge from the adjacent mountain ranges.

The Indian Wells Valley Cooperative Groundwater Management Committee was established in 1995 as part of the "Cooperative Groundwater Management Plan for Indian Wells Valley." The committee's goal is to coordinate operations in a manner that meets ongoing water supply demands while ensuring the availability of good quality groundwater for future generations. Additionally, a technical subcommittee was formed to address technical issue requests from the water management committee. The committee is made up of hydrogeologists, engineers, representatives from the Agency and various groundwater users in the valley. Among the issues being studied by the technical subcommittee are: 1) development of a groundwater

levels in wells located along the perimeter of the Indian Wells Valley, at sufficient distance from large pumping capacity wells to avoid their influence. Figure 21e charts a well in the northwest portion of the basin (about five miles northwest of Inyokern) near the foot of the Sierra Nevada (26S/38E-35B1). Figure 21f shows a well in the southeast portion of the basin, about 1.5 miles north of Cerro Coso College in southern Ridgecrest (27S/39E-7R11). Figure 21g shows a well in the southwest portion of the basin, about three miles south of Inyokern and within the Little Dixie Wash (27S/40E-15D1).

Groundwater levels have been declining from 0.5 to 1.0 feet per year in areas outside the Ridgecrest-Inyokern pumping corridor. In the center of the pumping area water levels have declined by an average of 1.5 feet annually. In this central area, groundwater levels declined only 15 feet between 1920 and 1953, while between 1953 and 1993 they declined 60 to 70 feet.

During the period 1996-2001, Plate 11, water levels in the Inyokern area have dropped between two to 12 feet. A drop of two to 12 feet occurred in the Ridgecrest area for this time period and the Brown Road Farming area saw a drop of two to three feet. Another area that shows a significant drop in water levels is the area on the far eastern side of the Indian Wells Valley near the intersections of Water Road and South Pole Line Road. The groundwater system represented in these areas is the shallow groundwater phenomenon, found along the eastern fringe of the basin. This shallow groundwater system is a result of disposal of sewage effluent from Ridgecrest and the Naval Air Weapons Station (NAWS). During this time period, effluent water normally sent to ponds that contributed to the shallow groundwater problem in this area was diverted for irrigation of the NAWS golf course and to the southern end of the basin for agriculture. As a result, the negative change in the shallow groundwater level in this area is due to lack of sewage effluent for the percolation ponds in the area (decreased recharge) and not groundwater pumping as is seen in other areas of the valley. In Figure 21f, recent water levels have declined from 1.0 to 1.5 feet per year, a matter of interest, since groundwater pumping in this area is limited.

The accelerated decline of groundwater levels in the southwest area is probably linked to a dramatic change in understanding of the subsurface geology. Plate 9, "Groundwater Surface Elevations," presents an anomalous steep hydraulic gradient in the southwest portion of the valley. A series of studies suggests that these extreme water level differences might be the manifestation of complex structural geology or stratigraphic relationships. The interpretation of continuity of groundwater flow along this steep gradient is tentative at best. It is presented to convey the existence of extreme differences in water levels in the southwest area and does not infer that continuous groundwater flow exists there. Additional work is needed to address whether such continuous flow exists.

Plate 9 shows an apparent steep hydraulic gradient in the two to three mile-wide zone trending southeast from Armitage Field to Ridgecrest Boulevard. This trend parallels the Little Lake Fault Zone. In this area, wells and piezometers perforated at various depths show significant water level differences. The degree of hydraulic communication across the Little Lake Fault Zone needs evaluation to determine whether pumping in the Ridgecrest-Inyokern pumping corridor influences the lateral or vertical migration of poor-quality groundwater.

Table 1. Sacramento River Indices* (in million acre-feet)

Ascending Order by Year				Ascending Order by Index			
Year	Index	Year	Index	Year	Index	Year	Index
1906	26.7	1955	11	1977	5.1	1954	17.4
1907	33.7	1956	29.9	1924	5.7	1936	17.4
1908	14.8	1957	14.9	1931	6.1	1946	17.6
1909	30.7	1958	29.7	1994	7.8	1922	18.0
1910	21.1	1959	12	1976	8.1	2000	18.9
1911	26.4	1960	13.1	1939	8.2	1975	19.2
1912	11.4	1961	12	1929	8.4	1973	20.0
1913	12.8	1962	15.1	1991	8.4	1953	20.1
1914	27.8	1963	23	1934	8.6	1943	21.1
1915	23.9	1964	10.9	1992	8.9	1910	21.1
1916	24.1	1965	25.7	1933	8.9	1999	21.2
1917	17.3	1966	12.9	1990	9.2	1996	22.2
1918	11	1967	24.1	1988	9.2	1980	22.3
1919	15.7	1968	13.6	1987	9.2	1993	22.4
1920	9.2	1969	27	1920	9.2	1986	22.4
1921	23.8	1970	24.1	1947	10.4	1984	22.4
1922	18	1971	22.6	1944	10.4	1940	22.4
1923	13.2	1972	13.4	1964	10.9	1971	22.6
1924	5.7	1973	20	1985	11.0	1951	22.9
1925	16	1974	32.5	1955	11.0	1963	23.0
1926	11.8	1975	19.2	1918	11.0	1927	23.8
1927	23.8	1976	8.1	1981	11.1	1921	23.8
1928	16.8	1977	5.1	1912	11.4	1978	23.9
1929	8.4	1978	23.9	1926	11.8	1915	23.9
1930	13.5	1979	12.4	1961	12.0	1970	24.1
1931	6.1	1980	22.3	1959	12.0	1967	24.1
1932	13.1	1981	11.1	1949	12.0	1916	24.1
1933	8.9	1982	33.3	1979	12.4	1942	25.2
1934	8.6	1983	37.7	1913	12.8	1997	25.2
1935	16.6	1984	22.4	1966	12.9	1965	25.7
1936	17.4	1985	11	1960	13.1	1911	26.4
1937	13.3	1986	22.4	1932	13.1	1906	26.7
1938	31.8	1987	9.2	1923	13.2	1969	27.0
1939	8.2	1988	9.2	1937	13.3	1941	27.1
1940	22.4	1989	14.8	1972	13.4	1914	27.8
1941	27.1	1990	9.2	1930	13.5	1952	28.6
1942	25.2	1991	8.4	1968	13.6	1958	29.7
1943	21.1	1992	8.9	1950	14.4	1956	29.9
1944	10.4	1993	22.4	1989	14.8	1909	30.7
1945	15.1	1994	7.8	1908	14.8	1998	31.4
1946	17.6	1995	33.9	1957	14.9	1938	31.8
1947	10.4	1996	22.2	1962	15.1	1974	32.5
1948	15.8	1997	25.2	1945	15.1	1982	33.3
1949	12	1998	31.4	1919	15.7	1907	33.7
1950	14.4	1999	21.2	1948	15.8	1995	33.9
1951	22.9	2000		1925	16.0	1983	37.7
1952	28.6			1935	16.6		
1953	20.1			1928	16.8		
1954	17.4			1917	17.3		

95 year average	18.1
95 year median	95.0
Minimum (1977)	5.1
Maximum (1983)	37.7

* An index used by the California Department of Water Resources to forecast available water supplies and SWP delivery capabilities. The index consists of the forecasted or computed unimpaired flows of the Sacramento River near Red Bluff, Feather River at Oroville Reservoir, Yuba River at Smartville and American River at Folsom Reservoir.

Table 2. Kern County Water Agency, Member Unit Contract Entitlements for 2000 (in acre-feet)

Member Unit	Year 2000			Firm Entitlement		
	Firm	Surplus ⁽¹⁾	Existing Table 1 Entitlement ⁽²⁾	M&I	Ag	Total
Berrenda Mesa WD	123,100	6,976	130,076		123,100	123,100
Lost Hills WD	119,110	0	119,110	2,000 ⁽³⁾	117,110	119,110
Belridge WSD	143,508	0	143,508	15,000 ⁽³⁾	128,508	143,508
Buttonwillow ID	83,000	13,100	96,100		83,000	83,000
Pond Poso ID	67,000	11,100	78,100		67,000	67,000
Schmitropic WSD	5,000	562	5,562		5,000	5,000
Cawelo WD	38,200	6,800	45,000		38,200	38,200
Improvement District No. 4	82,946	899	83,845	77,000	5,946	82,946
Rosedale-Rio Bravo WSD	29,900	5,100	35,000		29,900	29,900
Buena Vista WSD	21,300	3,750	25,050		21,300	21,300
Kern Delta WD	25,500	4,500	30,000		25,500	25,500
Henry Miller WD	35,500	6,250	41,750		35,500	35,500
West Kern WD	25,000	0	25,000	25,000		25,000
Wheeler Ridge-Maricopa WSD	197,088	34,205	231,293		197,088	197,088
Tehachapi-Cummings CWD	19,300	700	20,000	15,000	4,300	19,300
Tejon-Castac WD	5,278	471	5,749	2,000	3,278	5,278
Total	1,020,730	94,413	1,115,143	136,000	884,730	1,020,730

Note: Maximum annual entitlement is reached in 1990.

- (1) Per the Monterey Agreement surplus water was removed from the Member Unit contracts. Surplus water entitlements are still used in the allocation of interruptible water in proportion to the Member Unit's Former Table 1 Entitlements, if demands for interruptible water are greater than the supply of interruptible water (see footnote 2).
- (2) Former Table 1 Entitlement is the Member Unit's contract entitlement plus the amount of surplus water (see footnote 1).
- (3) Agricultural entitlement converted to M&I use.

Table 3. SWP deliveries to the San Joaquin Valley portion of Kern County (acre-feet)

Year	Annual ⁽¹⁾ Deliveries	Cumulative Deliveries	Intertie Deliveries	Deliveries ⁽²⁾ Outside SJV	Annual Importations	Cumulative Importations
1968	127,384	127,384			127,384	127,384
1969	141,265	268,649			141,265	268,649
1970	204,634	473,283			204,634	473,283
1971	375,505	848,788			375,505	848,788
1972	535,573	1,384,361			535,573	1,384,361
1973	515,546	1,899,907		25	515,521	1,899,882
1974	656,773	2,556,680		4,992	651,781	2,551,663
1975	828,437	3,385,117		6,699	821,738	3,373,401
1976	888,112	4,273,229		4,755	883,357	4,256,758
1977	432,837	4,706,066		3,424	429,413	4,686,171
1978	678,400	5,384,466	64,100	2,826	611,474	5,297,645
1979	1,295,388	6,679,854		3,630	1,291,758	6,589,403
1980	968,092	7,647,946	64,792	3,041	900,259	7,489,662
1981	1,386,641	9,034,587		1,897	1,384,744	8,874,406
1982	900,973	9,935,560	13,679	2,791	884,503	9,758,909
1983	601,183	10,536,743	365,505	724	234,954	9,993,863
1984	1,138,040	11,674,783	13,639	1,360	1,123,041	11,116,904
1985	1,078,147	12,752,930		4,015	1,074,132	12,191,036
1986	929,178	13,682,108	12,701	2,916	913,561	13,104,597
1987	1,028,124	14,710,232		2,217	1,025,907	14,130,504
1988	1,009,520	15,719,752		3,307	1,006,213	15,136,717
1989	1,146,062	16,865,814		48,833	1,097,229	16,233,946
1990	862,448	17,728,262		21,643	840,805	17,074,751
1991	34,886	17,763,148		2,213	32,673	17,107,424
1992	421,520	18,184,668		3,508	418,012	17,525,436
1993	1,219,653	19,404,321		14,139	1,205,514	18,730,950
1994	711,002	20,115,323		15,616	695,386	19,426,336
1995	1,219,146	21,334,469		107,950	1,111,196	20,537,532
1996	1,335,394	22,669,863		88,209	1,247,185	21,784,717
1997	1,303,900	23,973,763		290,523	1,013,377	22,798,094
1998	987,299	24,961,062		148,101	839,198	23,637,292
1999	1,386,481	26,347,543		78,181	1,308,300	24,945,592
2000	1,438,120	27,785,663		229,619	1,208,501	26,154,093

Mean Deliveries	841,990 AF	Minimum Deliveries (1991)	34,886 AF
Median Deliveries	900,973 AF	Maximum Deliveries (2000)	1,438,120 AF
Mean Importations	795,160 AF	Minimum Importations (1991)	32,673 AF
Median Importations	883,357 AF	Maximum Importations (1981)	1,384,744 AF

⁽¹⁾ Includes Pre-consolidation water deliveries, 1977 Dry Year Pool, 1991 State Bank water.

⁽²⁾ Includes Tehachapi-Cummings CWD and other deliveries outside the San Joaquin Valley portion of Kern County. Beginning in 1990, also includes local Groundwater programs.

Table 4. 2000 State Water Project Deliveries by Contract (acre-feet)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
	SWP Water Supplies																		
	Table 1	1999	Article 21	DWR	Total	Landowner	Misc.	Misc.	Misc.	Misc. and	CVP	USBR	Kern	Friant-	(Col 5..15)			(Col 15..16)	(Col 14-17)
District	Entitlement	Carryover	Water	Turnback	SWP	Transfers	Trans / Exch	Transfers	Transfers	Simultaneous	Contractor	EWA	River	Kern	Total	In-District	Recharge	Total	Balance
	(90% Firm)	into	(Interruptible	Pool	Supply	Out of	Out of	Into	Other	Other	Purch. Via	Purch. Via	for SWP	for SWP	SWP Water	Deliveries	Deliveries	Deliveries	to be
		2000	Water)	Purchase		Kern County	Kern County	Kern County			SWP Exc.	SWP Exc.	Exchange	Exchange	Available				Delivered
Berrenda Mesa WD	110,790	4,110	2,858	10,849	128,607	(20,671) (1)		11,662 (5)	300 (12)	(700) (23)	(4,185)	(11,200)		(24)	103,813	85,215	0	85,215	18,598
Lost Hills WD	107,199	(1,610)	14,515	22,425	142,529	(7,000) (2)	(400) (4)	8,990 (6)	(2,521) (13)	2,700 (24)	(4,580)	(10,800)		(4,100) (24)	124,818	115,705	333	116,038	8,780
Belridge WSD	129,157	1,564	7,971	12,066	150,758	(8,176) (3)		10,451 (7)	185 (14)	(770)	(5,610)	(14,848)		(4,100)	127,890	111,153	4,428	115,581	12,309
Semitropic WSD	139,500	(1,313)	7,549	65,983	211,719			61,050 (8)	20,149 (15)	2,000 (25)		(8,872)			286,048	287,860	0	287,860	(1,812)
Cawelo WD	34,380	767		2,500	37,647				(37,476) (16)		(22)			(25)	171	171	0	171	0
Improvement Dist. No. 4	74,652		13,637	33,485	121,774				9,880 (17)	(61,892)	(10,000)	(7,236)	(15,000) (23)	(554)	36,972	26,925	0	26,925	10,047
Rosedale-Rio Bravo WSD	26,910		3,254	16,872	47,036				(13,970) (18)	13,474				(7,000)	39,540	19,748	756	20,504	19,036
Buena Vista WSD	19,170		2,703	9,000	30,873				88,906 (19)	7,711 (26)					127,490	127,157	0	127,157	333
Kern Delta WD	22,950	338			23,288				(22,950) (16)	2,121					2,459	2,459	0	2,459	0
Henry Miller WD	31,950	1,479	877	18,022	52,328				(4,000) (20)	902 (27)					49,230	44,137	0	44,137	5,093
West Kern WD	22,500				22,500				(22,480) (16)						20	21	0	21	(1)
Wheeler Ridge-Maricopa WSD	177,379	7,824	11,731	42,000	238,934			19,208 (9)	(19,393) (21)		(18,000)	(18,074)			202,675	181,236	2,699	183,935	18,740
Tehachapi-Cummings CWD Ag	3,870	34			3,904										3,904	3,311	0	3,311	593
Tehachapi-Cummings CWD M&I	13,500		453		13,953				(10,600) (22)						3,353	3,015	0	3,015	338
Tejon-Castac WD Ag	2,950		537		3,487						(2,950)				537	0	537	537	0
Tejon-Castac WD M&I	1,800				1,800						(550)	(1,250)			0	0	0	0	0
MWD (AEWSD)					0			149,731	5,000 (18)	16,000				(5,000)	165,731	165,731	0	165,731	0
Westside Mutual WC			12,823		12,823			(10)		1,997					14,820	0	14,820	14,820	0
Westlands WD					0	35,847			24,167		45,875		15,000	29,724	150,613	150,613	0	150,613	0
Tulare Lake Basin WSD					0		400								400	400	0	400	0
Dudley Ridge WD (KWB)					0			953 (11)							953	0	953	953	0
KCWA															0				0
North Kern WD					0					16,457					16,457	16,457	0	16,457	0
Kern Tulare WD									8,970 (18)					(8,970)	0				0
USBR					0					16,457		72,280			72,280	72,280	0	72,280	0
Total	918,657	13,193	78,908	233,202	1,243,960	0	0	262,045	24,167	16,457	0	0	0	0	1,530,174	1,413,594	24,526	1,438,120	92,054
Deliveries to Kern County	918,657	13,193	78,908	233,202	1,243,960	(35,847)	(400)	262,045	(24,167)	0	(45,875)	(72,280)	(15,000)	(29,724)	1,306,881	1,190,301	24,526	1,214,827	92,054

[1] - Landowner transfer (20,671 AF) to Westlands WD (Woolf Enterprises, Inc. = 17,481 AF; Bill Gentle Farms = 3,190 AF).

[2] - Landowner transfer (7,000 AF) to Westlands WD (C.R. Shannon Family = 5,000 AF; Chevron USA = 2,000 AF).

[3] - Landowner transfer (8,176 AF) to Westlands WD (Woolf Enterprises, Inc. = 8,176 AF).

[4] - Transfer of 400 AF from Lost Hills WD to Tulare Lake Basin WSD (Westlake Farms, Inc.) for mitigation purposes.

[5] - Includes 5,662 AF transfer from MWD as payback toward the 1978 and 1982 exchanges with KCWA (see footnote 9); includes 6,000 AF of CVP water via the SLDMWA exchange (WMWC).

[6] - Transfer of 8,990 AF of CVP water via the SLDMWA exchange on behalf of Lost Hills WD (3,990 AF) and Westside Mutual Water Company (5,000 AF).

[7] - Includes transfer of 1,500 AF from Dudley Ridge WD to Belridge WSD in exchange for banked groundwater in the Kern Water Bank (Paramount/Westside Mutual Water Company); includes 8,951 AF of CVP water via the SLDMWA exchange (WMWC).

[8] - Storage transfers from Alameda County WD (13,380 AF), Alameda County WD - Zone 7 (23,940 AF) and Santa Clara Valley WD (23,730 AF).

[9] - Transfer from Metropolitan WD as payback toward the 1978 (21,547 AF) and 1982 (3,323 AF) exchanges with KCWA; 1978 exchange (BM = 5,662 AF and WRM = 15,885 AF) and 1982 exchange (WRM = 3,323).

[10] - Storage transfer from Metropolitan WD.

[11] - Dudley Ridge WD transfer of entitlement (0 AF) and interruptible (953 AF) waters for storage in the Kern Water Bank.

[12] - Inter-district landowner transfer (300 AF) from Lost Hills WD to Berrenda Mesa WD (C.J. Ritchie Farms).

[13] - Includes exchange payback (6,000 AF) to BVWSD per 1996 exchange; includes landowner transfer (300 AF) to BMWD (C.J. Ritchie Farms); includes landowner transfer (221 AF) to SWSD (Lost Hills Utility Dist); includes exchange (4,000 AF).

[14] - Inter-district landowner transfer (185 AF) from Wheeler Ridge-Maricopa WSD to Belridge WSD (Rod Stiefvater).

[15] - Includes exchange payback from ID4 pursuant to a 1995 exchange (agreement dated March 2, 1995); includes landowner transfer (221 AF) from Lost Hills WD; includes 9,208 AF from WRMWSD in exchange for a like amount of groundwater from the KWB.

[16] - Long-term exchange amounts to Buena Vista WSD from Cawelo WD (37,476 AF), Kern Delta WD (22,950 AF) and West Kern WD (22,480 AF).

[17] - Includes Long-Term M&I Pool quantity (10,600 AF) from Tehachapi-Cummings County WD; includes 10,720 AF to Semitropic WSD as payback for a 1995 exchange; includes 10,000 AF from WRMWSD in exchange for groundwater from the KWB.

[18] - Includes return water to Arvin-Edison WSD (5,000 AF) and Kern-Tulare WD (8,970 AF) pursuant to SWP / CVP (Friant Unit) exchanges.

[19] - Includes long-term exchange amounts from Cawelo WD (37,647 AF), Kern Delta WD (22,950 AF) and West Kern WD (22,486 AF); includes 6,000 AF from Lost Hills WD pursuant to a 1996 exchange.

[20] - Transfer of 4,000 AF from Henry Miller WD to Lost Hills WD in exchange for a like amount of water returned to Henry Miller WD in a future mutually agreeable time.

[21] - Includes exchange water to ID4 (10,000 AF) and Semitropic WSD (9,208 AF) for like amounts of banked water (KWB) assigned to WRMWSD; includes landowner transfer (185 AF) to Belridge WSD.

[22] - Long-Term M&I Pool quantity (10,600 AF) to Improvement District No. 4.

[23] - Inter-district landowner transfer (700 AF) from Berrenda Mesa WD to Lost Hills WD (Homa Farms).

[24] - Includes exchange transfer from ID4 (2,000 af; see footnote 23); includes inter-district landowner transfer from Berrenda Mesa WD (Homa Farms).

[25] - Transfers from ID4 to Lost Hills WD (2,000 AF) and Semitropic WSD (2,000 AF) in exchange for a like amount of water returned to ID4 in a future mutually agreeable year.

[26] - Includes 8,613 AF from Improvement District No. 4; includes 902 AF to Henry Miller WD.

[27] - Transfer of 902 AF from Buena Vista WSD to Henry Miller WD.

Table 5. Kern River Flows (acre-feet)

Calendar Year	Natural Flows	Cumulative		Calendar Year	Natural Flows	Regulated Flows ⁽¹⁾	Cumulative Flows		Calendar Year	Natural Flows	Regulated Flows ⁽¹⁾	Cumulative Flows	
		Natural Flows					Natural	Regulated				Natural	Regulated
1894	533,326	533,326		1931	185,645		26,249,601		1968	453,760	497,026	51,721,932	8,648,688
1895	1,023,052	1,556,378		1932	737,727		26,987,328		1969	2,461,370	2,313,769	54,183,302	10,962,457
1896	619,692	2,176,070		1933	441,086		27,428,414		1970	589,474	601,254	54,772,776	11,563,711
1897	893,434	3,069,504		1934	227,665		27,656,079		1971	427,454	442,651	55,200,230	12,006,362
1898	251,827	3,321,331		1935	474,128		28,130,207		1972	268,427	311,291	55,468,657	12,317,653
1899	338,872	3,660,203		1936	796,447		28,926,654		1973	979,652	785,133	56,448,309	13,102,786
1900	332,373	3,992,576		1937	1,260,182		30,186,836		1974	818,608	745,903	57,266,917	13,848,689
1901	880,089	4,872,665		1938	1,358,685		31,545,521		1975	564,567	572,091	57,831,484	14,420,780
1902	552,539	5,425,204		1939	461,073		32,006,594		1976	249,468	320,784	58,080,952	14,741,564
1903	546,395	5,971,599		1940	789,098		32,795,692		1977	196,998	200,702	58,277,950	14,942,266
1904	492,949	6,464,548		1941	1,401,076		34,196,768		1978	1,653,505	1,390,675	59,931,455	16,332,941
1905	531,809	6,996,357		1942	771,966		34,968,734		1979	672,661	656,068	60,604,116	16,989,009
1906	1,900,540	8,896,897		1943	1,220,827		36,189,561		1980	1,639,957	1,560,652	62,244,073	18,549,661
1907	990,900	9,887,797		1944	625,537		36,815,098		1981	449,263	460,469	62,693,336	19,010,130
1908	498,503	10,386,300		1945	938,055		37,753,153		1982	1,271,139	1,121,088	63,964,475	20,131,218
1909	1,838,643	12,224,943		1946	650,683		38,403,836		1983	2,489,128	2,381,575	66,453,603	22,512,793
1910	658,911	12,883,854		1947	406,698		38,810,534		1984	821,797	834,036	67,275,400	23,346,829
1911	1,013,384	13,897,238		1948	329,506		39,140,040		1985	672,431	668,971	67,947,831	24,015,800
1912	387,432	14,284,670		1949	302,870		39,442,910		1986	1,444,939	1,331,561	69,392,770	25,347,361
1913	367,840	14,652,510		1950	601,360		40,044,270		1987	375,935	432,309	69,768,705	25,779,670
1914	1,113,513	15,766,023		1951	442,222		40,486,492		1988	294,685	335,473	70,063,390	26,115,143
1915	646,287	16,412,310		1952	1,500,999		41,987,491		1989	397,038	348,773	70,460,428	26,463,916
1916	2,520,149	18,932,459		1953	548,833		42,536,324		1990	203,571	219,501	70,663,999	26,683,417
1917	823,082	19,755,541		1954	528,357	510,320 ⁽²⁾	43,064,681	510,320	1991	406,289	333,494	71,070,288	27,016,911
1918	538,503	20,294,044		1955	444,300	367,783	43,508,981	878,103	1992	296,829	272,822	71,367,117	27,289,733
1919	499,124	20,793,168		1956	840,862	755,500	44,349,843	1,633,603	1993	853,760	642,339	72,220,877	27,932,072
1920	600,643	21,393,811		1957	444,338	445,859	44,794,181	2,079,462	1994	336,456	422,361	72,557,333	28,354,433
1921	509,519	21,903,330		1958	1,104,730	967,511	45,898,911	3,046,973	1995	1,385,160	1,197,100	73,942,493	29,551,533
1922	861,426	22,764,756		1959	257,978	353,165	46,156,889	3,400,138	1996	1,038,261	968,036	74,980,754	30,519,569
1923	500,515	23,265,271		1960	300,037	324,088	46,456,926	3,724,226	1997	1,181,969	1,133,463	76,162,723	31,653,032
1924	187,727	23,452,998		1961	177,642	177,063	46,634,568	3,901,289	1998	1,717,967	1,662,556	77,880,690	33,315,588
1925	465,913	23,918,911		1962	697,704	607,848	47,332,272	4,509,137	1999	433,971	461,621	78,314,661	33,777,209
1926	366,706	24,285,617		1963	801,450	676,237	48,133,722	5,185,374	2000	476,819	472,536	78,791,480	34,249,745
1927	792,580	25,078,197		1964	339,266	361,624	48,472,988	5,546,998					
1928	312,828	25,391,025		1965	720,362	634,303	49,193,350	6,181,301					
1929	322,958	25,713,983		1966	678,595	504,506	49,871,945	6,685,807					
1930	349,973	26,063,956		1967	1,396,227	1,465,855	51,268,172	8,151,662					

⁽¹⁾ Regulated flows do not include deliveries above First Point.⁽²⁾ Isabella Dam in operation. All subsequent flows are controlled releases.

107 Year Mean Natural First Point Flow	736,400 AF	Minimum Natural First Point Flow (1961)	177,642 AF
107 Year Median Natural First Point Flow	564,600 AF	Maximum Natural First Point Flow (1916)	2,520,149 AF
47 Year Mean Regulated First Point Flow	728,700 AF	Minimum Regulated First Point Flow (1961)	177,063 AF
47 Year Median Regulated First Point Flow	572,100 AF	Maximum Regulated First Point Flow (1983)	2,381,575 AF

Table 6. 2000 Kern River Water Diversions by Entity (acre-feet)

Area of Use	Diversions
Above First Point	
California Water Service	933
City of Bakersfield	4
Kern Valley Golf Course (Kernville)	198
La Hacienda, Inc.	188
Lake Ming	790
Olcese WD	756
Subtotal	2,869
Below First Point	
Arvin-Edison WSD	5,280
Buena Vista WSD	14,993
Cawelo WD	62,181
City of Bakersfield, Irrigation and Spreading ⁽¹⁾	48,052
Henry Miller WD	0
Improvement District No. 4	32,258
Kern County Water Agency (Pioneer Property)	0
Kern Delta WD	198,567
Kern -Tulare WD	0
Kern Water Bank Authority	0
North Kern WSD	106,913
Rag Gulch WD	0
Rosedale Ranch Improvement District	1,621
Rosedale-Rio Bravo WSD	1,771
South Fork	900
Subtotal	472,536
Total	475,405

⁽¹⁾ Includes Kern River Canal & Irrigating Company deliveries, Truxtun Lakes deliveries, Carrier Canal losses and percolation, Kern River channel losses and percolation.

Table 7. 2000 Central Valley Project deliveries by Entity⁽¹⁾ (acre-feet)

	Class I	Class II	215 Water	Other Water	sub Total	Other ⁽⁴⁾ Water	Total
Arvin-Edison WSD	18,870	85,827	-	-	104,697	168,393	273,090
Delano-Earlimart ID ⁽¹⁾	89,396	35,586	5,079	1,701	131,762	5,065	136,827
Kern County Water Agency	-	-	-	-	-	-	-
Kern-Tulare WD ⁽²⁾	15,672	-	-	-	15,672	17,000	32,672
Rag Gulch WD	4,924	-	-	-	4,924	9,000	13,924
Rosedale-Rio Bravo WSD	-	48,279	-	-	48,279	-	48,279
Shafter-Wasco ID	44,716	6,732	9,674	-	61,122	2,609	63,731
So. San Joaquin MUD ⁽³⁾	97,000	8,500	24,789	(2,722)	127,567	-	127,567
Total	270,578	184,924	39,542	(1,021)	494,023	202,067	696,090

⁽¹⁾ Other Water includes 1,701 af of CVP transferred in.

⁽²⁾ Per exchange of Cross Valley Canal water with Arvin-Edison WSD, Other Water is Kern River

⁽³⁾ Other includes water transferred out of district.

⁽⁴⁾ Other water for Arvin-Edison includes MWD exchange water.

Table 8. 2000 Central Valley Project deliveries to Kern County (acre-feet)

Year	Annual Delivery	Cumulative Delivery	Year	Annual Delivery	Cumulative Delivery
1950	762	762	1981	469,966	7,899,255
1951	27,005	27,767	1982	656,608	8,555,863
1952	49,500	77,267	1983	550,874	9,106,737
1953	83,558	160,825	1984	425,371	9,532,108
1954	112,093	272,918	1985	337,514	9,869,622
1955	126,238	399,156	1986	589,262	10,458,884
1956	279,134	678,290	1987	291,981	10,750,865
1957	141,684	819,974	1988	292,828	11,043,693
1958	223,830	1,043,804	1989	293,865	11,337,558
1959	166,099	1,209,903	1990	200,141	11,537,699
1960	156,978	1,366,881	1991	204,396	11,742,095
1961	126,412	1,493,293	1992	208,021	11,950,116
1962	231,045	1,724,338	1993	489,783	12,439,899
1963	234,283	1,958,621	1994	186,303	12,626,202
1964	189,330	2,147,951	1995	647,077	13,273,279
1965	245,482	2,393,433	1996	611,262	13,884,541
1966	232,084	2,625,517	1997	630,026	14,514,567
1967	319,706	2,945,223	1998	466,490	14,981,057
1968	206,499	3,151,722	1999	350,526	15,331,583
1969	372,826	3,524,548	2000	494,023	15,825,606
1970	351,392	3,875,940			
1971	348,865	4,224,805			
1972	238,475	4,463,280			
1973	412,178	4,875,458			
1974	480,575	5,356,033			
1975	442,130	5,798,163			
1976	226,512	6,024,675			
1977	121,469	6,146,144			
1978	357,847	6,503,991			
1979	462,526	6,966,517			
1980	462,772	7,429,289			

Mean Delivery	310,306 AF	Median Delivery	1975-2000	433,751 AF
Median Delivery	291,981 AF	Min. Delivery	1975-00 (1977)	121,469 AF
Mean Delivery 1975-00	402,676 AF	Max. Delivery	1975-00 (1982)	656,608 AF

Table 9. Minor Stream Flows in the San Joaquin Valley portion of Kern County (acre-feet)

Year	Annual Stream Flows	Cumulative Stream Flows
1970	132,400	132,400
1971	63,200	195,600
1972	21,600	217,200
1973	22,900	240,100
1974	104,900	345,000
1975	39,400	384,400
1976	42,700	427,100
1977	32,900	460,000
1978	429,200	889,200
1979	96,700	985,900
1980	65,200	1,051,100
1981	63,600	1,114,700
1982	91,700	1,206,400
1983	273,300	1,479,700
1984	43,200	1,522,900
1985	20,200	1,543,100
1986	32,600	1,575,700
1987	61,900	1,637,600
1988	22,900	1,660,500
1989	6,900	1,667,400
1990	17,000	1,684,400
1991	34,600	1,719,000
1992	52,200	1,771,200
1993	72,900	1,844,100
1994	36,800	1,880,900
1995	162,100	2,043,000
1996	88,100	2,131,100
1997	100,000	2,231,100
1998	286,400	2,517,500
1999	37,300	2,554,800
2000	25,800	2,580,600
Mean Flow		83,200 AF
Median Flow		52,200 AF
Minimum Flow (1989)		6,900 AF
Maximum Flow (1978)		429,200 AF

Table 10. 2000 monthly Rainfall at selected Stations (inches)

OPERATOR/Station	Elev.	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	(ft)														
ARVIN-EDISON WATER STORAGE DISTRICT															
District Headquarters	500	31S/30E-29	1.18	2.46	1.42	0.60	0.05	0.07	0	0.13	0	0.72	0	0	6.63
Sycamore	420	31S/30E-20	1.16	2.34	1.31	0.62	0.05	0.04	0	0.12	0	0.71	0	0	6.35
Tejon	480	32S/29E-15	1.04	1.97	1.28	0.50	0.03	0.05	0	0.10	0	0.61	0	0	5.58
CALIFORNIA DEPARTMENT OF WATER RESOURCES															
Lost Hills O&M Center	300	27S/21E-03	0.68	1.94	1.24	0.73	0	0.11	0	0	0	0.33	0.40	0.05	5.48
Wasco 7E	410	27S/26E-06	0.93	1.71	1.00	1.16	0	0.18	0	0	0	0	0.12	0.05	5.15
Wind Gap O&M Center	780	11N/20W-26	1.23	1.83	0.90	0.36	0.12	0.19	0	0	0	0.83	0.06	0.16	5.68
J.G. BOSWELL COMPANY															
Buena Vista #4	300	32S/25E-06	0.83	1.13	0.96	0.59	0	0	0	0	0	0.39	0	0.02	3.92
Buena Vista Gin	300	32S/25E-12	0.86	1.01	1.09	0.64	0	0	0	0	0	0.28	0	0.02	3.90
Buena Vista Office	290	31S/25E-25	0.81	1.42	1.09	0.62	0	0	0	0	0	0.19	0	0.02	4.15
Kern Lake Shop	280	32S/28E-18	0.96	1.09	1.63	0.50	0	0	0	0	0	0.30	0	0.02	4.50
Kern Lake Time Room	280	32S/27E-16	0.87	1.32	1.41	0.52	0	0	0	0	0	0.41	0	0.02	4.55
Paloma	290	32S/24E-02	1.03	1.20	1.23	0.47	0	0	0	0	0	0	0.42	0.02	4.37
KERN COUNTY PLANNING DEPARTMENT															
Arvin Fire Station	450	31S/29E-28	0.85	1.77	1.09	0.50	0.07	0	0	0.03	0	0.47	0	0	4.78
Buena Vista Aquatic Rec Area	300	31S/25E-15	0.61	1.00	0.79	0.60	0	0.02	0	0	0	0.15	0	0	3.17
Buttonwillow Fire Station	270	29S/23E-14													
Communications Center	770	29S/28E-16	0.63	1.77	1.28	0.58	0.10	0	0	0	0	0.45	0	0	4.81
Edmonston Pump Station	1,310	10N/18W-17M													0
McFarland Fire Station	350	26S/25E-10	0.57	2.28	1.35	0.71	0	0.09	0	0	0	0.34	0	0.01	5.35
Pine Mountain	5,200	09N/21W-19	2.38	4.19	1.02	2.27	0.07	0.02	0	0	0	0.70	0	0	10.65
Rio Bravo Fire Station	610	29S/29E-04	1.04	1.99	1.35	1.04	0.17	0	0	0	0	0.27	0	0	5.86
NATIONAL WEATHER SERVICE															
Bakersfield	380	30S/28E-08	0.94	1.62	1.30	0.57	0.08	0.06	0	0	0	0.39	0	0	4.96
Bear Valley	4,100	32S/31E-03	2.58	3.89	1.23	0.27	0.19	0	0	0	0.05	1.21	0	0.11	9.53
Delano	320	25S/25E-S11	0.67	2.83	0.87	0.64	0	0.17	0	0	0	0.31	0	0	5.49
Glennville	3,100	25S/30E-25	3.20	4.62	2.63	1.57	0.53	0.19	0	0	0.03	1.48	0.35	0.17	14.77
Keene	2,900	31S/32E-20	2.33	3.23	1.78	0.53	0.93	0.45	0	0.23	0	1.43	0.02	0.03	10.96
Lebec	3,600	09N/19W-26	1.15	3.99	1.54	2.04	0.05	0.16	0	0.06	0	0.47	0	0	9.46
Lost Hills	280	26S/21E-35	0.47	1.56	0.70	1.05	0	0.04	0	0	0	0.08	0	0	3.90
Maricopa	700	10N/24W-11	0.19	1.24	0.03	0.60	0	0	0	0	0	0	0	0	2.06
Piute	4,290	29S/33E-36	1.59	4.31	1.92	0.74	0.39	0	0	0.16	0	0.18	0.07	0.06	9.42
Tehachapi	3,980	32S/33E-21	1.37	4.11	1.46	0.61	0.79	0.08	0	0.30	0	0.81	0.30	0.39	10.22
Wasco	300	27S/24E-11	0.14	1.66	0.98	0.81	0	0.17	0	0	0	0.24	0	0	4.00
Woody	1,600	25S/29E-35	0.97	1.88	1.79	1.44	0.15	0.04	0	0.06	0	0.81	0.30	0.39	7.83
TEHACHAPI-CUMMINGS COUNTY WATER DISTRICT															
Station 6	4,890	12N/15W-01	2.24	5.45	1.60	0.65	0.80	0	0	0.07	0	0.85	0.25	0.50	12.41
Station 20	5,730	12N/15W-12	2.70	6.75	2.05	0.55	0.87	0	0	0.12	0	1.17	0.35	0.55	15.11
WHEELER RIDGE-MARICOPA WATER STORAGE DISTRICT															
SP-P2	590	11N/22W-09	0.85	1.38	1.15	0.60	0	0.03	0	0	0	0.57	0	0	4.58
District Headquarters	480	11N/12W-11	1.05	1.35	1.45	0.41	0	0.11	0	0	0	0.50	0	0.02	4.89
Greenlee's Pasture	380	12N/21W-36	1.16	1.36	1.31	0.38	0.02	0.04	0	0	0	0.75	0	0.09	5.11
PA-2	960	11N/19W-30	0.96	2.05	1.16	0.32	0	0.09	0	0	0	0.70	0.05	0.02	5.35
Spill Basin	850	11N/18W-31	1.25	1.32	1.06	0.41	0.12	0.06	0	0	0	1.00	0.02	0.02	5.26
WRM-2	510	32S-24E-35	0.72	1.25	0.75	0.45	0	0.01	0	0	0	0.33	0	0	3.51

OPERATOR/Station	Elev. (ft)	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
OTHER OPERATORS															
Belridge WSD Office	550	28S/21E-34	0.73	1.09	0.70	0.95	0	0	0	0	0	0.10	0	0	3.57
Blackwell's Corner (BMWD)	630	27S/20E-06	1.00	1.63	1.12	1.41	0	0.27	0	0	0	0.26	0	0	5.69
City of Bakersfield DWR Yd.	400	30S/27E-06	1.01	1.58	1.41	0.46	0.01	0	0	0	0	0.36	0.02	0.02	4.87
Del Kern Station (KDWD)	350	31S/28E-06C	0.80	1.76	1.25	0.51	0.02	0	0	0	0	0.51	0.02	0.04	4.91
Shafter Cotton Research Sta.	370	27S/25E-33J	1.39	1.99	1.37	0.75	0.01	0.13	0	0.07	0	0.14	0.02	0.05	5.92
So. Belridge (Cal Resources)	600	28S/21E-33	1.00	1.34	0.76	0.90	0	0.20	0	0	0	0.11	0.03	0.01	4.35
Approximate Average For All Stations			1.14	2.22	1.25	0.74	0.13	0.07	0	0.03	0.00	0.50	0.06	0.07	6.20
Note: Boxed numbers are estimated values															
"m" indicates missing data															

Table 11. Effective Precipitation in the San Joaquin Valley portion of Kern County (acre-feet)

	Annual Effective Precipitation	Unit Rate (inches per acre)	Cumulative Effective Precipitation
1970	380,200	5.72	380,200
1971	148,300	2.13	528,500
1972	264,900	3.78	793,400
1973	131,900	1.84	925,300
1974	220,200	2.88	1,145,500
1975	240,500	3.17	1,386,000
1976	175,300	2.25	1,561,300
1977	198,400	2.74	1,759,700
1978	612,500	8.08	2,372,200
1979	152,600	1.97	2,524,800
1980	281,200	3.58	2,806,000
1981	255,400	3.21	3,061,400
1982	332,300	4.18	3,393,700
1983	438,100	6.15	3,831,800
1984	139,300	1.72	3,971,100
1985	160,700	2.04	4,131,800
1986	162,600	2.40	4,294,400
1987	168,200	2.57	4,462,600
1988	144,200	2.08	4,606,800
1989	106,100	1.49	4,712,900
1990	90,500	1.29	4,803,400
1991	171,700	2.82	4,975,100
1992	142,300	2.16	5,117,400
1993	168,700	2.53	5,286,100
1994	169,100	2.53	5,455,200
1995	192,400	2.72	5,647,600
1996	192,500	2.62	5,840,100
1997	105,600	1.43	5,945,700
1998	575,200	8.01	6,520,900
1999	136,500	1.85	6,657,400
2000	123,800	1.67	6,781,200

Mean EP (total)	218,700 AF
Median EP (total)	169,100 AF
Mean EP (per acre)	3.02 Inches/Acre
Median EP (per acre)	2.53 Inches/Acre

Table 12. 2000 Waste Water Treatment Plant Volumes

Facility	Volume		Influent Source	Treatment System	Effluent Use
	(MG)	(AF)			
City of Arvin	442	1,358	Dom	Secondary	Agriculture
City of Bakersfield					
#2	5,932	18,205	Dom/Ind	Secondary	Restricted Agriculture
#3	4,160	12,767	Dom/Ind	Secondary	Restricted Agriculture
Kern County Waste Management Department					
KSA (Mt. Vernon)	1,567	4,808	Dom	Secondary	Agriculture
BVARA	8	25	Agr	Secondary	Percolation
Sheriff's Lerdo Facility	105	321	Dom	Secondary	Same
Reeder Tract	11	35	Dom	Secondary	Same
NOR Sanitary District #1	1,424	4,368	Dom/Ind	Secondary	Restricted Agriculture Percolation
City of Delano	1,605	4,926	Dom	Secondary	Restricted Agriculture
Lamont Public Utilities District	593	1,821	Dom	Primary	Agriculture
City of McFarland	323	988	Dom	Secondary	Agriculture
City of Shafter	n/a	n/a	Dom/Ind	Secondary	Agriculture
Shafter Airport ⁽¹⁾	88	269	Ind	Secondary	Percolation
City of Wasco	26	79	Dom/Ind	Secondary	Agriculture
Total	16,285	49,970			

For influent source:

Dom - domestic

Ind - industrial

Agr - agricultural

Primary treatment removes settleable solids.

Secondary treatment involves further oxidation of waste water to remove dissolved and biologically degradable substances.

Tertiary treatment involves further filtration and disinfection to inactivate pathogens.

Table 13. Waste Water Reuse (in acre-feet)

Year	Annual Flows	Cumulative Flows
1970	26,900	26,900
1971	27,800	54,700
1972	25,300	80,000
1973	25,600	105,600
1974	26,000	131,600
1975	26,100	157,700
1976	26,600	184,300
1977	28,100	212,400
1978	28,200	240,600
1979	28,800	269,400
1980	32,800	302,200
1981	34,100	336,300
1982	32,100	368,400
1983	35,300	403,700
1984	35,800	439,500
1985	34,200	473,700
1986	39,200	512,900
1987	41,400	554,300
1988	44,200	598,500
1989	44,000	642,500
1990	42,500	685,000
1991	45,200	730,200
1992	46,100	776,300
1993	47,600	823,900
1994	49,700	873,600
1995	49,700	923,300
1996	51,300	974,600
1997	50,800	1,025,400
1998	48,800	1,074,200
1999	48,533	1,122,733
2000	49,970	1,172,703
Mean Water Reuse	37,800 AF	
Median Water Reuse	35,800 AF	
Minimum Water Reuse (1972)	25,300 AF	
Maximum Water Reuse (1996)	51,300 AF	

Table 14. Oil Field Produced Water (acre-feet)

Year	Annual Flows	Cumulative Flows
1970	5,300	5,300
1971	5,600	10,900
1972	6,100	17,000
1973	6,400	23,400
1974	6,900	30,300
1975	7,400	37,700
1976	7,700	45,400
1977	8,100	53,500
1978	8,500	62,000
1979	9,400	71,400
1980	10,100	81,500
1981	10,100	91,600
1982	10,600	102,200
1983	11,600	113,800
1984	11,700	125,500
1985	11,700	137,200
1986	11,800	149,000
1987	10,000	159,000
1988	12,700	171,700
1989	9,100	180,800
1990	5,300	186,100
1991	14,100	200,200
1992	8,700	208,900
1993	9,600	218,500
1994	16,800	235,300
1995	19,800	255,100
1996	13,800	268,900
1997	4,200	273,100
1998	2,000	275,100
1999	2,700	277,800
2000	4,100	281,900
Mean Oil Field Water		9,100 AF
Median Oil Field Water		9,100 AF
Minimum Oil Field Water (1998)		2,000 AF
Maximum Oil Field Water (1995)		19,800 AF

Table 15. Groundwater Pumping in the San Joaquin Valley portion of Kern County (acre-feet)

Year	Annual Groundwater Pumped	Cumulative Groundwater Pumped
1970	1,422,000	1,422,000
1971	1,700,000	3,122,000
1972	1,857,000	4,979,000
1973	1,662,000	6,641,000
1974	1,333,000	7,974,000
1975	1,587,000	9,561,000
1976	1,738,000	11,299,000
1977	1,703,000	13,002,000
1978	825,000	13,827,000
1979	1,260,000	15,087,000
1980	977,000	16,064,000
1981	1,161,000	17,225,000
1982	802,200	18,027,200
1983	762,700	18,789,900
1984	1,252,200	20,042,100
1985	1,293,800	21,335,900
1986	947,600	22,283,500
1987	1,208,700	23,492,200
1988	1,540,200	25,032,400
1989	1,588,500	26,620,900
1990	1,796,500	28,417,400
1991	2,002,400	30,419,800
1992	1,673,600	32,093,400
1993	987,700	33,081,100
1994	1,897,700	34,978,800
1995	1,242,800	36,221,600
1996	1,609,600	37,831,200
1997	1,091,400	38,922,600
1998	1,290,200	40,212,800
1999	1,471,500	41,684,300
2000	1,360,100	43,044,400
Mean Groundwater Pumping		1,391,700 AF
Median Groundwater Pumping		1,360,100 AF
Minimum Pumping (1983)		762,700 AF
Maximum Pumping (1991)		2,002,400 AF

Table 16. Irrigated Acreage in the San Joaquin Valley portion of Kern County

Year	Total Irrigated Acreage	Year	Total Irrigated Acreage
1970	797,300	1996	880,600
1971	834,800	1997	886,700
1972	841,000	1998	861,500
1973	858,700	1999	887,540
1974	919,000	2000	884,105
1975	909,600		
1976	934,800		
1977	868,100		
1978	909,400		
1979	928,700		
1980	943,500		
1981	955,400		
1982	954,100		
1983	854,200		
1984	972,800		
1985	945,100		
1986	813,900		
1987	786,800		
1988	831,100		
1989	856,100		
1990	842,400		
1991	729,400		
1992	789,600		
1993	800,100		
1994	802,400		
1995	848,400		

Mean Irrigated Acreage	868,600 Acres
Minimum Irrigated Acreage (1991)	729,400 Acres
Maximum Irrigated Acreage (1984)	972,800 Acres

⁽¹⁾ Double-cropped acreage is counted twice, since it is irrigated twice. Double-cropping is generally a small percentage of total irrigated acreage, in the order of 10,000 to 20,000 acres annually.

Table 17. 2000 Monthly Evaporation for San Joaquin Valley Climatic Stations (inches)

	Wasco 7E	USDA Cotton Station	Greenlee's Pasture	Avg. All Stations
January	1.82	1.59	1.67	1.69
February	2.22	2.78	2.92	2.64
March	4.28	4.25	3.89	4.14
April	6.42	6.63	6.62	6.56
May	7.97	9.16	9.00	8.71
June	10.29	9.36	9.53	9.73
July	11.35	9.27	10.04	10.22
August	9.85	8.41	9.73	9.33
September	6.65	6.80	7.14	6.86
October	4.37	4.64	4.78	4.60
November	2.04	2.05	2.00	2.03
December	1.39	1.44	1.25	1.36
Total	68.65	66.38	68.57	67.87
Percent of Normal	96	111	98	101

Station Locations

Wasco 7E

Section 6Q, T27S, R26E, MDB&M.
Equipment: USWB Class "A" evaporation pan in an irrigated pasture environment.

USDA Cotton Station

Section 33F, T27S, R25E, MDB&M.
Equipment: USWB Class "A" evaporation pan in an irrigated grass turf environment.

Greenlee's Pasture

Section 36N, T12N, R21W, SBB&M.
Equipment: USWB Class "A" evaporation pan in an irrigated pasture environment.

Table 18. 2000 Irrigated Acreage, San Joaquin Valley portion of Kern County

Crop	Acres ⁽²⁾	Percent of Total	Consumptive Water Use ⁽¹⁾ (AF/Acre)
Alfalfa (including seed)	64,234	6.5	4.55
Almonds	120,418	12.3	2.75
Apples	3,862	0.4	2.54
Apricots	657	-	2.56
Asparagus	19	-	3.21
Avocado	-	-	2.54
Barley	486	-	1.59
Beans	7,358	0.7	1.41
Broccoli	99	-	0.79
Carrots	15,324	1.6	0.55
Citrus	49,406	5.0	3.78
Corn, Field & Sweet	30,910	3.1	2.53
Cotton	184,164	18.8	2.67
Dry Farmed Grains, Pasture	24,270	2.5	-
Figs	538	-	2.65
Grapes	143,414	14.6	2.19
Guayale, Jojoba	20	-	2.01
Idle, Fallow Lands	73,264	7.5	-
Kiwi	300	-	2.95
Lettuce	757	-	0.88
Melons, Squash, Cucumbers	6,201	0.6	1.95
Misc. Deciduous Trees	7,336	0.7	2.87
Misc. Field Crops	17,178	1.7	2.65
Misc. Hay/Grain	51,212	5.2	1.59
Misc. Subtropical Trees	676	-	2.51
Misc. Vegetables	5,364	0.5	1.33
Nursery	3,784	0.4	4.02
Oats	3,826	0.4	1.46
Olives	597	-	2.66
Onions, Garlic	11,789	1.2	2.15
Pasture, Turf	6,488	0.7	2.90
Peaches, Nectarines	4,714	0.5	2.74
Pears	104	-	2.74
Peas	108	-	1.83
Peppers	1,518	0.2	2.40
Pistachios	45,468	4.6	2.36
Plums, Prunes	3,032	0.3	2.77
Potatoes	21,982	2.2	1.93
Rice	-	-	3.50
Safflower	4,122	0.4	2.39
Sorghum/Milo	5,167	0.5	2.49
Sudan Grass	2,339	0.2	2.20
Sugar Beets	5,568	0.6	3.58
Tomatoes	8,132	0.8	2.78
Turnips	-	-	1.70
Walnuts	1,223	0.1	2.72
Wheat	44,210	4.5	1.59
Total Irrigated Lands	884,105	100.0	-
Total Harvested Lands	908,376		
Double Cropped	8,761		

Note: Double-cropped acreage is counted twice, since it is irrigated twice.

⁽¹⁾ Weighted average consumptive use of all crops.

⁽²⁾ Excludes acreage in Arvin-Edison WSD/Wheeler Ridge-Maricopa WSD overlap area.

Table 19. Average Applied Water Requirements for Various Crops, San Joaquin Valley portion of Kern County

Crop	Drip ⁽¹⁾	Sprinkler ⁽²⁾	Row/Border ⁽³⁾
Alfalfa		3.45-4.35	3.5-5.15
Almonds	2.85-4.10	2.85-4.50	2.85-4.50
Apples	1.95-3.80	3.40-4.75	
Beans (dry)			2.00-2.75
Carrots		1.75-2.45	
Citrus	2.05-3.75	2.75-4.40	3.50-4.50
Corn (field)			3.00-5.00
Cotton		2.25-3.75	2.45-3.75
Grapes	2.00-4.00	2.15-4.50	2.35-4.85
Lettuce			1.50-2.50
Onions, Garlic		1.00-2.65	1.25-4.25
Melons, Squash, Cucumbers			2.00-3.40
Misc. Deciduous Trees	2.75-3.35	3.00-4.00	3.00-4.50
Nursery			2.25-3.50
Pasture, Irrigated		3.50-4.50	3.50-6.00
Pistachios	2.65-4.40	2.35-3.35	3.00-3.50
Potatoes		1.10-2.30	
Small Grains		1.00-2.50	1.00-2.50
Tomatoes			2.50-3.50
Walnuts			3.50-5.00

⁽¹⁾ Includes emitters, misters, mini-sprinklers and fan jets.

⁽²⁾ Includes portables, solid-sets, linear moves, sprinkler guns.

⁽³⁾ Border includes border strip, level basin, contour strip.

Note: A blank entry indicates that an irrigation system is generally not utilized on a crop.

Table 20. 2000 Urban Water Use, San Joaquin Valley portion of Kern County

Water Purveyor Service area	Metered Connections	Non-metered Connections	Annual Water Use		Permanent Population	GPCD ⁽¹⁾
			Million Gals.	Acre Feet		
Arvin						
Arvin CSD	2,547	-	892	2,738	11,847	206
Bakersfield Metro Area						
Airport Mutual WC	79	-	-	-	0	-
California Water Service						
Bakersfield Division	20,307	36,860	24,704	75,814	193,060	351
Ashe Water Division	25,554	250	8,930	27,405	95,059	209
Casa Loma WC ⁽²⁾	-	215	-	-	600	-
East Niles CSD	6,569	-	3,093	9,491	24,305	349
Greenfield CWD	762	361	433	1,329	6,200	191
North of the River MWD	489	1,462	812	2,493	7,000	318
Oildale MWC	754	6,038	2,292	7,033	22,000	285
Rancho Verdugo WC	-	300	37	114	812	-
Stockdale MWC	-	80	69	212	200	945
Stockdale Annex MWC	-	142	45	138	337	366
Vaughn WC	5,321	1,141	2,964	9,096	18,160	447
Victory MWC	-	188	27	83	432	171
Metro Area Subtotal	59,835	47,037	43,406	133,207	368,165	317
Buttonwillow						
Buttonwillow CWD	-	419	52	161	1,400	102
Delano						
City of Delano	3,457	3,728	2,900	8,899	38,000	209
Lamont						
Lamont PUD and ID#1	334	3,200	1,717	5,269	13,500	348
Lost Hills						
Lost Hills Utility District	281	-	98	301	1,900	141 ⁽³⁾
McFarland						
McFarland MWC	1,809	-	526	1,614	8,000	180
Rio Bravo						
Olcese WD ⁽⁴⁾	564	-	323	991	1,525	580 ⁽⁵⁾
Shafter						
City of Shafter	31	3,079	1,440	4,419	11,895	332
Taft-Maricopa-McKittrick						
West Kern WD	7,019	-	5,556	17,050	22,000	692 ⁽⁶⁾
Wasco						
City of Wasco	123	3,557	1,422	4,364	14,492	269
Wasco State Prison	1,767	-	332	1,019	7,150	127
Total	77,767	61,020	58,664	180,031	499,874	294 ⁽⁶⁾

(1) Gallons per capita per day. Note that the computed GPCD includes residential, commercial, industrial and public Authority water use.

(2) Casa Loma WC is reported by DHS

(3) Includes significant quantities of water used by oil companies.

(4) Per Cal Water Service: Olcese sold to CWS in 1999. 564 connections reported

(5) Water used to irrigate a golf course.

(6) Weighted average GPCD, excluding Rio Bravo, Lost Hills and Taft-Maricopa-McKittrick.

Table 21. Surface* and Groundwater Usage or Availability, San Joaquin Valley portion of Kern County (acre-feet)

	Kern River		Other Local Water ⁽¹⁾		Central Valley Project		State Water Project		Groundwater		Total Supplies
	Available	% of Total	Available	% of Total	Usage	% of Total	Usage	% of Total	Usage	% of Total	
1970	589,500	19.1	517,900	16.8	351,400	11.4	204,600	6.6	1,422,000	46.1	3,085,400
1971	427,500	13.9	217,100	7.1	348,900	11.4	375,500	12.2	1,700,000	55.4	3,069,000
1972	268,400	8.4	292,600	9.2	238,500	7.5	535,600	16.8	1,857,000	58.2	3,192,100
1973	979,700	26.3	161,200	4.3	412,200	11.0	515,500	13.8	1,662,000	44.6	3,730,600
1974	818,600	22.6	332,000	9.2	480,600	13.3	651,800	18.0	1,333,000	36.9	3,616,000
1975	564,600	15.2	287,300	7.8	442,100	11.9	821,700	22.2	1,587,000	42.9	3,702,700
1976	249,500	7.5	225,700	6.8	226,500	6.8	883,400	26.6	1,738,000	52.3	3,323,100
1977	197,000	7.3	239,400	8.9	121,500	4.5	429,400	16.0	1,703,000	63.3	2,690,300
1978	1,653,500	36.8	1,050,200	23.3	357,800	8.0	611,500	13.6	825,000	18.3	4,498,000
1979	672,700	17.0	258,700	6.6	462,500	11.7	1,291,800	32.7	1,260,000	31.9	3,945,700
1980	1,640,000	37.8	356,500	8.2	462,800	10.7	900,300	20.8	977,000	22.5	4,336,600
1981	449,300	11.8	329,100	8.7	470,000	12.4	1,384,700	36.5	1,161,000	30.6	3,794,100
1982	1,271,100	31.4	434,600	10.7	656,600	16.2	884,500	21.8	802,200	19.8	4,049,000
1983	2,489,100	52.2	723,000	15.2	550,900	11.6	238,200	5.0	762,700	16.0	4,763,900
1984	821,800	21.5	194,200	5.1	425,400	11.1	1,123,000	29.4	1,252,200	32.8	3,816,600
1985	672,400	18.8	192,600	5.4	337,500	9.5	1,074,100	30.1	1,293,800	36.2	3,570,400
1986	1,444,900	35.2	207,000	5.0	589,300	14.4	913,600	22.3	947,600	23.1	4,102,400
1987	375,900	12.0	240,100	7.6	292,000	9.3	1,025,900	32.6	1,208,700	38.5	3,142,600
1988	294,700	8.9	179,800	5.4	292,800	8.8	1,006,200	30.4	1,540,200	46.5	3,313,700
1989	397,000	11.3	122,100	3.5	293,900	8.4	1,097,200	31.4	1,588,500	45.4	3,498,700
1990	203,600	6.4	112,800	3.6	200,100	6.3	857,300	27.0	1,796,500	56.7	3,170,300
1991	406,300	14.2	220,400	7.7	204,400	7.1	32,700	1.1	2,002,400	69.9	2,866,200
1992	296,800	10.6	203,200	7.3	208,000	7.4	418,000	14.9	1,673,600	59.8	2,799,600
1993	853,800	22.5	251,200	6.6	489,800	12.9	1,205,500	31.8	987,700	26.1	3,788,000
1994	336,500	10.1	222,700	6.7	186,300	5.6	695,400	20.8	1,897,700	56.8	3,338,600
1995	1,385,200	29.1	374,300	7.9	647,100	13.6	1,111,200	23.3	1,242,800	26.1	4,760,600
1996	1,038,300	21.6	294,400	6.1	611,300	12.7	1,247,200	26.0	1,609,600	33.5	4,800,800
1997	1,182,000	28.2	209,800	5.0	630,000	15.1	1,072,200	25.6	1,091,400	26.1	4,185,400
1998	1,718,000	33.2	863,600	16.7	466,500	9.0	839,200	16.2	1,290,200	24.9	5,177,500
1999	434,000	11.6	176,500	4.7	350,500	9.4	1,315,900	35.1	1,471,500	39.3	3,748,400
2000	476,800	12.9	153,700	4.2	494,000	13.4	1,208,500	32.7	1,360,100	36.8	3,693,100
Avg.	793,800	21.3	311,100	8.3	396,800	10.6	837,800	22.5	1,388,500	37.2	3,728,500

* Adjusted for deliveries within Kern County. SWP includes Intertie deliveries.

⁽¹⁾ Includes effective precipitation, minor stream flows and wastewater reuse.

Table 22. Summary of Kern River-California Aqueduct Intertie Activity (in acre-feet)

	Intertie Inflow			Amount Exported			Retained in County		
	Kern River	Friant-Kern	Total	Kern River	Friant-Kern	Total	Kern River	Friant-Kern	Total
1978	168,818	9,113	177,931	n/a*	n/a*	113,831	n/a*	n/a*	64,100
1980	138,816	0	138,816	74,024	0	74,024	64,792	0	64,792
1982	10,339	11,968	22,307	5,928	2,700	8,628	4,411	9,268	13,679
1983	662,856	96,200	759,056	n/a*	n/a*	393,551	n/a*	n/a*	365,505
1984	27,524	0	27,524	13,885	0	13,885	13,639	0	13,639
1986	1,867	15,580	17,447	0	4,746	4,746	1,867	10,834	12,701
1995	(13,117)	0	(13,117) ⁽¹⁾	0	0	0	(13,117)	0	(13,117) ⁽¹⁾
1997	1,793	51,055	52,848	1,793	47,496	49,289	0	5,352	5,352 ⁽¹⁾
1998	130,226	57,822	188,048	130,226	57,822	188,048	0	0	0
Total	1,129,122	241,738	1,370,860 ⁽²⁾			846,002			526,651 ⁽²⁾

* A breakdown between sources was not available.

⁽¹⁾ A major flood event north of Kern County caused SWP water to be reverse flowed into the Kern River flood channel. This is the opposite operation for which the Intertie was designed and constructed.

⁽²⁾ The year 1995 is not included in totals.

Source: State Department of Water Resources and City of Bakersfield Kern River Annual Reports.

Table 23. Summary of Groundwater Recharge Activities (in acre-feet)

Entity/Location	Source	1971-94	1995	1996	1997	1998	1999	2000	Total
BANKING									
City of Bakersfield									
2,800 Acre Spreading Area	Combined ⁽¹⁾	622,704	39,117	21,994	27,510	68,481	210	--	780,016
Kern County Water Agency									
Kern Water Bank	Combined ⁽¹⁾	--	688	18,069	--	--	--	--	18,757
Pioneer Property	Combined ⁽²⁾	--	102,693	52,367	13,235	61,667	21,416	15,049	266,427
Berrada Mesa Spreading Area	Combined ⁽²⁾	43,856	34,280	9,554	6,565	20,349	1,904	--	116,508 ⁽¹⁾
Kern River Channel	Combined ⁽¹⁾	60,046	2,029	6,179	5,883	458	2,003	--	76,598
2,800 Acre Spreading Area	Combined ⁽¹⁾	229,018	73,337	16,612	875	--	--	--	319,842
Subtotal KCWA		332,970	213,027	102,781	26,558	82,474	25,323	15,049	798,132
DWR-Kern Water Bank									
2800 Acre Spreading Area	SWP	7,379	--	--	--	--	--	--	7,379
Local Elements In-lieu Rechg	SWP	136,300	--	--	--	--	--	--	136,300
Local Elements Direct Rechg	SWP	4,200	--	--	--	--	--	--	4,200
Subtotal DWR		147,879	--	--	--	--	--	--	147,879
Kern Water Bank Authority									
Kern Water Bank	Combined ⁽¹⁾	--	230,938	143,615	115,590	306,641	36,031	40,323	873,138
2800 Acres	Combined ⁽¹⁾	--	--	--	--	--	--	--	--
Pioneer Property	Combined ⁽¹⁾	--	--	--	--	--	--	--	--
Subtotal KWBA		--	230,938	143,615	115,590	306,641	36,031	40,323	873,138
Semutropic WSD In-lieu	SWP	--	--	--	--	--	151,850	67,990	219,840
Arvin-Edison WSD Direct	SWP	--	--	--	--	--	80,667	104,887	185,554
In-lieu	SWP	--	--	--	--	--	4,644	29,057	33,701
Total Banking		1,103,503	483,082	268,390	169,658	457,596	298,725	257,306	2,599,165
CONJUNCTIVE USE									
Arvin-Edison WSD Direct Rechg.	F-K	847,583	108,664	51,954	73,151	49,000	--	--	1,130,352
	SWP	--	--	--	--	--	--	--	--
In-Lieu Rechg.	SWP	--	--	--	--	--	--	--	--
Buena Vista WSD Direct Rechg.	Combined ⁽²⁾	1,471,926	128,203	81,156	52,831	89,321	13	2	1,823,452
	Kern	--	--	--	--	--	28,634	29,790	58,424
	SWP	--	--	--	--	--	7,640	17,652	25,292
	F-K	--	--	--	--	--	3,807	--	3,807
In-Lieu Rechg.	Combined ⁽¹⁾	--	--	--	--	--	15,617	17,389	33,006
	Kern	--	--	--	--	--	25,385	28,977	54,362
	SWP	--	--	--	--	--	75,529	57,939	133,468
	F-K	--	--	--	--	--	5,135	--	5,135
Semutropic WSD Direct Rechg.	SWP	87,496	20,881	23,560	21,997	103,596	17,231	10,703	285,464
	Combined ⁽¹⁾	--	--	--	--	--	273	--	273
	Kern	--	--	--	--	--	495	541	1,036
In-Lieu Rechg.	SWP	704,868	73,954	114,135	110,995	13,736	130,978	179,958	1,328,624
	F-K	--	--	--	--	--	1,383	--	1,383
	Combined ⁽¹⁾	7,289	--	--	--	69,040	--	--	76,329 ⁽¹⁾
I.D. No. 4 Direct Rechg.	Kern	470,981	30,692	64,753	60,224	26,345	13,872	22,843	689,710
	SWP	320,419	19,523	138	--	--	70,821	26,304	437,205
	F-K	27,112	7,098	9,754	2,629	2,547	842	4,699	54,681
Kern Delta WD Direct Rechg.	Combined ⁽¹⁾	1,243,611	61,252	65,301	69,016	52,034	679	--	1,491,893
	Kern	--	--	--	--	--	53,636	49,609	103,245
	SWP	--	--	--	--	--	5,275	8,393	13,668
North Kern WSD Direct Rechg.	Kern	1,540,419	242,263	121,233	137,340	264,694	52,010	29,412	2,387,371
	Combined ⁽¹⁾	--	--	--	--	--	9,736	3,477	13,213
In-Lieu Rechg.	Kern	2,506,036	124,873	140,781	135,657	95,135	36,787	75,707	3,114,976
	SWP	--	--	--	--	--	67,922	21,868	89,790
	F-K	--	--	--	--	--	5,175	--	5,175
	Combined ⁽¹⁾	--	--	--	--	--	239	3,005	3,244
Rosedale-Rio Bravo WSD Direct Rechg.	Kern	545,911	102,307	44,293	72,875	104,879	14,787	8,384	893,436
	SWP	584,680	48,375	29,545	17,080	26,923	34,009	7,030	747,642
	F-K	168,728	8,470	25,919	31,843	4,660	3,187	31,871	274,678
	Combined ⁽¹⁾	279,800	--	--	--	--	--	--	279,800 ⁽¹⁾
In-Lieu Rechg.	SWP	2,657	--	--	--	--	10,344	66	13,067
	F-K	--	--	--	--	--	--	3,030	3,030
	Kern	--	--	--	--	--	354	--	354
Rosedale Ranch ID Direct Rechg.	Kern	--	--	--	--	--	413	--	413
In-Lieu Rechg.	Kern	--	--	--	--	--	5,387	1,621	7,008
	SWP	--	--	--	--	--	121	--	121
Wheeler Ridge-Maricopa WSD	SWP	--	--	--	--	--	2,788	--	2,788
In-Lieu Recharge	SWP	200,596	12,650	--	--	--	--	--	213,246
Total Conjunctive Use		11,010,112	989,205	772,522	785,638	901,910	700,504	640,270	15,808,161
OVERDRAFT CORRECTION									
Groundwater Replenishment Programs									
Direct Rechg.	Kern	188,185	--	5,365	10,084	58,321	--	--	261,955
	SWP	258,441	--	38,795	1,912	3,129	--	180	302,457
	F-K	7,723	--	4,396	6,969	3,144	2,070	23,341	47,643
In Lieu Rechg.	Kern	573	3,725	3,189	889	6,631	--	--	15,007
	SWP	98,065	--	--	--	--	--	--	98,065
Total Overdraft Correction		552,987	3,725	51,745	19,854	71,225	2,070	23,521	715,127
GRAND TOTALS									
	Kern	5,252,105	503,860	379,614	417,069	556,005	231,760	246,884	7,587,297
	SWP	2,405,101	175,383	206,173	151,984	147,384	659,819	532,027	4,277,871
	F-K	1,051,146	124,232	92,023	114,592	59,351	21,599	62,941	1,525,884
	Combined ⁽¹⁾	3,958,250	672,537	414,847	291,505	667,991	88,121	79,245	6,172,496 ⁽¹⁾
Total		12,666,602	1,476,012	1,092,657	975,150	1,430,731	1,001,299	921,097	19,563,548

⁽¹⁾ Breakdown between sources not available.⁽²⁾ Includes banking by Olcese WD, Hacienda WD, Buena Vista WSD, City of Bakersfield; for breakdown between districts see Table 24.

Note: For a breakdown of 1971 to 1994, see prior Water Supply Reports. These numbers may be revised from previous years Water Supply Reports.

Table 24. Groundwater Banking Summary

197819791980198119821983198419851986198719881989													19901991199219931994199519961997199819992000Total												
Alameda County WD (banking in STWSD)													Alameda County WD (banking in STWSD)												
Recharge/Purchase																	5,580	10,000	9,750	39,010	37,320			101,660	
Recovery/Sale																									
Storage Balance																	5,580	15,580	25,330	64,340	101,660			101,660	
Belridge WSD													Belridge WSD												
Recharge/Purchase															14,204	325	15,642	3,942	2,196	13,204	3,234	4,947		57,694	
Recovery/Sale																(2,029)								(2,029)	
Storage Balance															14,204	12,500	28,142	32,084	34,280	47,484	50,718	55,665		55,665	
Buena Vista WSD													Buena Vista WSD												
Recharge/Purchase	6,056	9,913		24,465				10,000							7,849		27,535	20,000	215	15,875	210			122,118	
Recovery/Sale									(6,000)	(5,000)	(3,138)													(24,794)	
Storage Balance	6,056	15,969	15,969	15,969	40,434	40,434	40,434	50,434	44,434	39,434	36,296		(2,242)	(4,410)	(4,004)	33,489	33,489	61,024	81,024	81,239	97,114	97,324	97,324	97,324	
Berrenda Mesa WD													Berrenda Mesa WD												
Recharge/Purchase				9,500											7,936	6,568	59,819	4,686	7,125	29,065	3,426	2,593		134,720	
Recovery/Sale																(400)								(13,902)	
Storage Balance				9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500		(9,500)	(4,002)		7,936	14,104	73,923	78,609	85,734	114,799	118,225	120,818	120,818	
Cawelo WD													Cawelo WD												
Recharge/Purchase															14,068		3,245	2,000						19,313	
Recovery/Sale																								(44)	
Storage Balance															14,068	14,024	17,269	19,269	19,269	19,269	19,269	19,269	19,269	19,269	
City of Bakersfield													City of Bakersfield												
Recharge/Purchase	104,587	4,505	68,804	2,603	37,913	113,380	16,058	402	64,168	109					32		13,089	300	16,635	52,606				495,191	
Recovery/Sale			(13,772)	(100,837)			(472)	(1,615)		(656)	(5,432)	(2,859)				(8,311)	(1,297)	(1,781)	(618)	(30,269)	(6,741)	(3,426)		(288,829)	
Storage Balance	104,587	109,092	164,124	65,890	103,803	217,183	232,769	231,556	295,724	295,177	289,745	286,886	(23,318)	(57,159)	(30,266)	167,864	179,656	178,175	194,192	216,529	209,788	206,362	206,362	206,362	
Dudley Ridge WD													Dudley Ridge WD												
Recharge/Purchase																	1,587	20,748	10,246	22,721	1,307	952		57,561	
Recovery/Sale																									
Storage Balance																	1,587	22,335	32,581	55,302	56,609	57,561	57,561	57,561	
Henry Miller WD													Henry Miller WD												
Recharge/Purchase																	3,999	5,223	664	1,885	1,483			13,254	
Recovery/Sale																									
Storage Balance																	3,999	9,222	9,886	11,771	13,254	13,254	13,254	13,254	
Improvement District No. 4													Improvement District No. 4												
Recharge/Purchase									12,766		3,500				23,007	10,641	92,765	71,851	6,720	39,373	77	2		260,702	
Recovery/Sale																(100)	(1,500)							(5,100)	
Storage Balance									12,766	12,766	12,766	16,266	16,266	16,266	35,773	46,314	137,579	209,430	216,150	255,523	255,600	255,602	255,602	255,602	
Kern County Water Agency													Kern County Water Agency												
Recharge/Purchase				63,364	14,155	416	15,055	29,389							5,542		28,999	45,069		6,690	8,104	7,507		272,836	
Recovery/Sale											(16,105)			(66,775)	(22,684)									(105,564)	
Storage Balance				63,364	63,364	77,519	77,935	92,990	122,379	122,379	122,379	106,274	106,274	81,595	65,361	70,903	70,903	99,902	144,971	144,971	151,661	159,765	167,272	167,272	
Kern Delta WD													Kern Delta WD												
Recharge/Purchase																				647	534			1,181	
Recovery/Sale																									
Storage Balance																				647	1,181	1,181	1,181	1,181	
Lost Hills WD													Lost Hills WD												
Recharge/Purchase														2,035	31,153	5,280	26,191	8,079	10,898	18,633	5,275			107,544	
Recovery/Sale																									
Storage Balance														2,035	2,035	33,188	38,468	64,659	72,738	83,636	102,269	107,544	107,544	107,544	
Metropolitan WD of So. Calif. (banking in AEWSD)													Metropolitan WD of So. Calif. (banking in AEWSD)												
Recharge/Purchase																			1,332	26,466	85,311	133,944		247,053	
Recovery/Sale																									
Storage Balance																			1,332	27,798	113,109	247,053	247,053	247,053	
Metropolitan WD of So. Calif. (banking in STWSD)													Metropolitan WD of So. Calif. (banking in STWSD)												
Recharge/Purchase															50,000		45,000	85,499	156,220	39,500	75,850			452,069	
Recovery/Sale																									
Storage Balance															50,000	50,000	95,000	180,499	336,719	376,219	452,069	452,069	452,069	452,069	
OlceseWD/Hacienda WD													OlceseWD/Hacienda WD												
Recharge/Purchase	24,328		52,604	4,465	14,266			56,197	5,344	3,214							6,028	1,694	10,000					206,686	
Recovery/Sale											(873)		(104,305)	(23,496)	(6,450)		(1,160)					(41,826)		(178,110)	
Storage Balance	24,328	24,328	76,932	81,397	95,663	95,663	95,663	151,860	157,204	160,418	159,545		55,240	53,840	53,840	53,840	52,680	58,708	60,402	70,402	70,402	28,576	28,576	28,576	
Rosedale-Rio Bravo WSD													Rosedale-Rio Bravo WSD												
Recharge/Purchase																	6,355	14,342	2,288					22,985	
Recovery/Sale																		(12,265)						(12,265)	
Storage Balance																	6,355	8,432	10,720	10,720	10,720	10,720	10,720	10,720	
Semitropic WSD													Semitropic WSD												
Recharge/Purchase															19,972		1,100	29,945	35,310	16,458	19,784			122,569	
Recovery/Sale																								(181)	
Storage Balance															19,972	19,791	20,891	50,836	86,146	102,604	122,388	122,388	122,388	122,388	
Santa Clara Valley WD													Santa Clara County FC&WD (banking in STWSD)												
Recharge/Purchase																		40,500	35,000	23,800	30,000	23,730		153,030	
Recovery/Sale																									
Storage Balance																		40,500	75,500	99,300	129,300	153,030	153,030	153,030	
State of California													State of California												
Recharge/Purchase									7,379						248,005									255,384	
Recovery/Sale																								(126,822)	
Storage Balance									7,379	7,379	7,379				255,384	255,384	(72,049)	183,335	170,877	170,125	128,562	128,562	128,562	128,562	
Tejon-Castac WD													Tejon-Castac WD												
Recharge/Purchase																	70	2,324	6,211	1,675	5,795	359	1,895	18,329	
Recovery/Sale																									
Storage Balance																	70	2,394	8,605	10,280	16,075	16,434	18,329	18,329	
Westside Mutual Water Co.													Westside Mutual Water Co.												
Recharge/Purchase																		134,517	65,321	51,183	150,920	7,883	29,650	439,474	
Recovery/Sale																			(5,000)					(5,000)	
Storage Balance																		134,517	194,838	246,021	396,941	404,824	434,474	434,474	
Wheeler Ridge-Maricopa WSD													Wheeler Ridge-Maricopa WSD												
Recharge/Purchase				5,600							15,019						58,290							283,683	
Recovery/Sale																		(7,551)	61,387	27,807	83,634	9,888	7,826	(7,551)	
Storage Balance				5,600	5,600	5,600	5,600	5,600	5,600	5,600	20,619						71,358	132,745	160,552	174,784	258,418	268,306	276,132	276,132	
Total of All Accounts													Total of All Accounts												
Recharge/Purchase	134,971	14,418	121,408	85,532	76,644	127,535	16,474	15,457	172,520</																

TABLE 25. Areal Extent of Shallow Groundwater, San Joaquin Valley Portion of Kern County
(in acres)

Year	Summer Measurements						Winter Measurements					
	0-5 ft.	5-10 ft.	10-15 ft.	15-20 ft.	Total Within 20 ft.	No. of Piezo's	0-5 ft.	5-10 ft.	10-15 ft.	15-20 ft.	Total Within 20 ft.	No. of Piezo's
1976	27,940	64,700	--	79,680 ⁽¹⁾	172,320	--	--	--	--	--	--	--
1977	19,320	68,980	--	95,960 ⁽¹⁾	184,260	180	16,930	52,530	--	67,300 ⁽²⁾	136,760	143
1978	27,680	65,760	--	87,920 ⁽¹⁾	181,360	174	9,600	59,520	--	86,400 ⁽²⁾	155,520	--
1979	30,270	67,310	--	95,870 ⁽¹⁾	193,450	--	15,320	83,200	--	80,640 ⁽²⁾	179,160	126
1980	74,357	82,787	--	125,883 ⁽¹⁾	283,027	--	45,882	92,998	126,665	62,578	328,123	154
1981	62,002	85,556	--	128,323 ⁽¹⁾	275,881	178	46,746	75,318	36,736	104,200	263,000	168
1982	78,725	95,615	76,271	30,226	280,837	259	90,658	85,541	55,392	43,181	274,772	199
1983	109,915	90,090	63,510	48,980	312,495	227	--	--	--	--	--	--
1984	110,500	57,650	45,400	47,649	261,199	246	--	--	--	--	--	--
1985	49,396	120,396	123,776	90,323	383,891	290	--	--	--	--	--	--
1986	84,160	79,774	73,698	83,264	320,896	330	--	--	--	--	--	--
1987	57,600	84,864	89,816	76,672	308,952	261	90,800	74,100	61,200	72,200	298,300	--
1988	82,700	86,500	83,900	93,400	346,500	288	--	--	--	--	--	--
1989	65,536	95,949	83,558	85,760	330,803	328	--	--	--	--	--	--
1990	67,561	91,257	82,823	-- ⁽³⁾	241,641 ⁽²⁾	350	--	--	--	--	--	--
1991	40,363	101,888	45,141	-- ⁽³⁾	187,392 ⁽²⁾	351	--	--	--	--	--	--
1992	9,954	102,114	46,287	-- ⁽³⁾	158,355 ⁽²⁾	344	--	--	--	--	--	--
1993	25,184	97,357	46,893	-- ⁽³⁾	169,434 ⁽²⁾	518	--	--	--	--	--	--
1994	19,176	106,506	69,362	-- ⁽³⁾	195,044 ⁽²⁾	422	--	--	--	--	--	--
1995	96,431	82,231	57,427	55,416	291,505	377	--	--	--	--	--	--
1996	27,117	157,484	68,300	65,176	318,077	398	--	--	--	--	--	--
1997	29,597	146,439	58,702	62,982	297,720	240 ⁽⁴⁾	--	--	--	--	--	--
1998	40,702	121,414	37,566	88,523	288,205	273	--	--	--	--	--	--
1999	37,016	119,333	56,017	71,638	284,004	264	--	--	--	--	--	--
2000	33,956	130,232	69,056	63,816	297,060	232	--	--	--	--	--	--

(1) 10-20 ft. measurement.

(2) Data insufficient to establish a 20 foot contour. Total is area within 15 feet.

(3) No 15 foot contour established. Total is within 20 feet.

(4) Some cooperators did not report shallow groundwater data in 1997.

-- Data not available.

Note: Annual changes in shallow Groundwater area may be perceived rather than real, due to increases in the number of monitoring wells used to prepare the maps. More monitoring wells may have provided better coverage, allowing for a more accurate map to be produced.

Figure 1

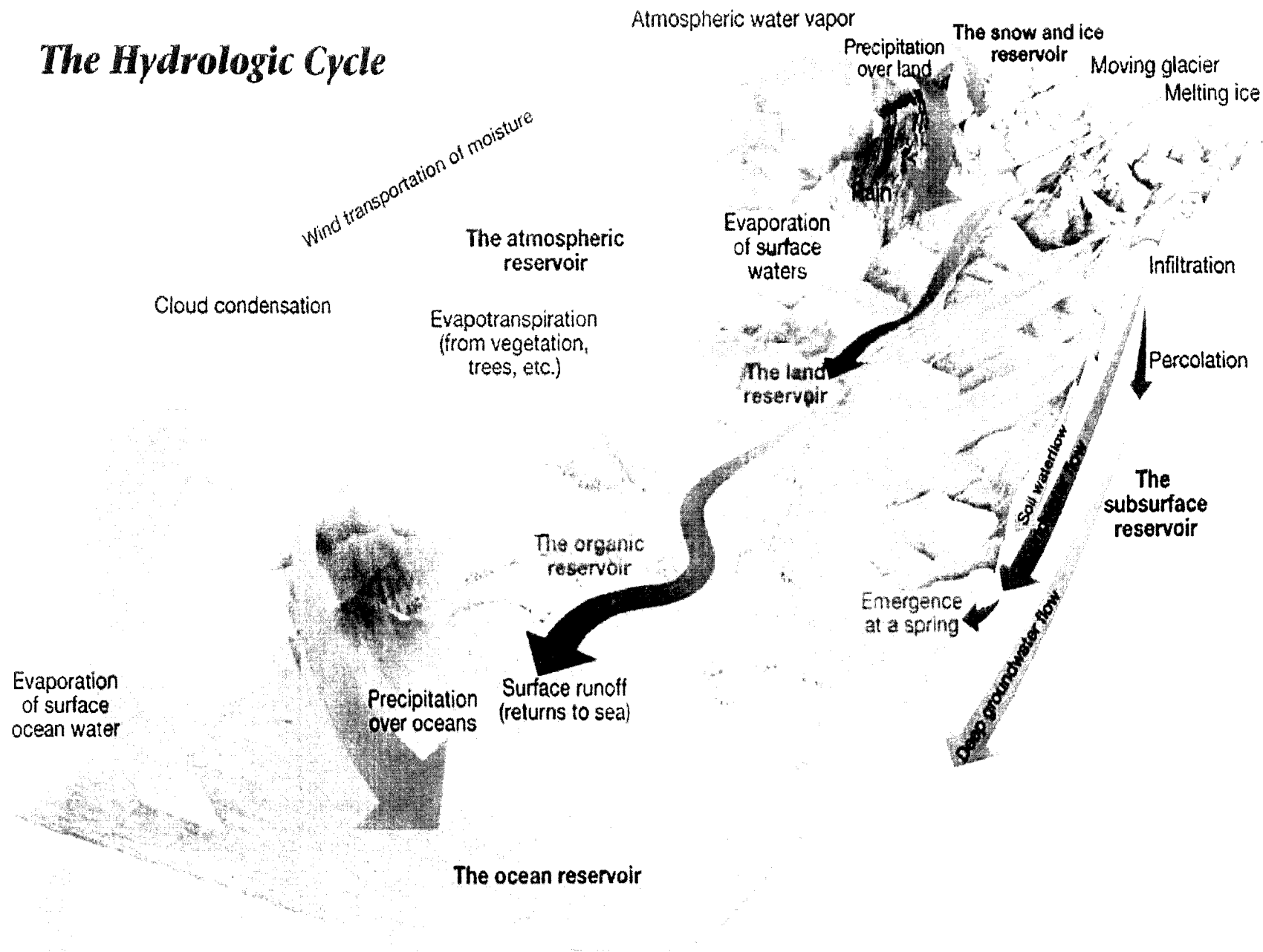


Figure 2. Sacramento River Indices

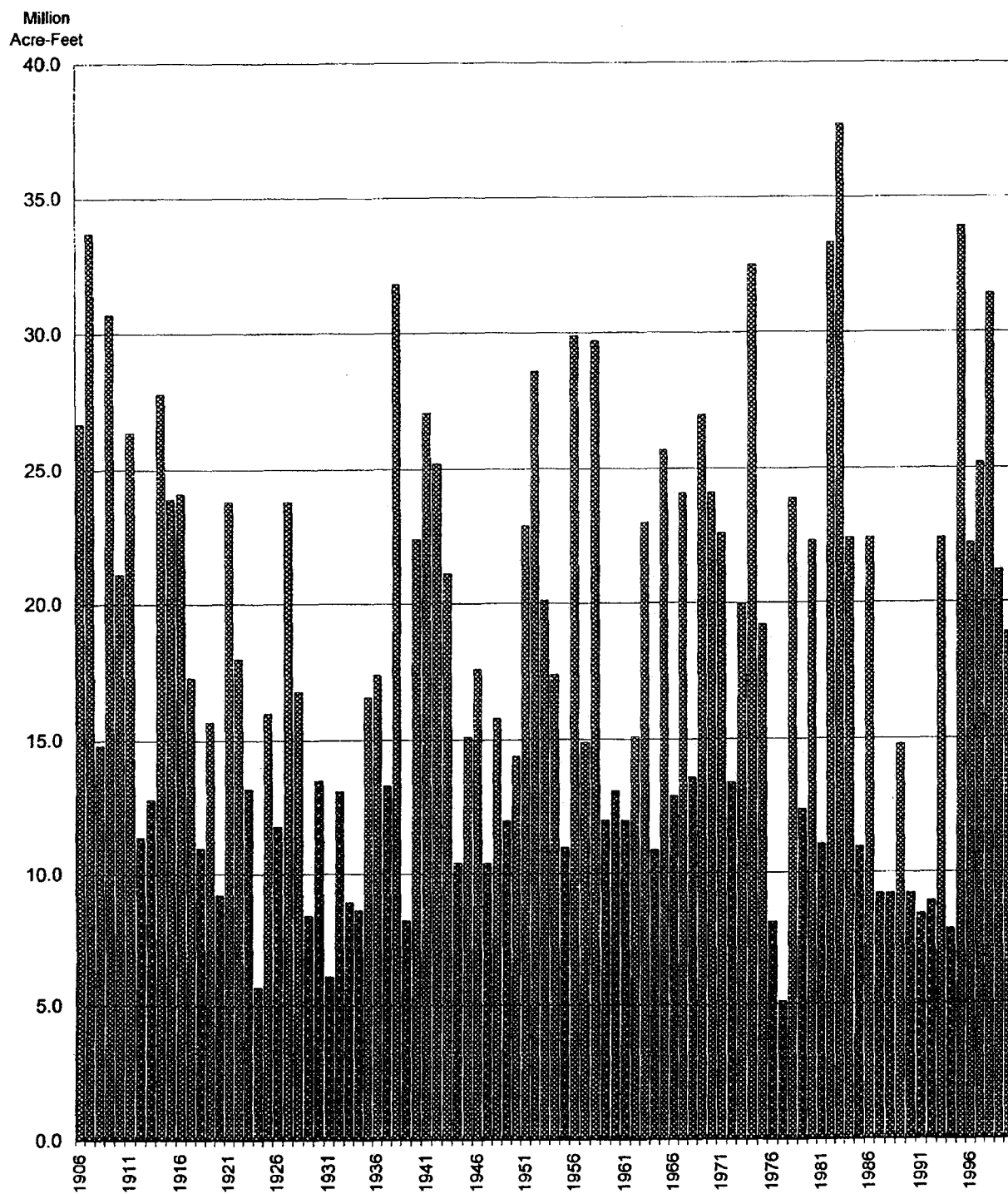


Figure 3. State Water Project Deliveries to Kern County Water Agency

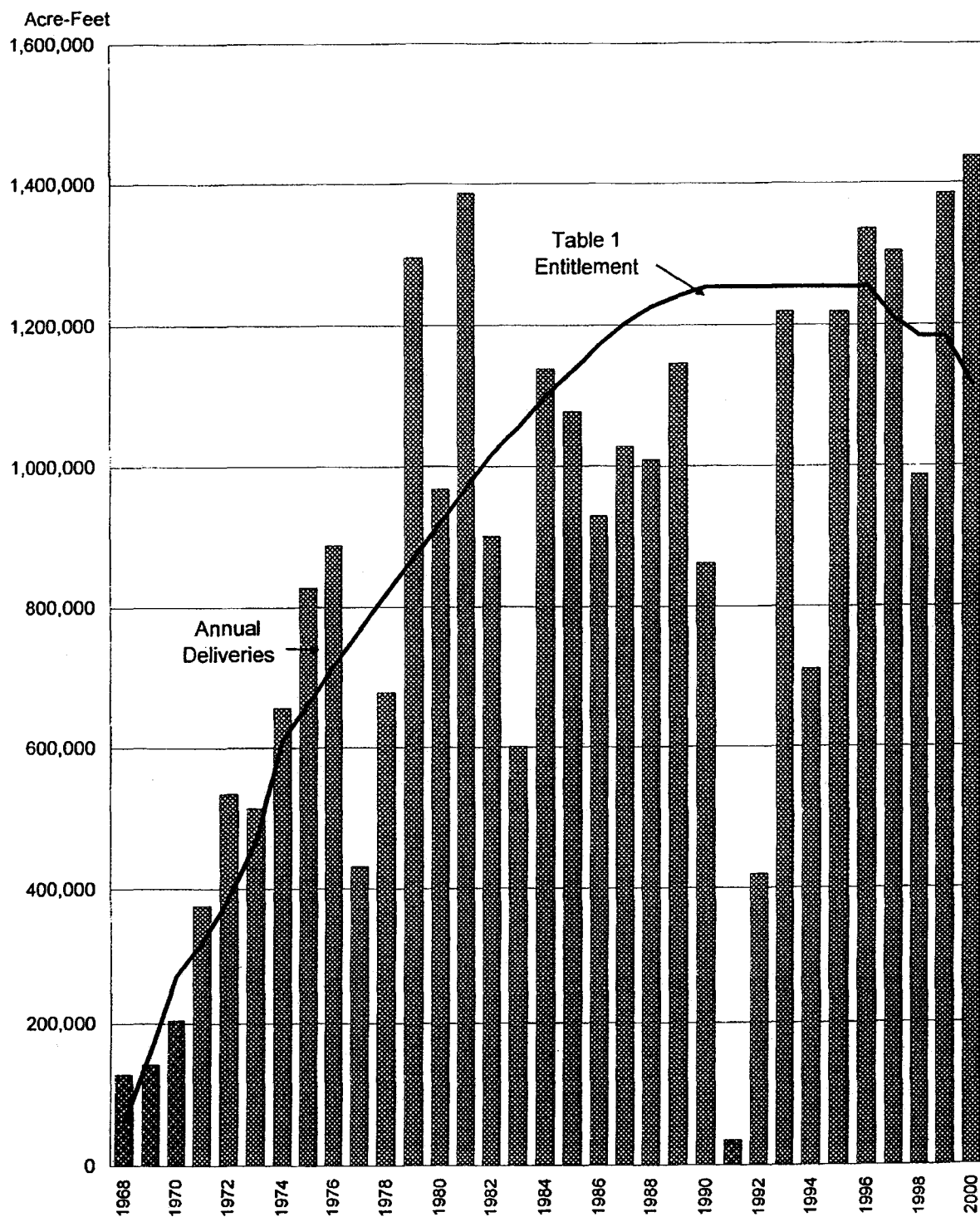


Figure 4. Kern River Regulated Flows at First Point of Measurement

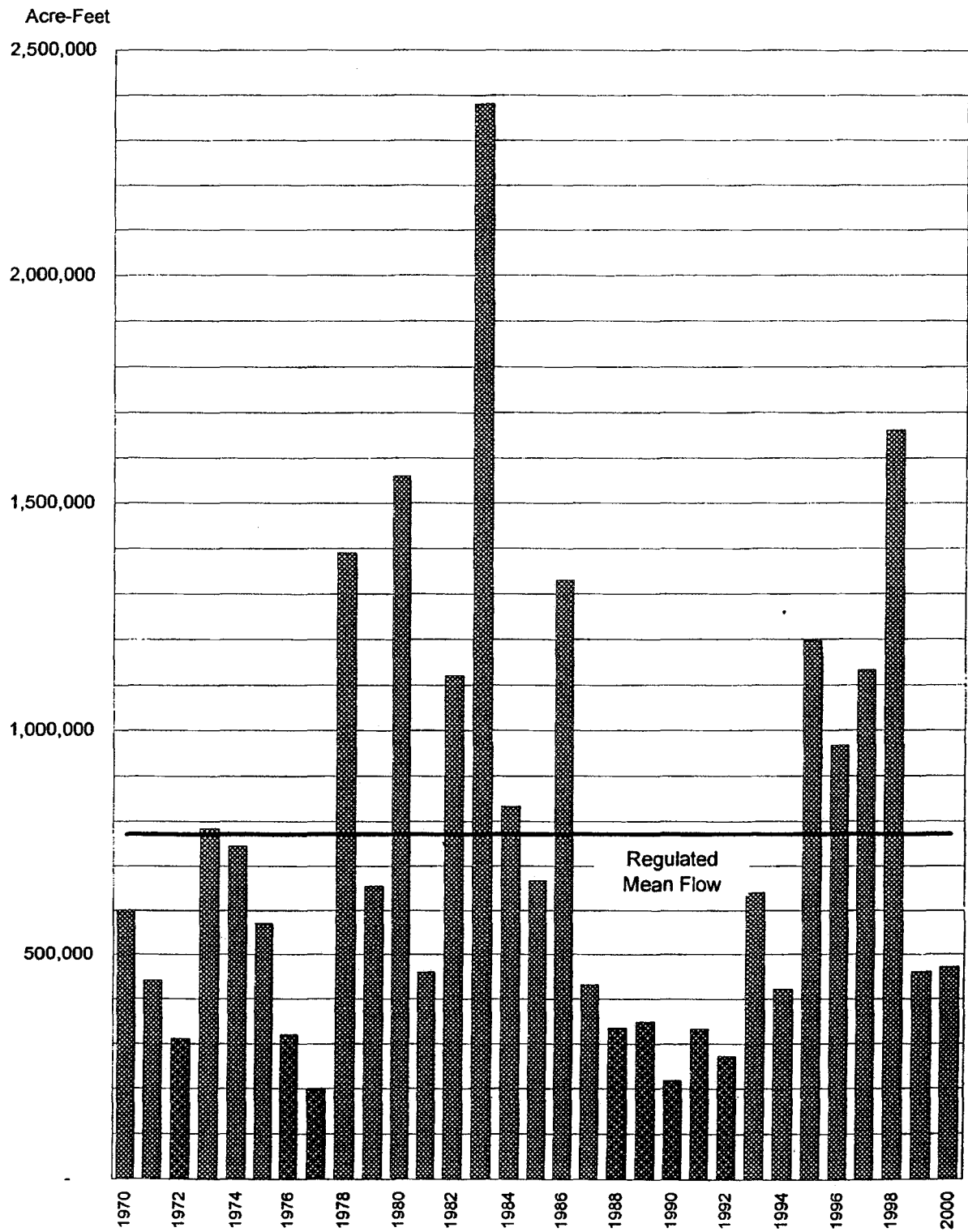


Figure 5. Central Valley Project Deliveries to Kern County

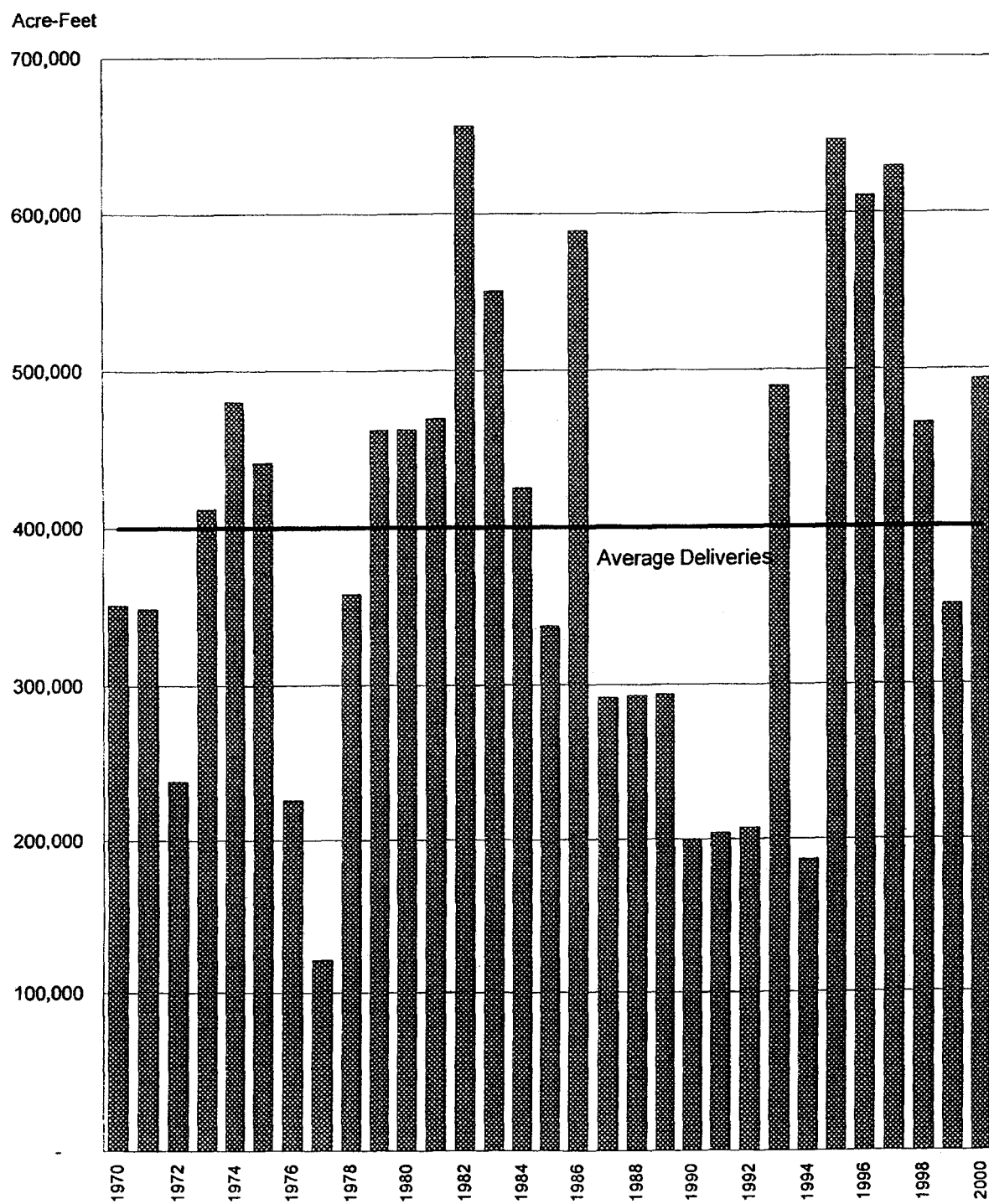


Figure 6. Minor Stream Flows in the San Joaquin Valley portion of Kern County

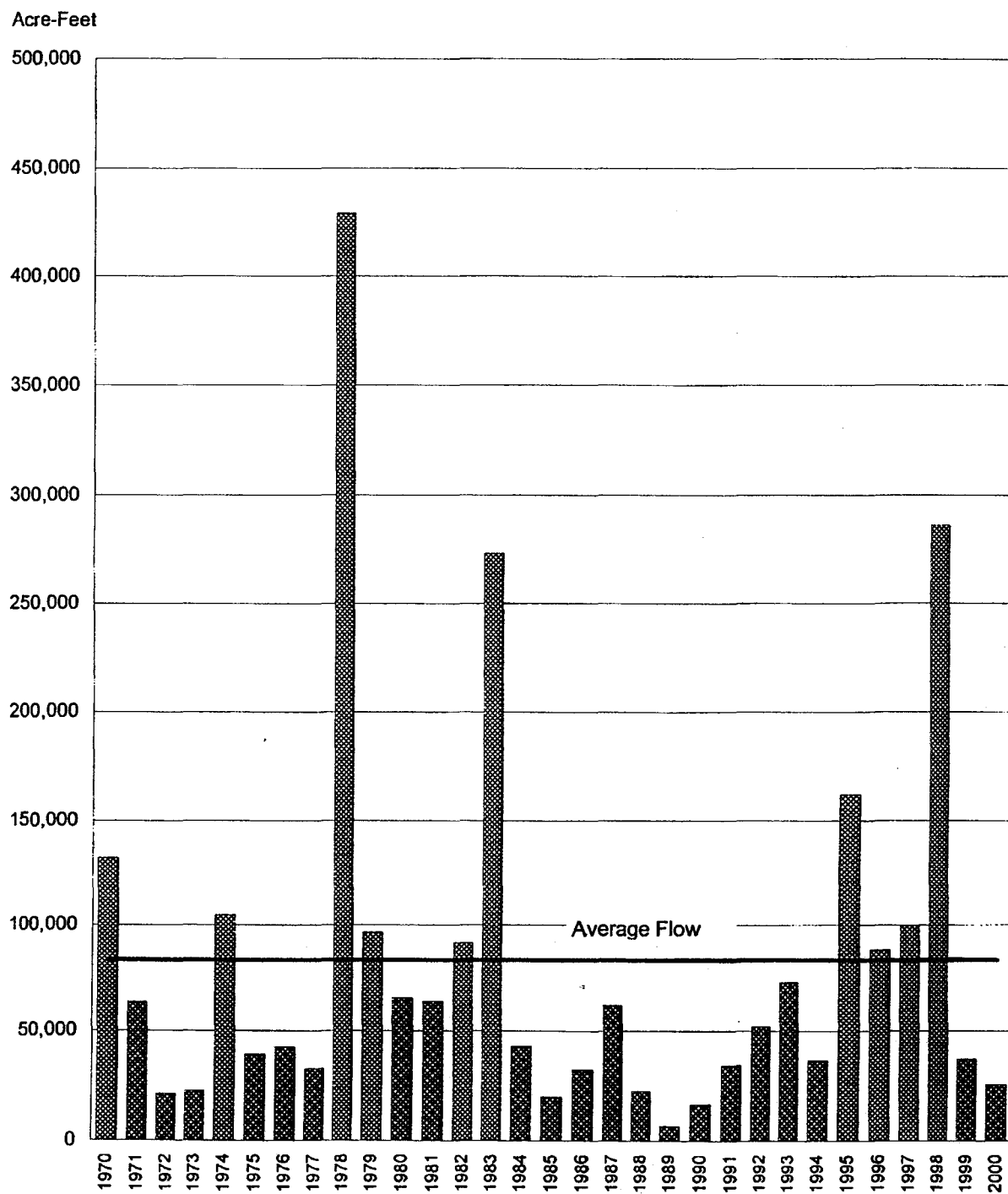


Figure 7a. Tehachapi Creek Hydrograph (cfs) 2000

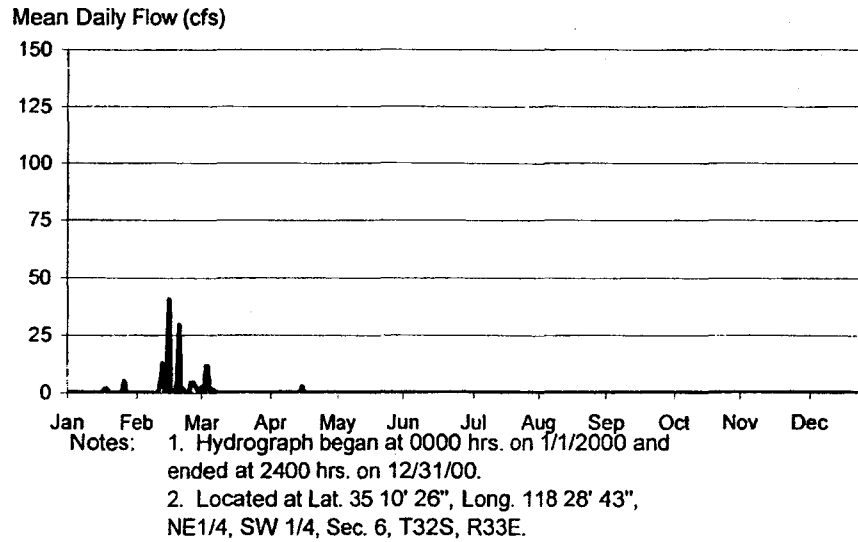
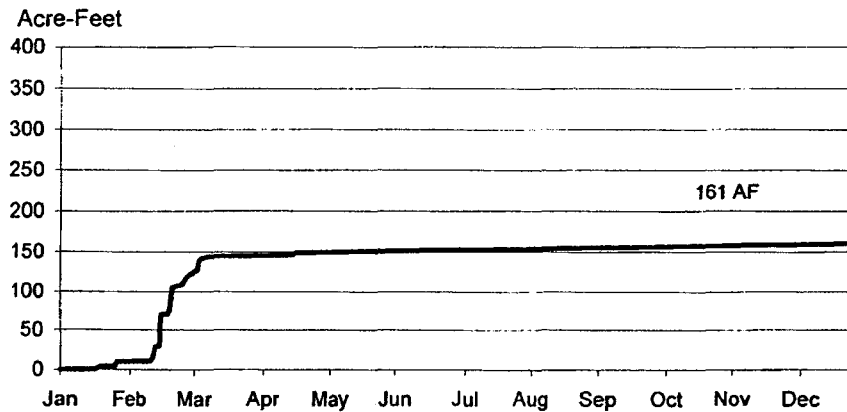
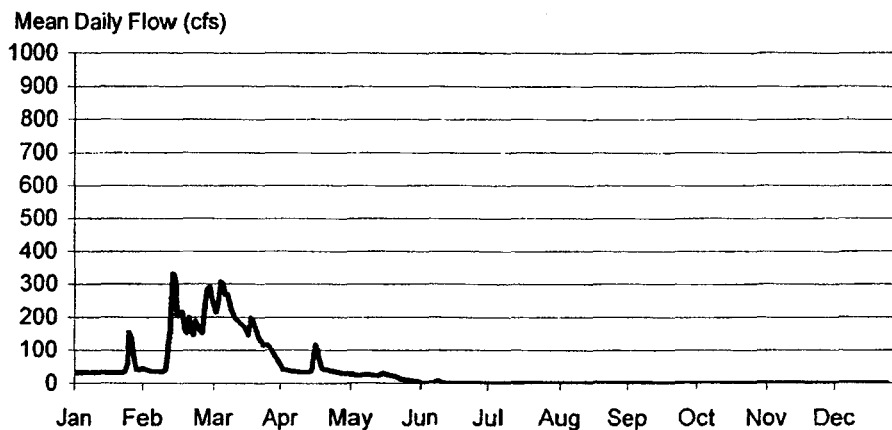


Figure 7b. Tehachapi Creek Hydrograph (acre-feet) 2000



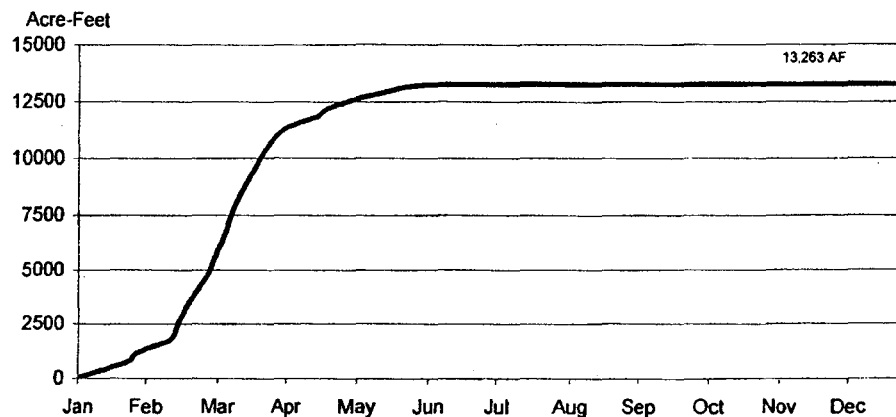
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Volume (AF)	11	110	27	5	1	1	1	1	1	1	1	1
Cumulative Volume (AF)	11	121	148	153	154	155	156	157	158	159	160	161

Figure 7c. Poso Hydrograph (cfs) 2000



- Notes:
1. Hydrograph began at 0000 hrs. on 1/1/2000 and ended at 2400 hrs. on 12/31/00.
 2. Located at Lat. 35 30' 49", Long. 118 54' 17", SW1/4, SW 1/4, Sec. 6, T28S, R29E.
 3. Peak discharge, 331.8 cfs, 2/14/2000.

Figure 7d. Poso Creek Hydrograph (acre-feet) 2000



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Volume (AF)	1,298	3,964	5,899	1,377	685	40	0	0	0	0	0	0
Cumulative Volume (AF)	1,298	5,262	11,161	12,538	13,223	13,263	13,263	13,263	13,263	13,263	13,263	13,263

FIGURE 8. Annual Precipitation at three stations in the San Joaquin Valley portion of Kern County

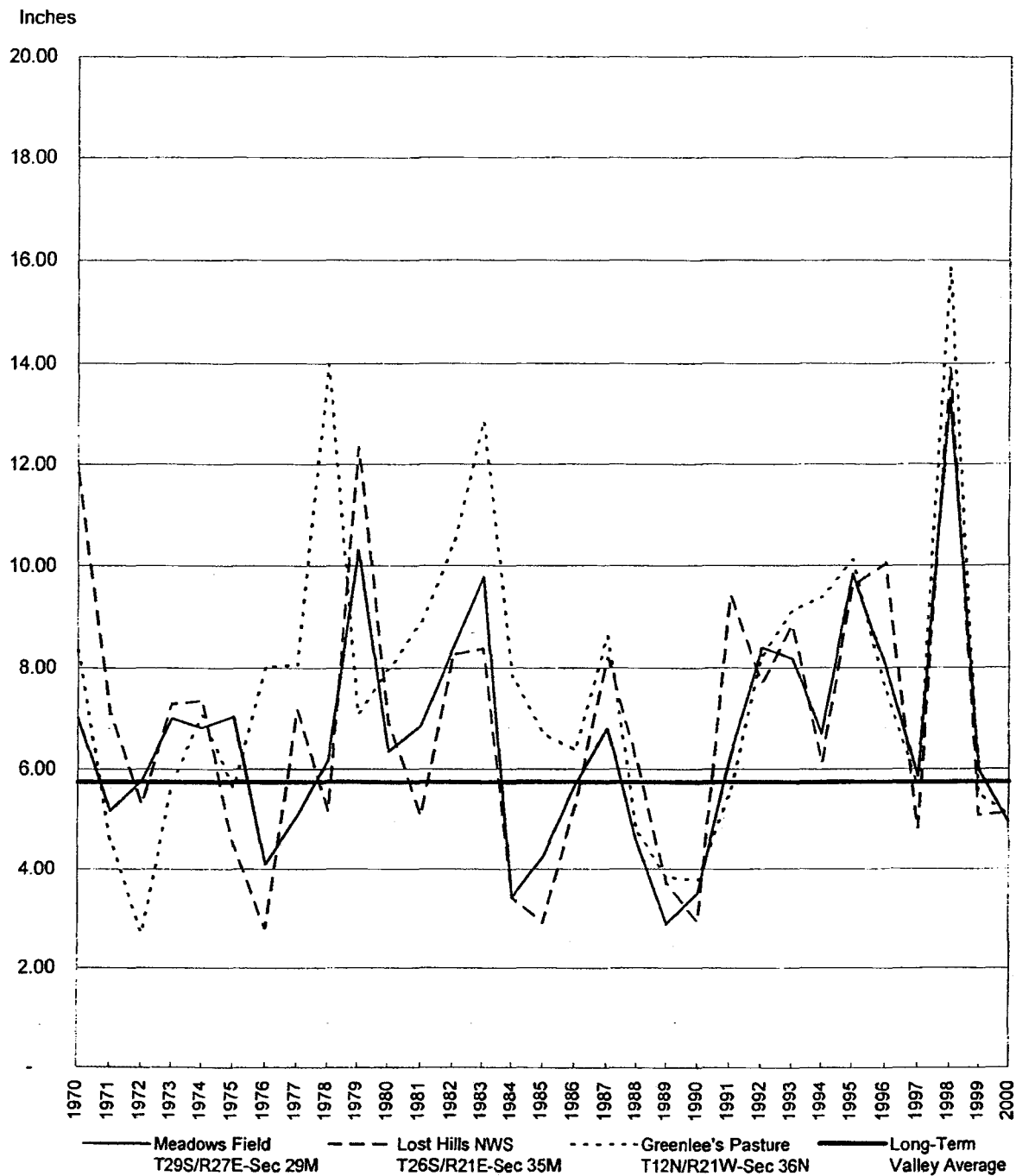


Figure 9. Effective Precipitation in the San Joaquin Valley portion of Kern County

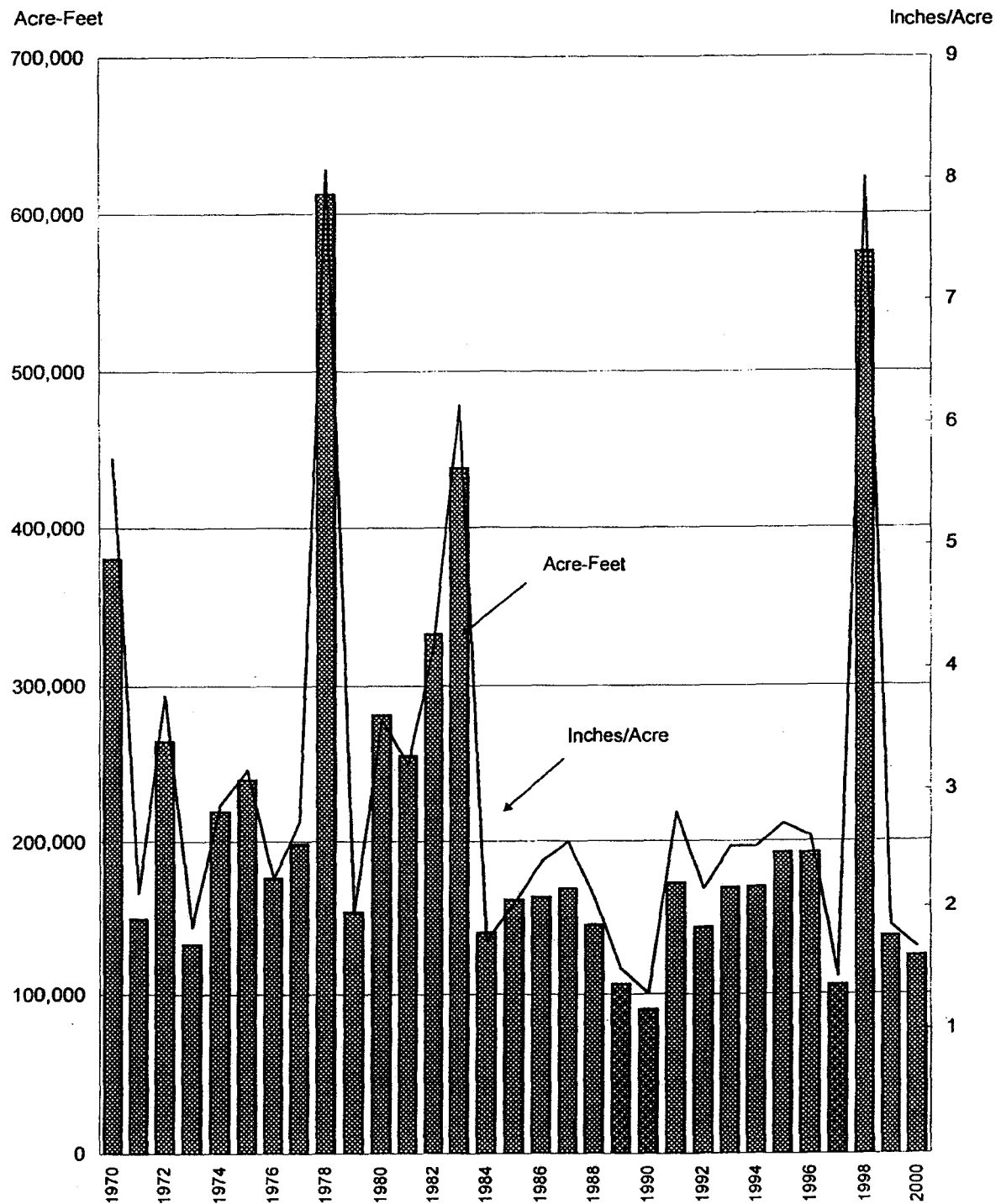


Figure 10. Waste Water Reuse in Kern County

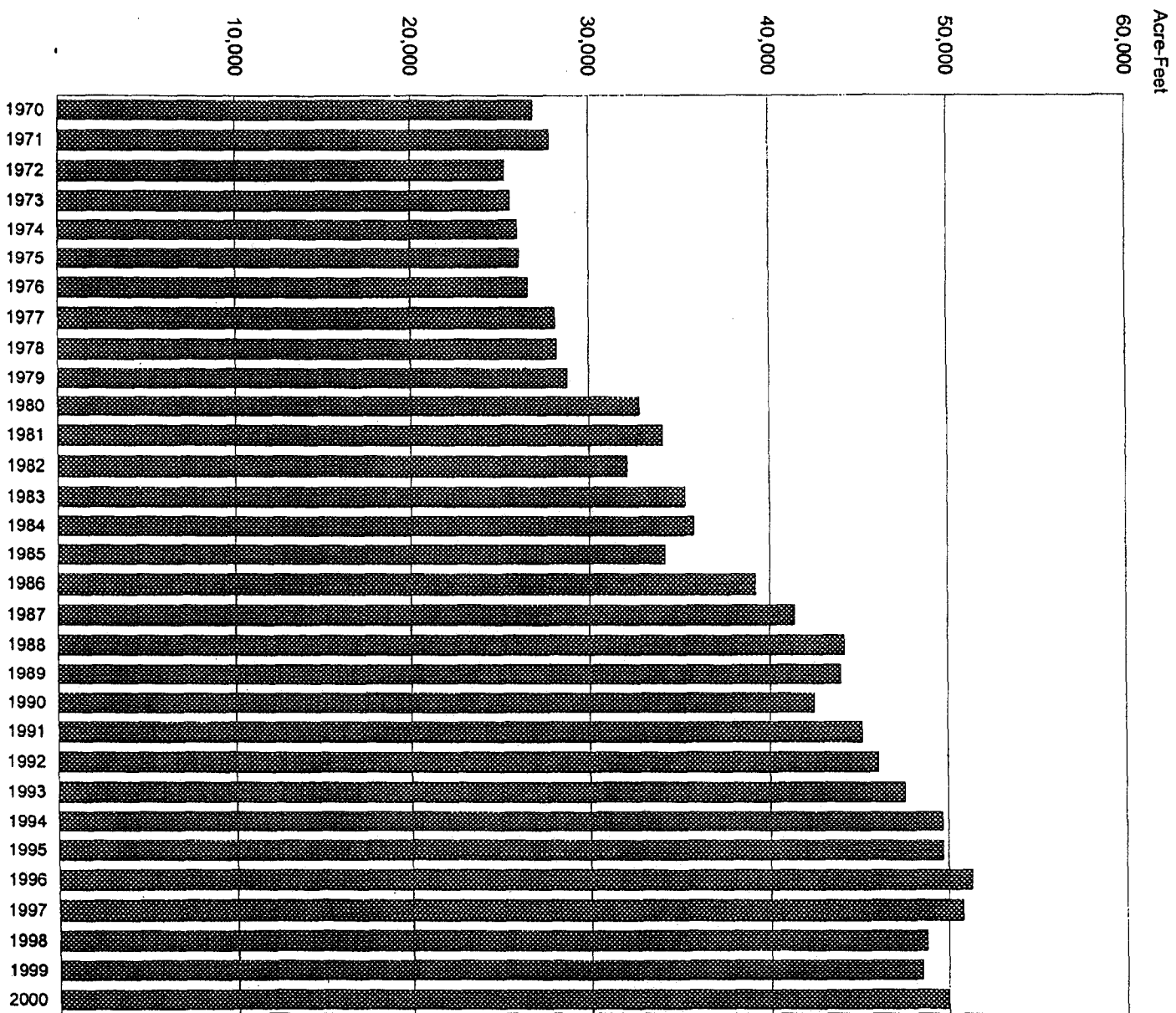


Figure 11. Oil Field Produced Water in Kern County

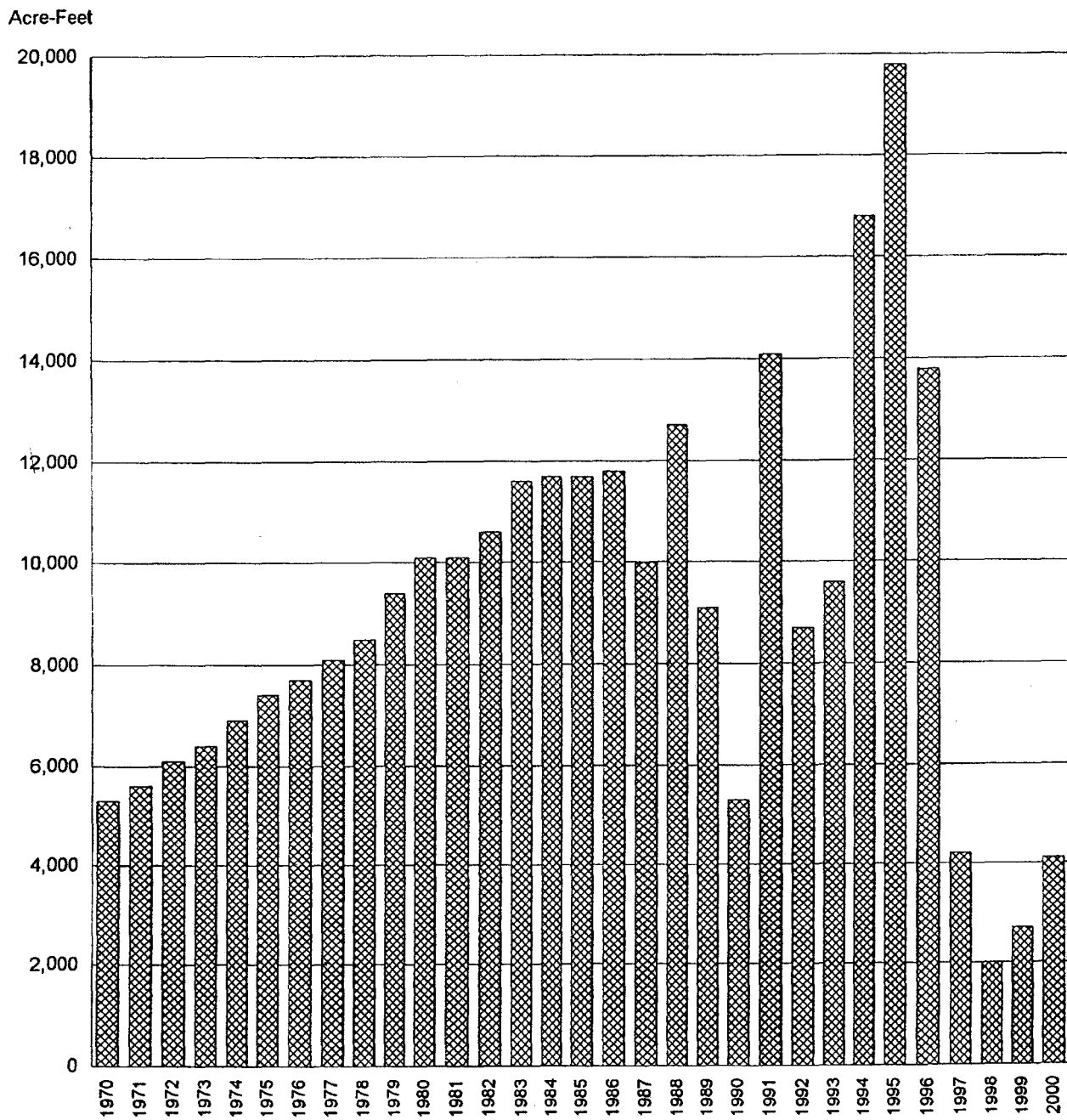


Figure 12. Groundwater Pumping in the San Joaquin Valley portion of Kern County.

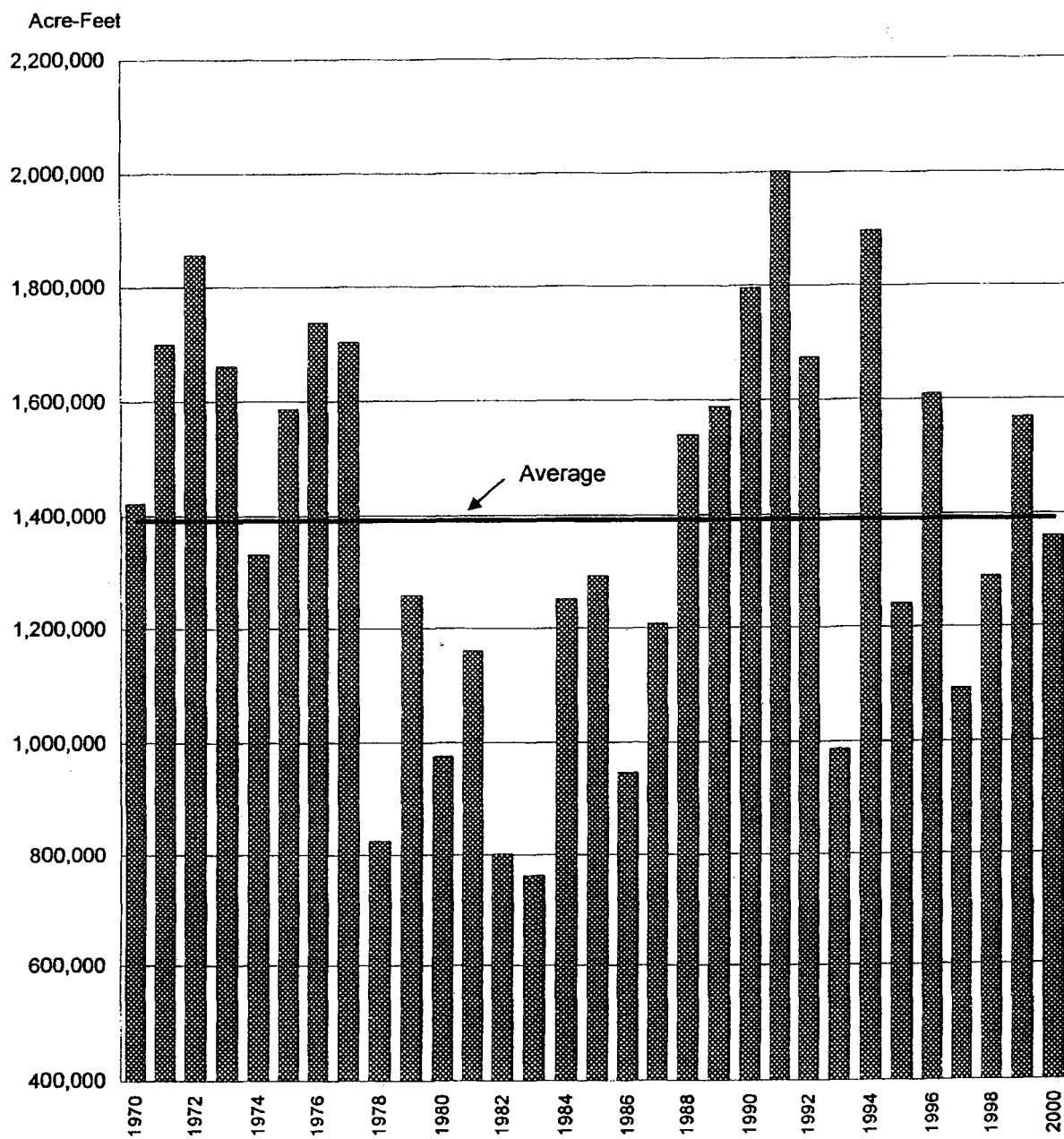


Figure 13. Irrigated Acreage in the San Joaquin Valley portion of Kern County

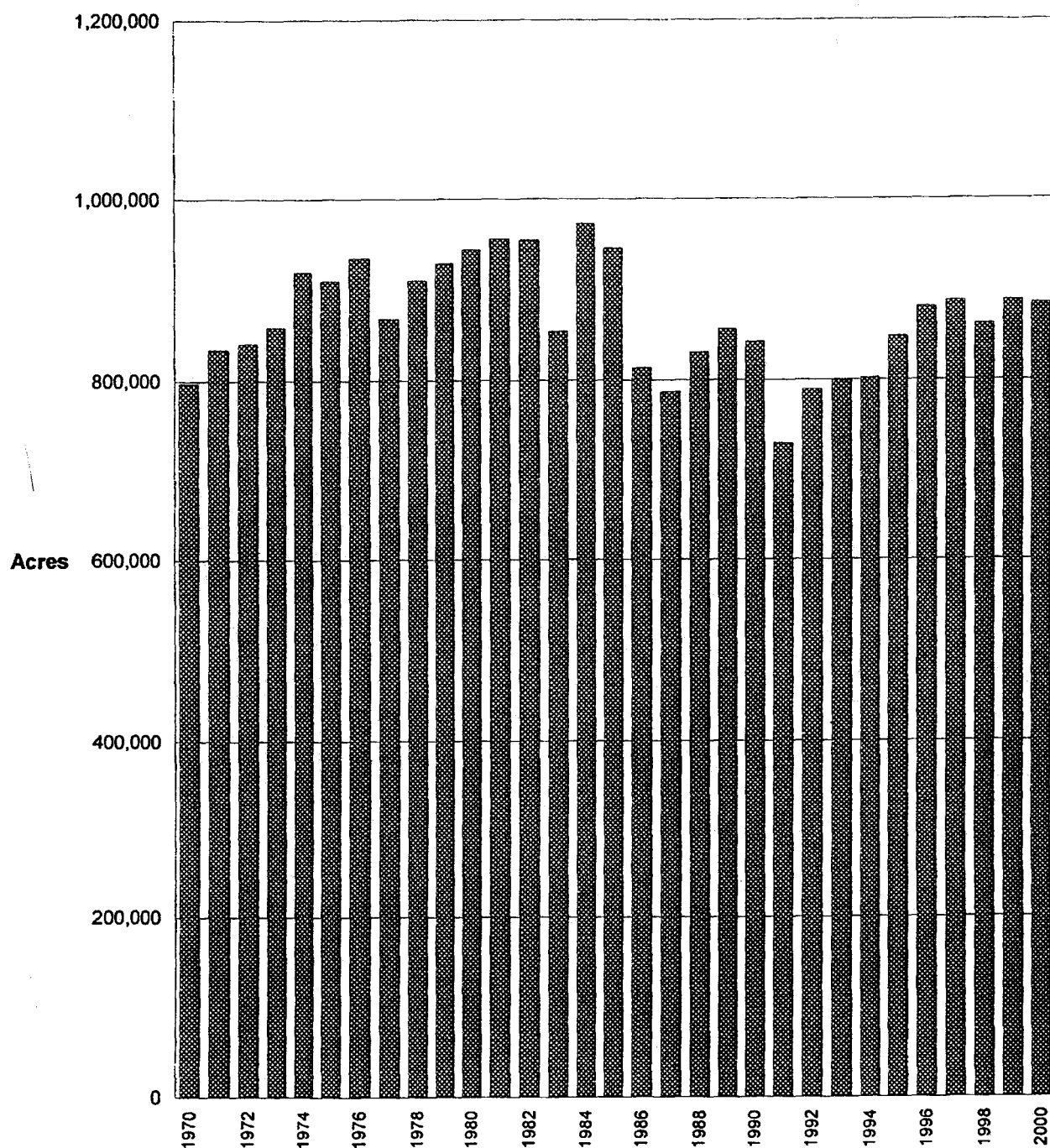


Figure 14. 2000 Summary of Irrigated Acreage

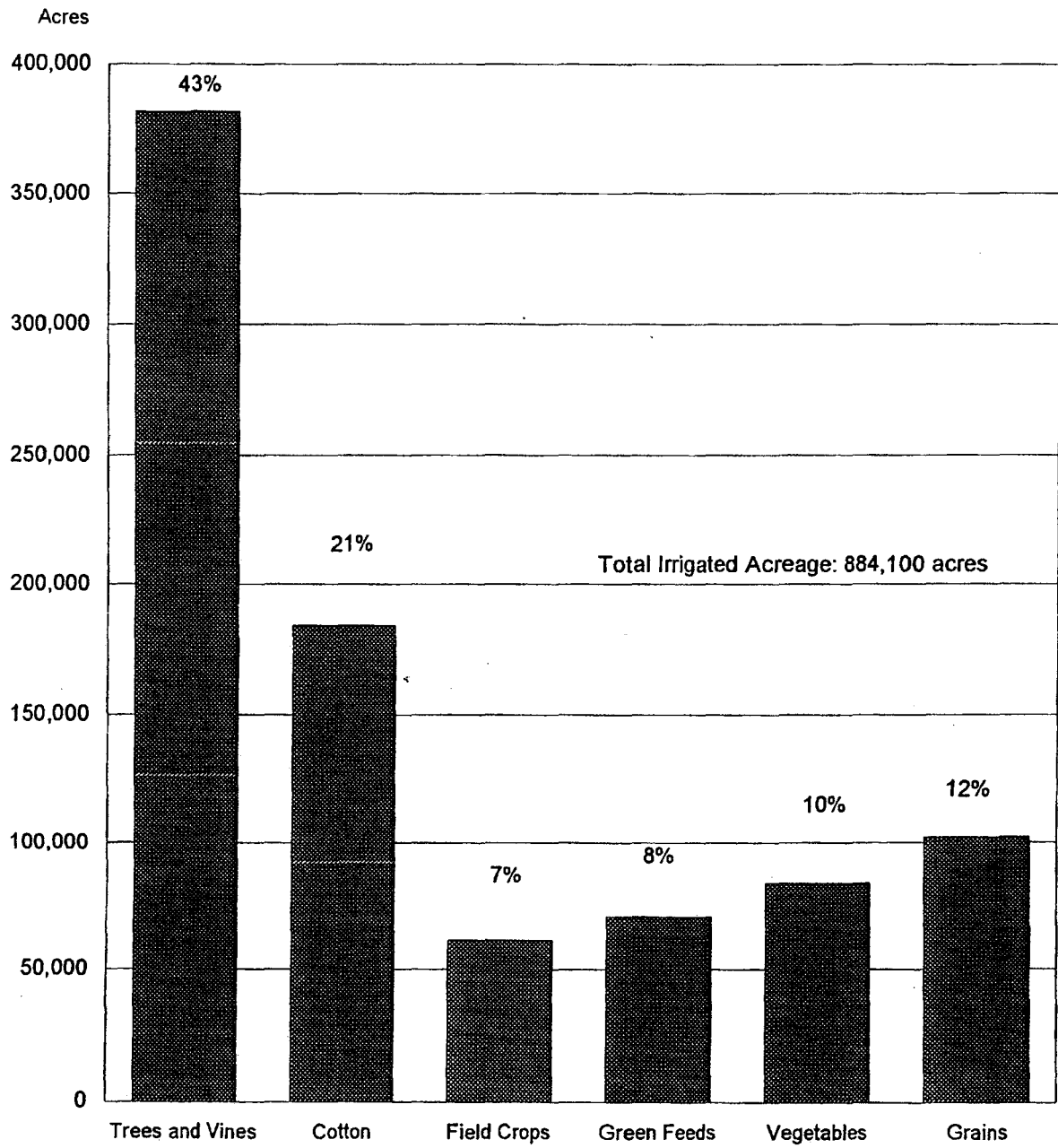
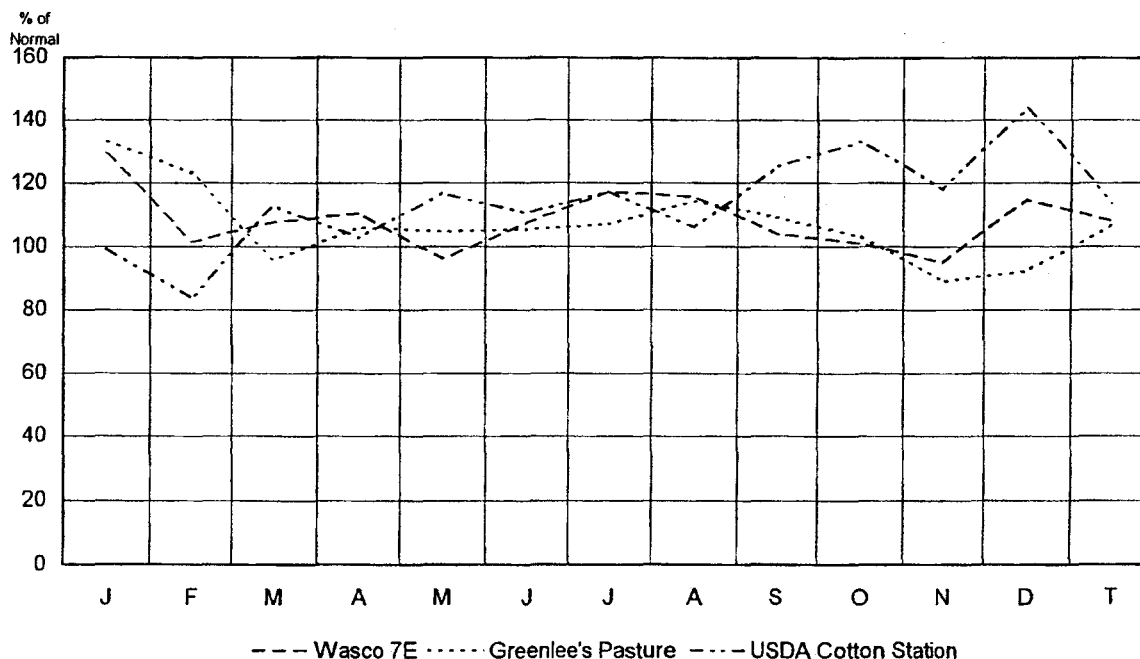


Figure 15. 2000 Percent of Normal Evaporation



Percent of Normal, Total:

Wasco 7E	108.1
Greenlee's Pasture	106.8
USDA Cotton Station	113.7

Wasco 7E

2000 observed monthly EP, Wasco 7E (irrigated pasture) compared to long-term average for pasture pans in the San Joaquin Valley. This station is indicative of EP on the valley floor.

Greenlee's Pasture

2000 observed monthly EP, Greenlee's Pasture (irrigated pasture - Wheeler Ridge area) compared to long-term average for pasture pans in the San Joaquin Valley. This station is indicative of EP in the foothill regions of the valley.

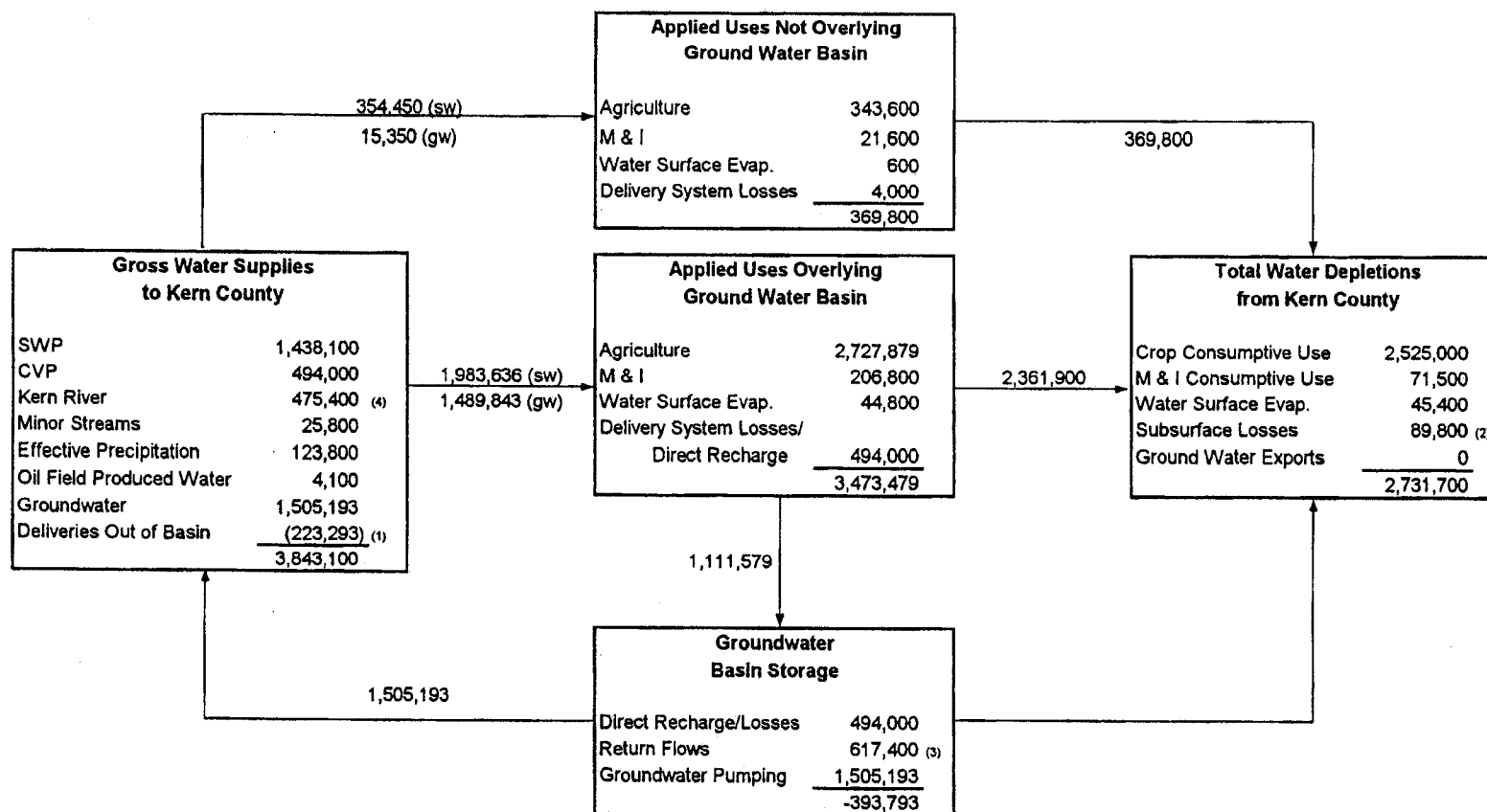
USDA Cotton Station

2000 observed monthly EP, USDA Cotton Station (irrigated turf) compared to long-term average for long-term average for USDA Cotton Station in the San Joaquin Valley. This station is indicative of EP for cotton in Kern County.

2000
Wasco 7E Greenlee's F USDA Cotton Station

J	129	133	99
F	101	123	83
M	108	96	113
A	110	106	103
M	96	105	117
J	108	105	111
J	117	107	117
A	116	114	106
S	104	109	125
O	101	103	133
N	95	89	118
D	115	92	144
T	108.1	106.8	113.7

Figure 16. 2000 Water Resources Inventory, San Joaquin Valley Portion of Kern County (acre-feet).



2,337,907 (Surface Supplies) minus 2,731,700 (Consumptive Use) equals -393,793 (Subtraction from Storage)

Notes:

- ⁽¹⁾ See Table 4 for deliveries outside of Kern County.
- ⁽²⁾ Includes 79,900 AF to saline sinks, and 9,800 AF losses to moisture deficient soils.
- ⁽³⁾ A total of 48,500 AF of municipal waste water was treated and reused. The reuse is not included here.
- ⁽⁴⁾ Total excludes 186 AF delivered to Kern Valley Golf Course (Kernville).

(sw) Surface Water
(gw) Ground Water

Figure 17. Gross Water Supplies and Net Water Requirements, San Joaquin Valley portion of Kern County

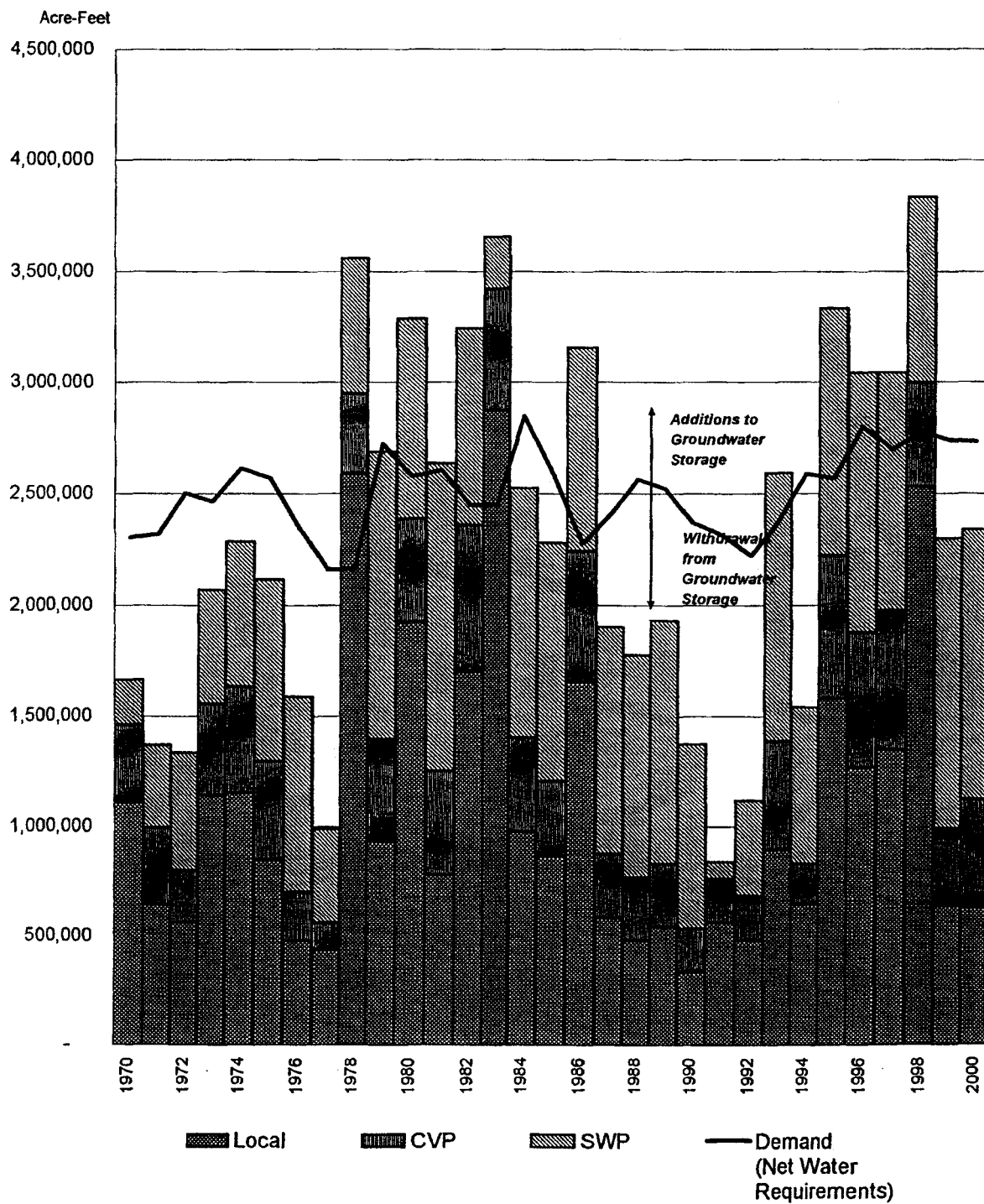


Figure 18. Cumulative Change in Groundwater Storage, San Joaquin Valley portion of Kern County

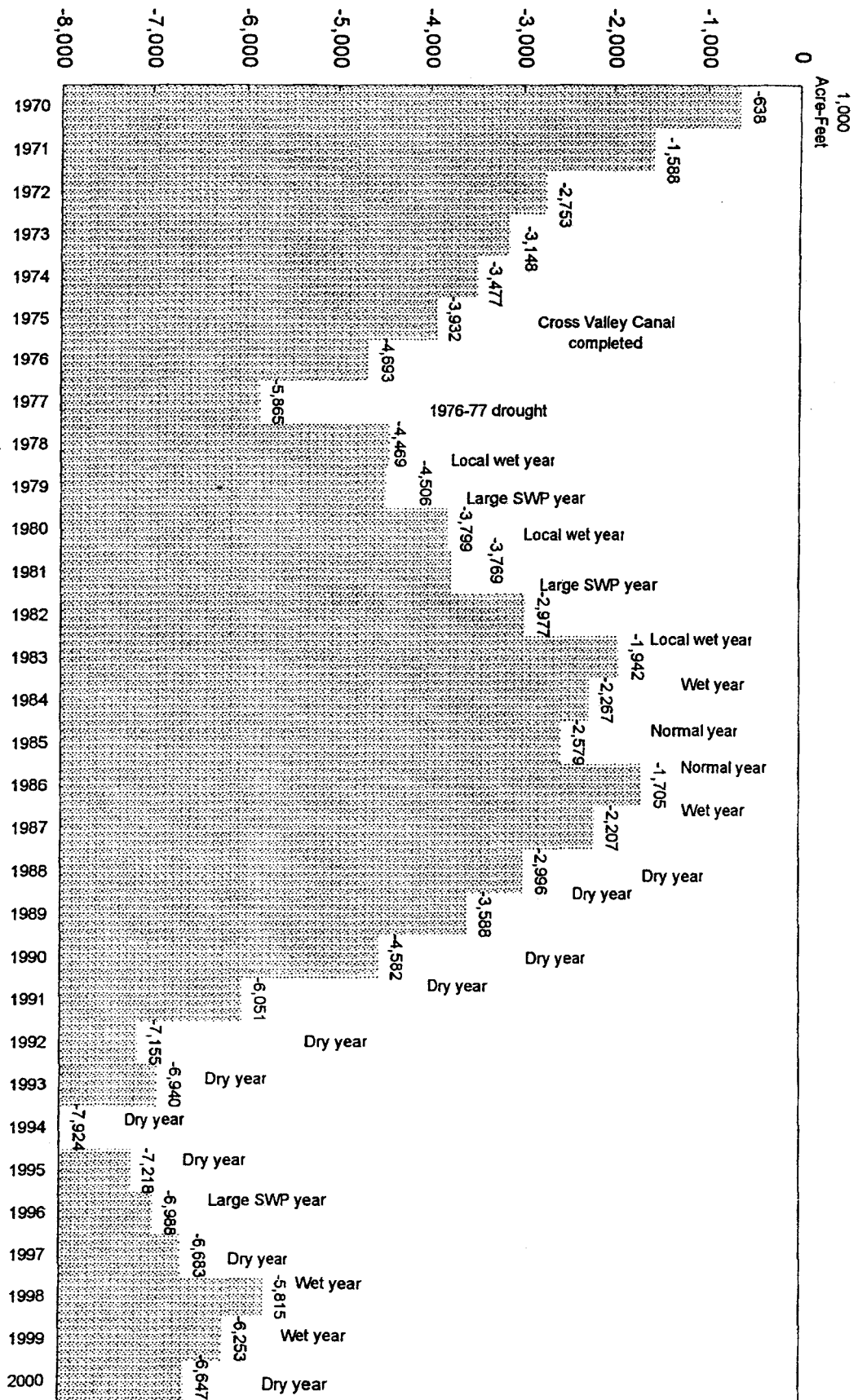


Figure 19.

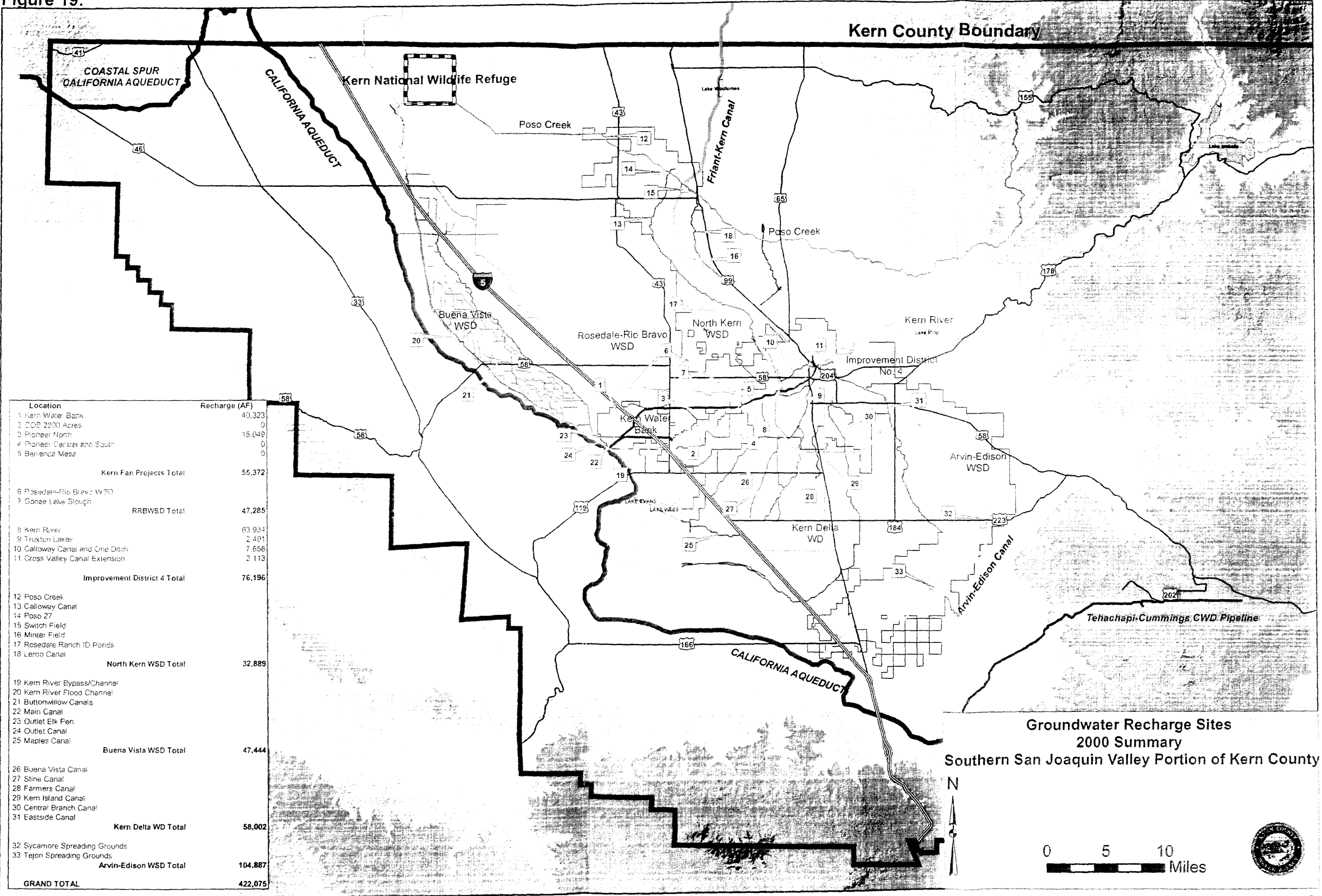


Figure 20. Groundwater Recharge, 2000 Summary, Southern San Joaquin Valley portion of Kern County

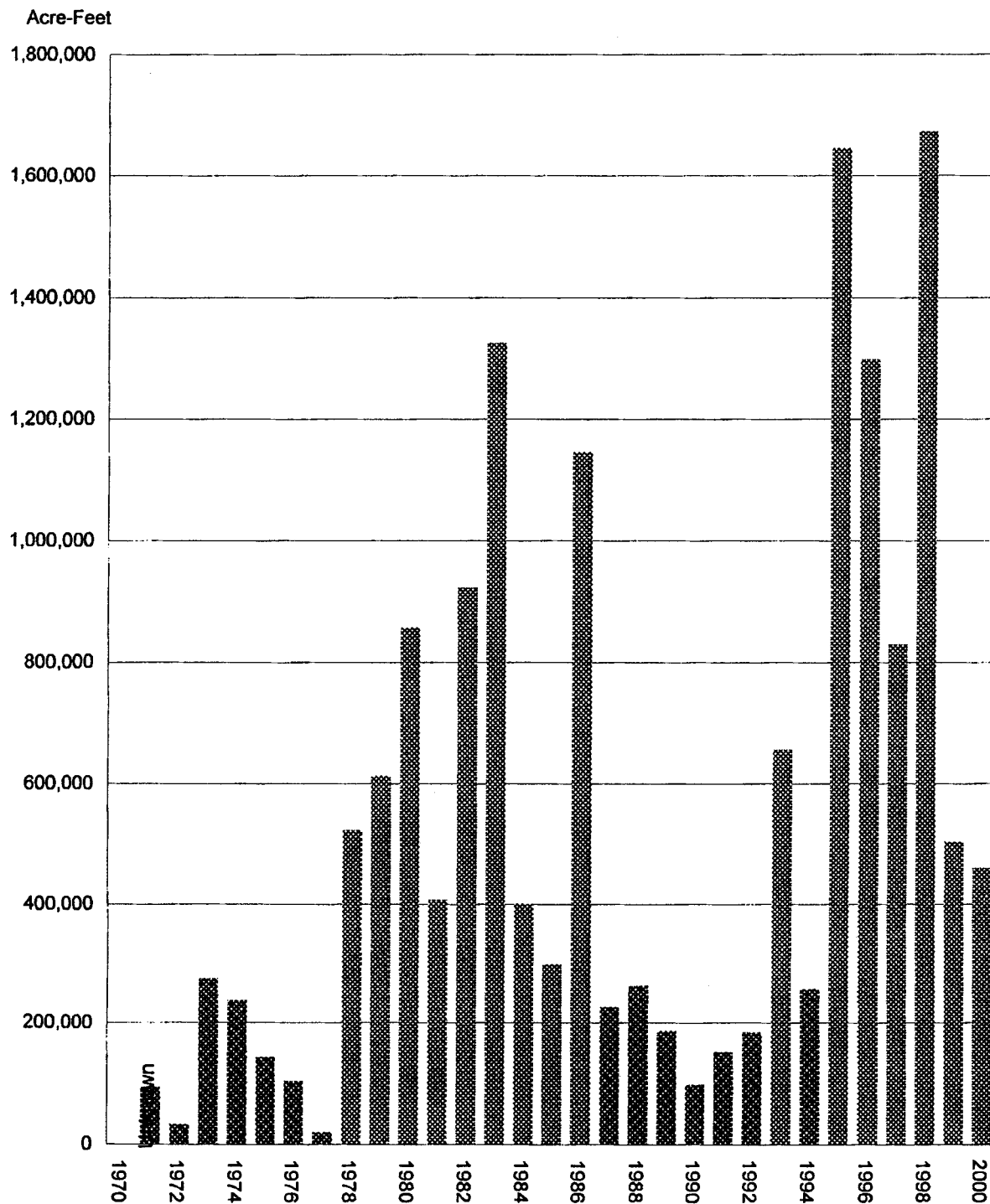


Figure 21a. Water Well Hydrograph Pond-Poso area

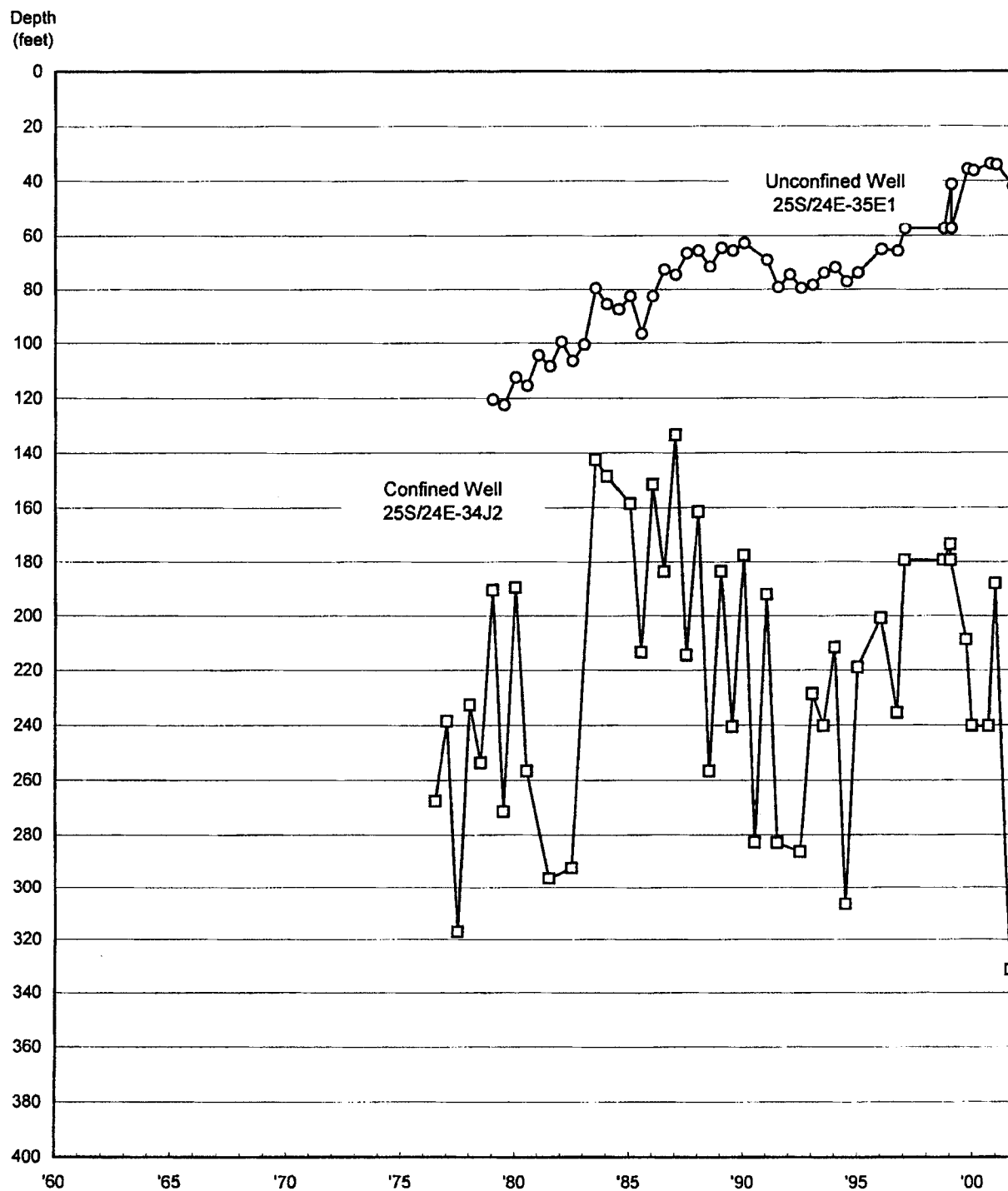


Figure 21b. Water Well Hydrograph Shafter/Rosedale area

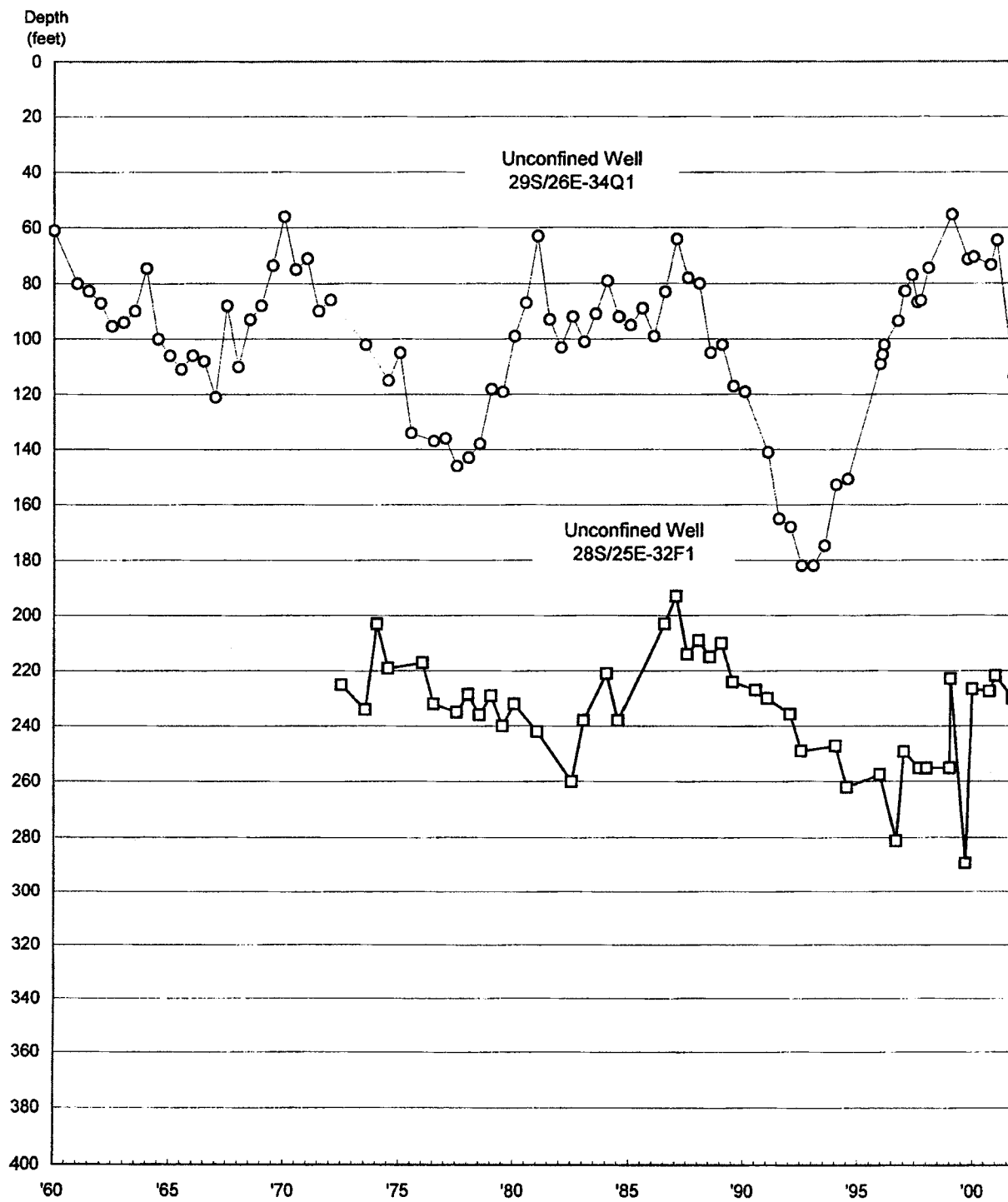


Figure 21c. Water Well Hydrograph Southwest Bakersfield area

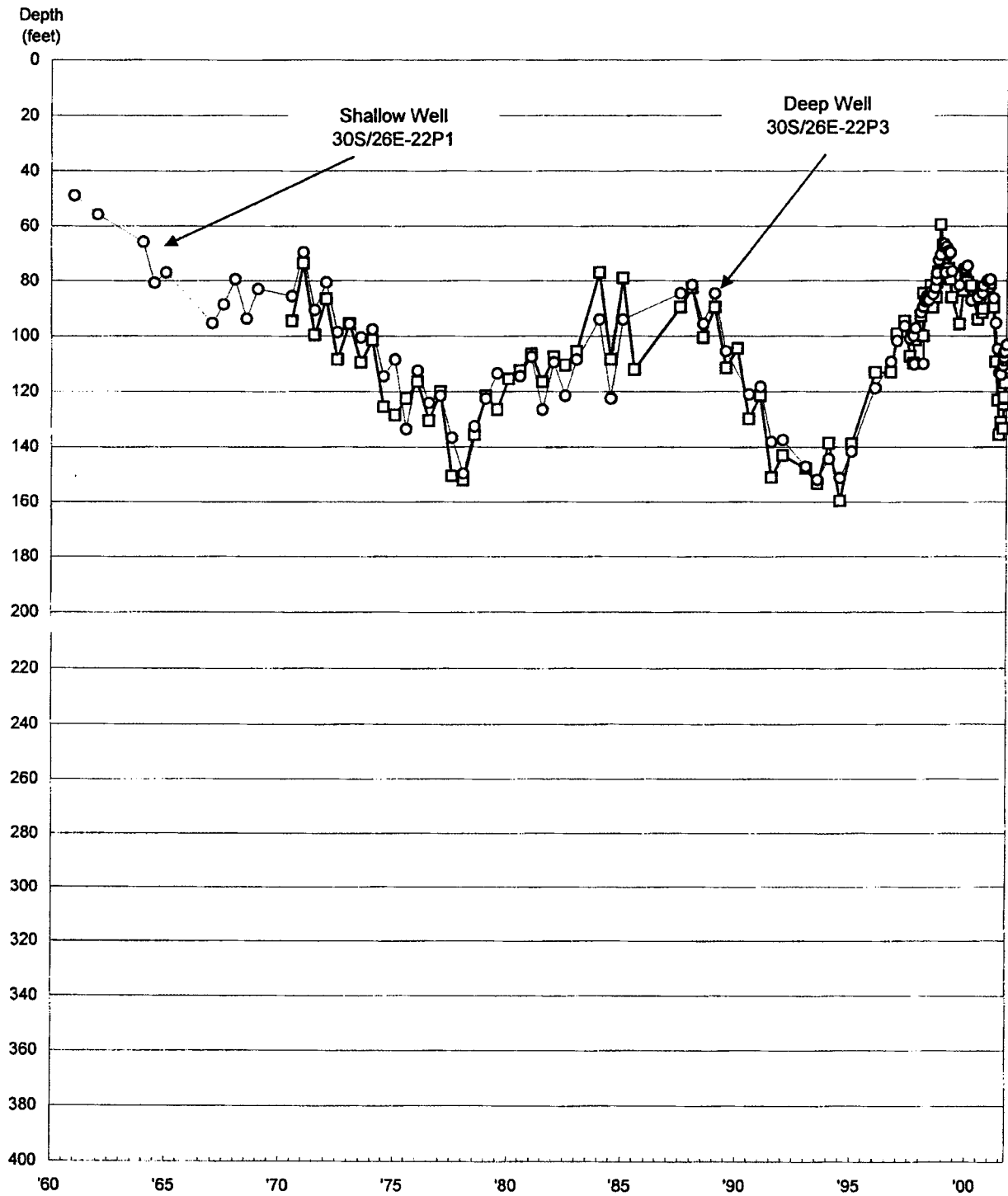


Figure 21d. Water Well Hydrograph Arvin-Edison area

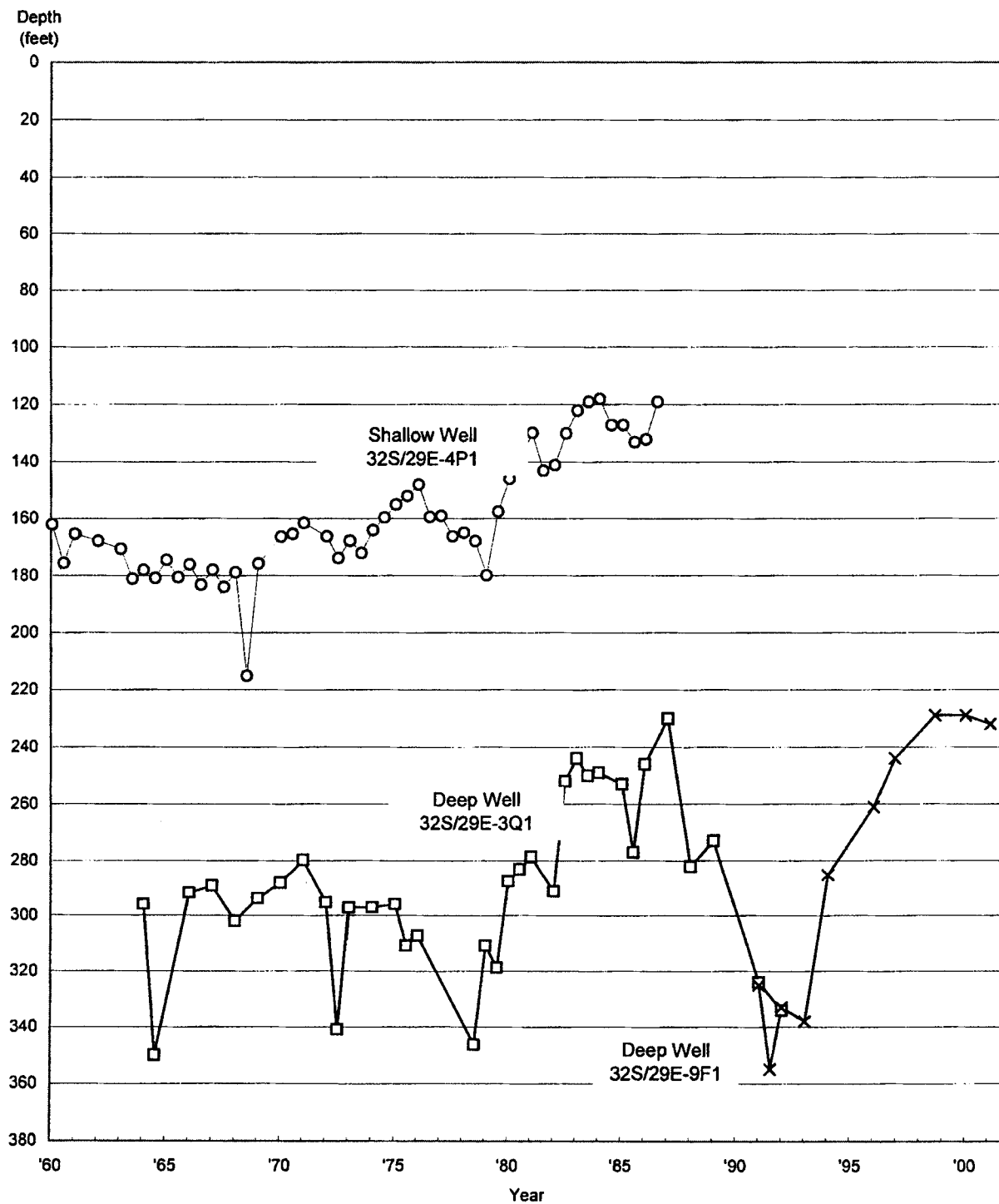


Figure 21e. Water Well Hydrograph Indian Wells Valley

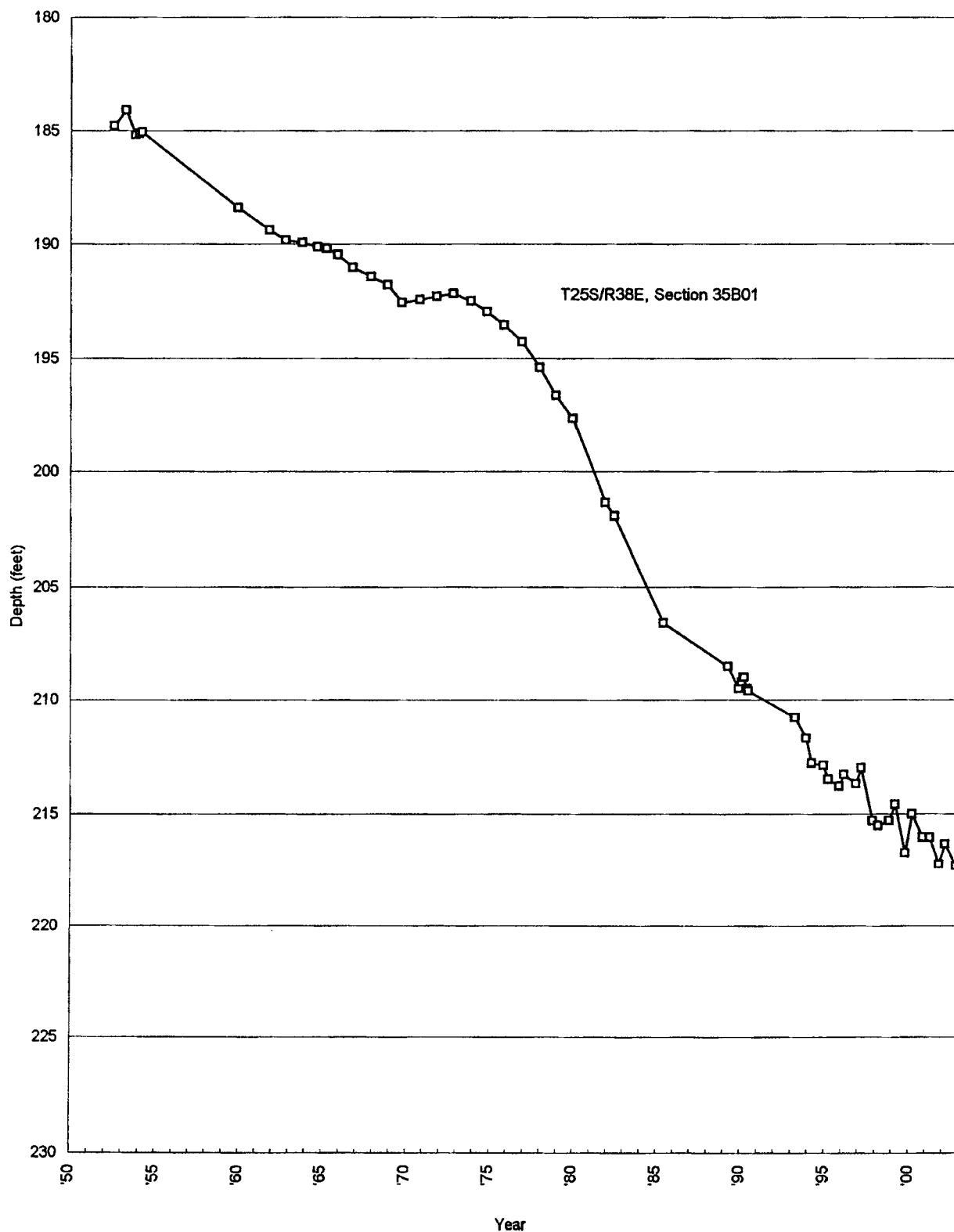


Figure 21f. Water Well Hydrograph Indian Wells Valley

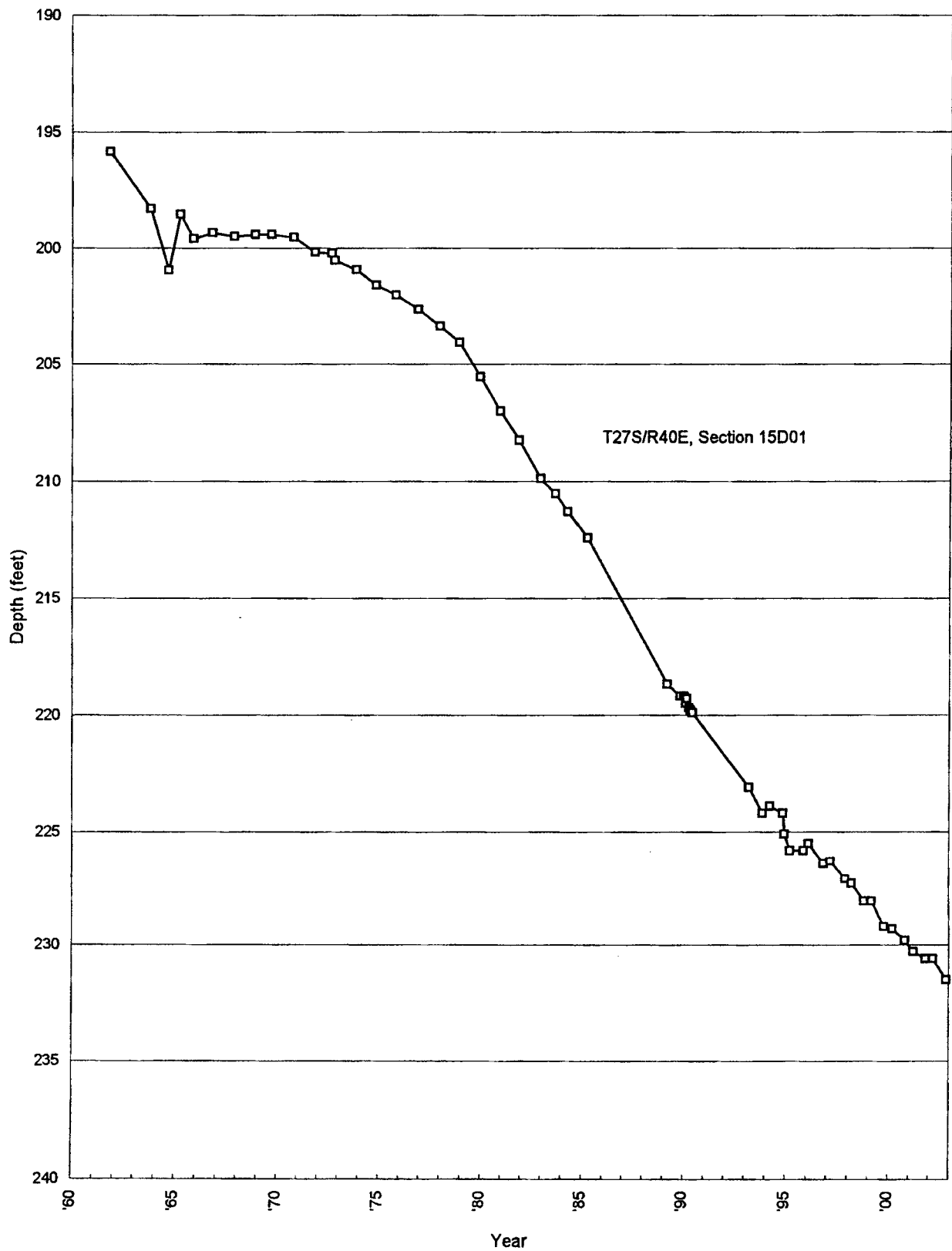
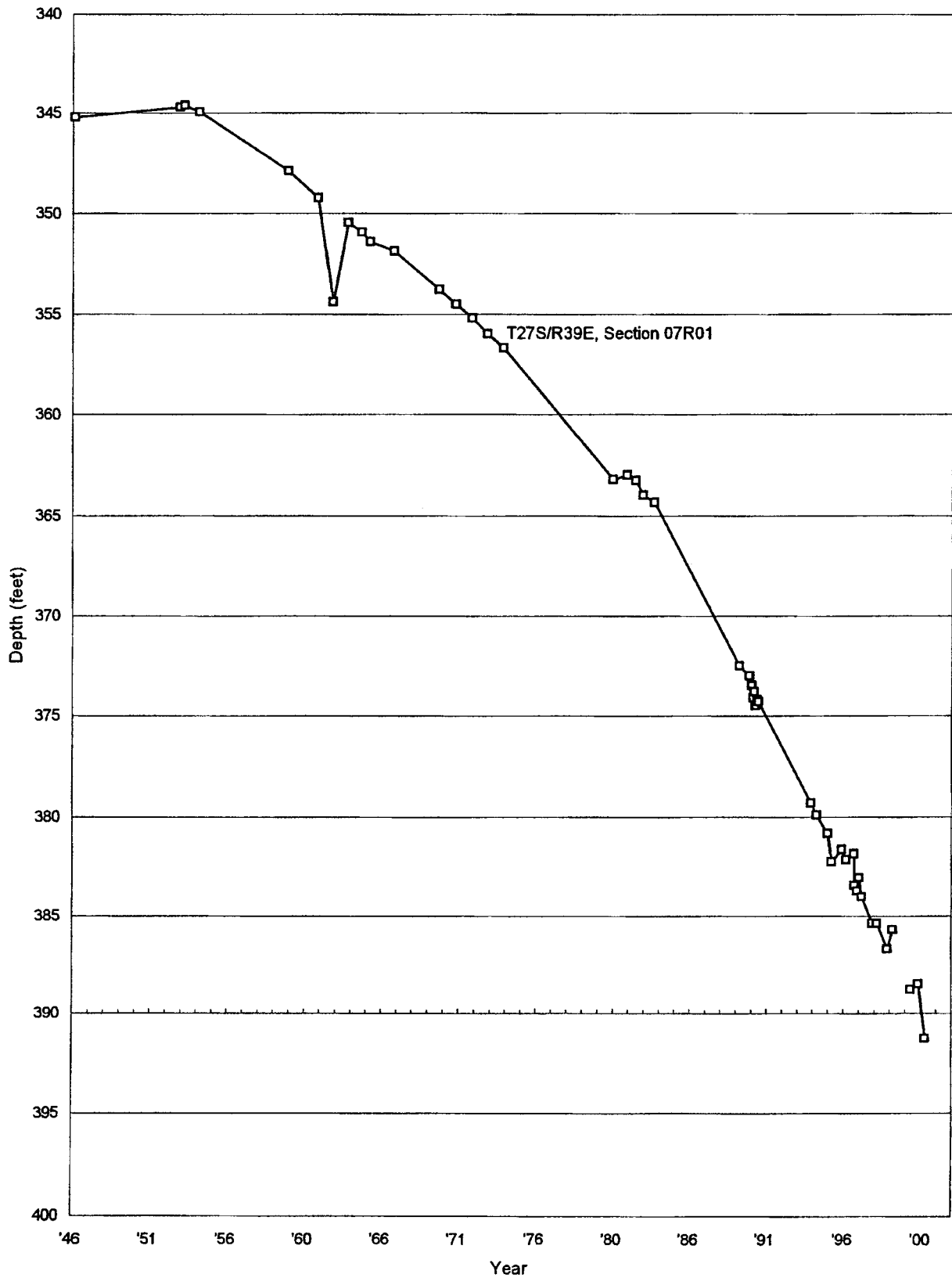
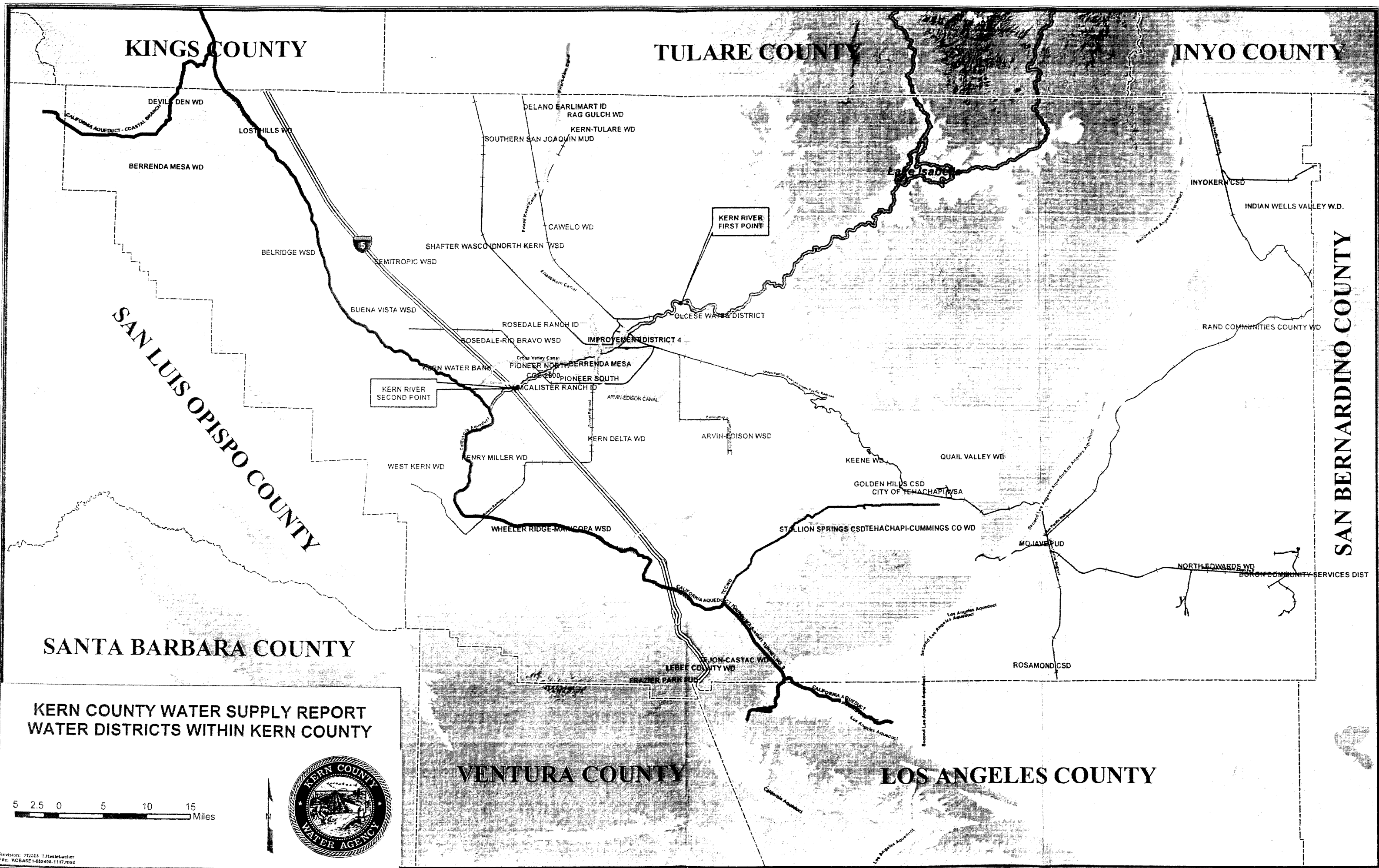


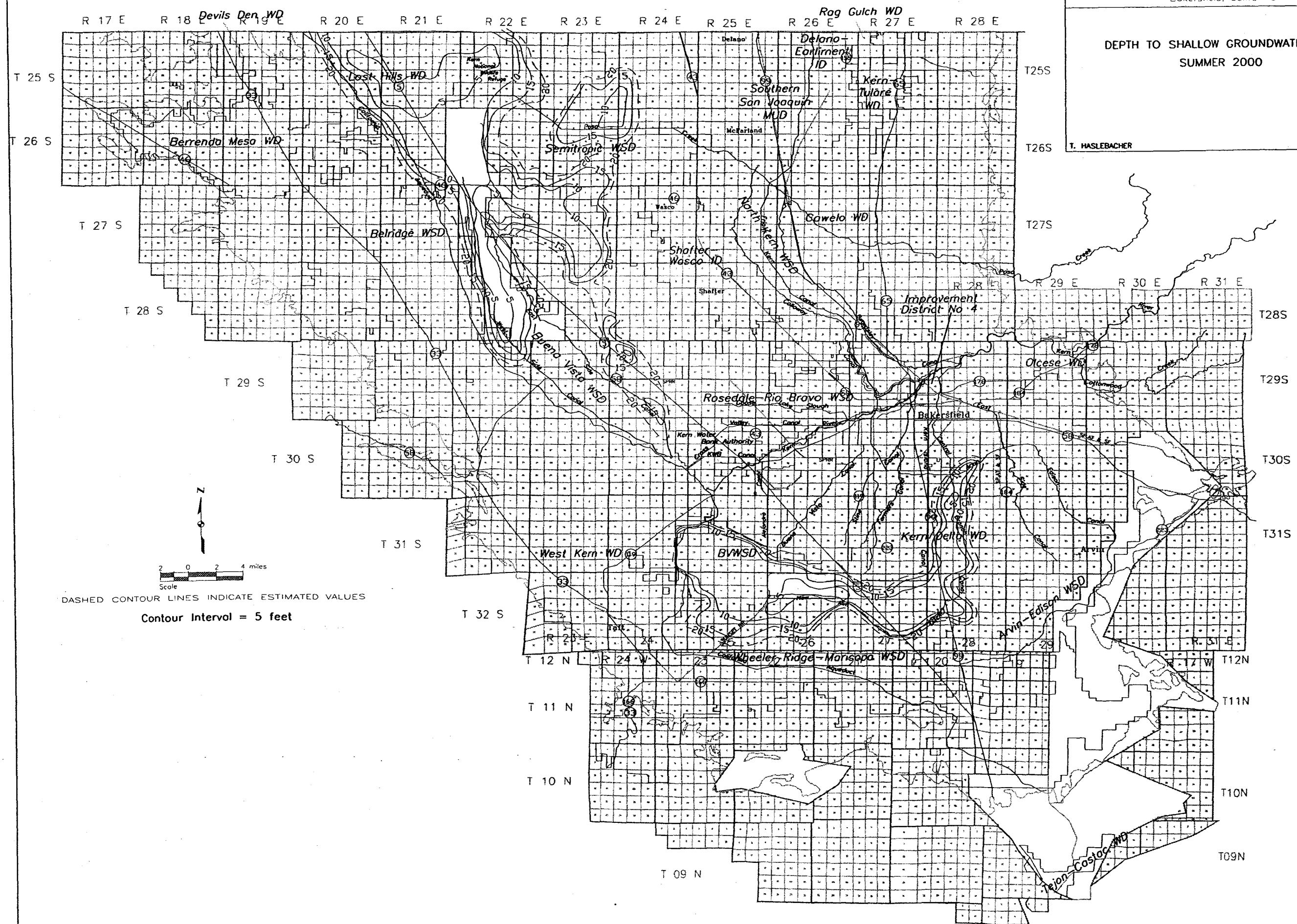
Figure 21g. Water Well Hydrograph Indian Wells Valley





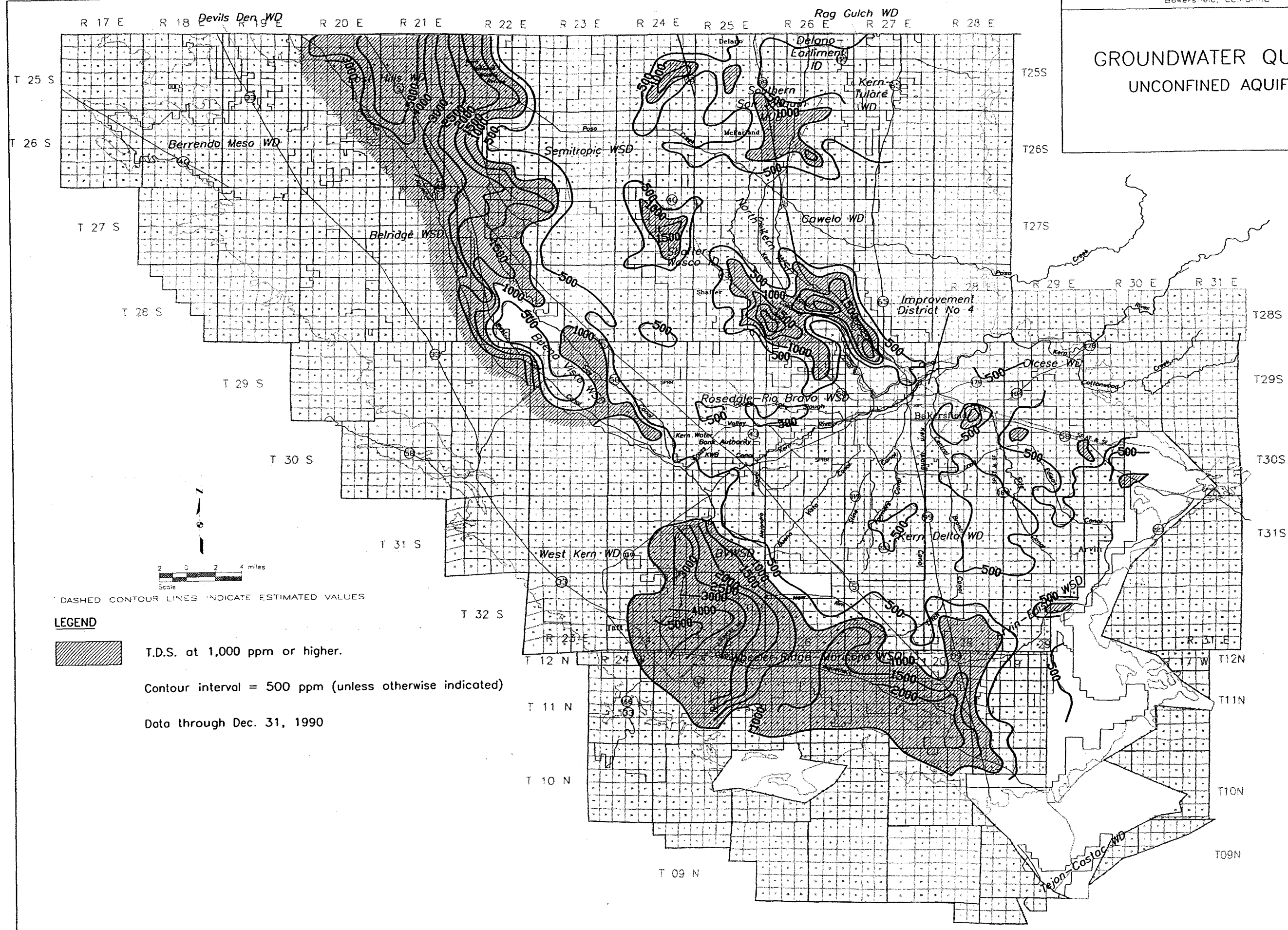
KERN COUNTY WATER SUPPLY REPORT WATER DISTRICTS WITHIN KERN COUNTY





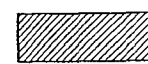
GROUNDWATER QUALITY UNCONFINED AQUIFER

JULY 1997



DASHED CONTOUR LINES INDICATE ESTIMATED VALUES

LEGEND



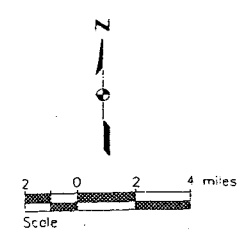
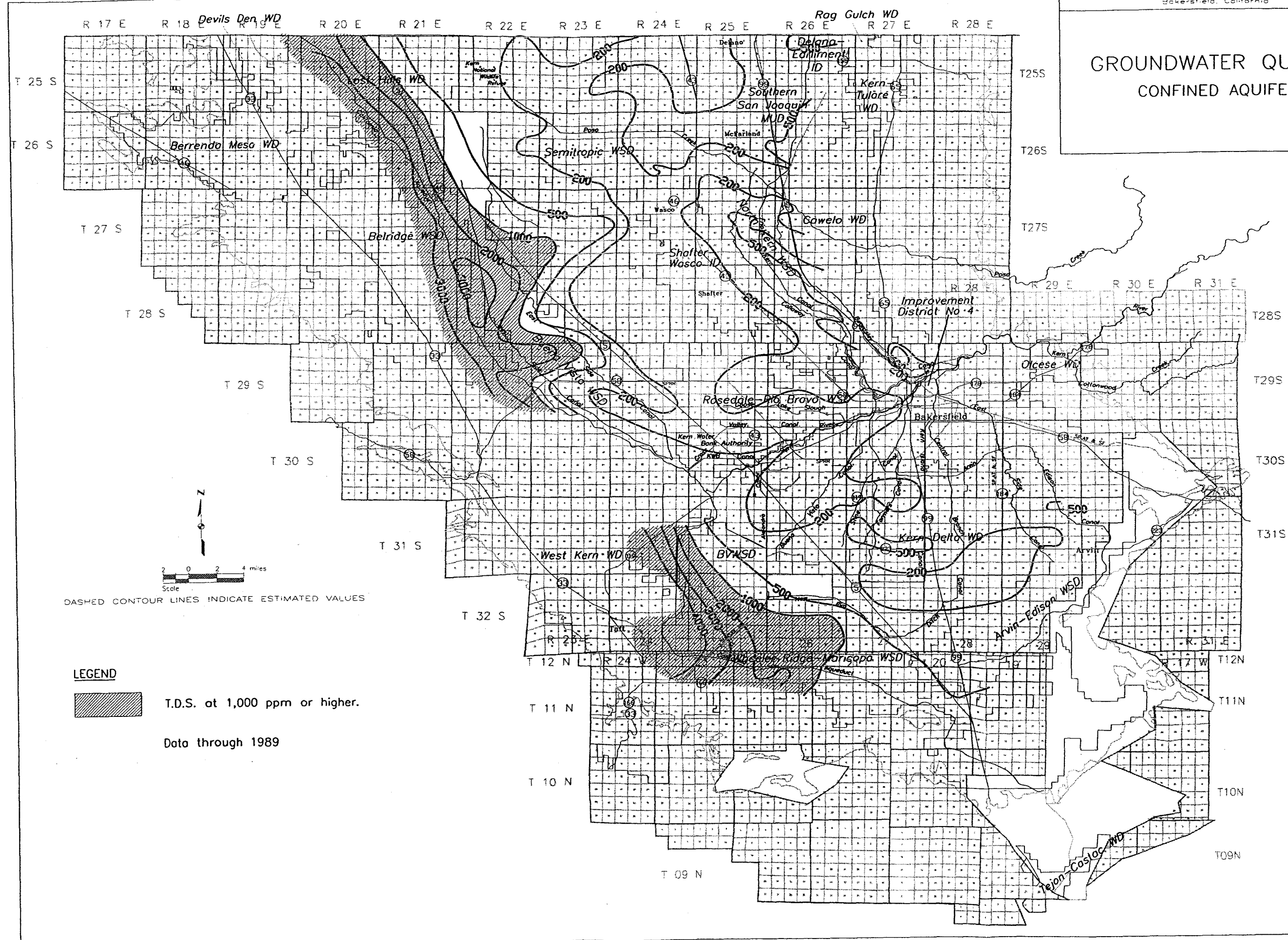
T.D.S. at 1,000 ppm or higher.

Contour interval = 500 ppm (unless otherwise indicated)

Data through Dec. 31, 1990

GROUNDWATER QUALITY CONFINED AQUIFER

MARCH 1997



DASHED CONTOUR LINES INDICATE ESTIMATED VALUES

LEGEND

-  T.D.S. at 1,000 ppm or higher.
- Data through 1989

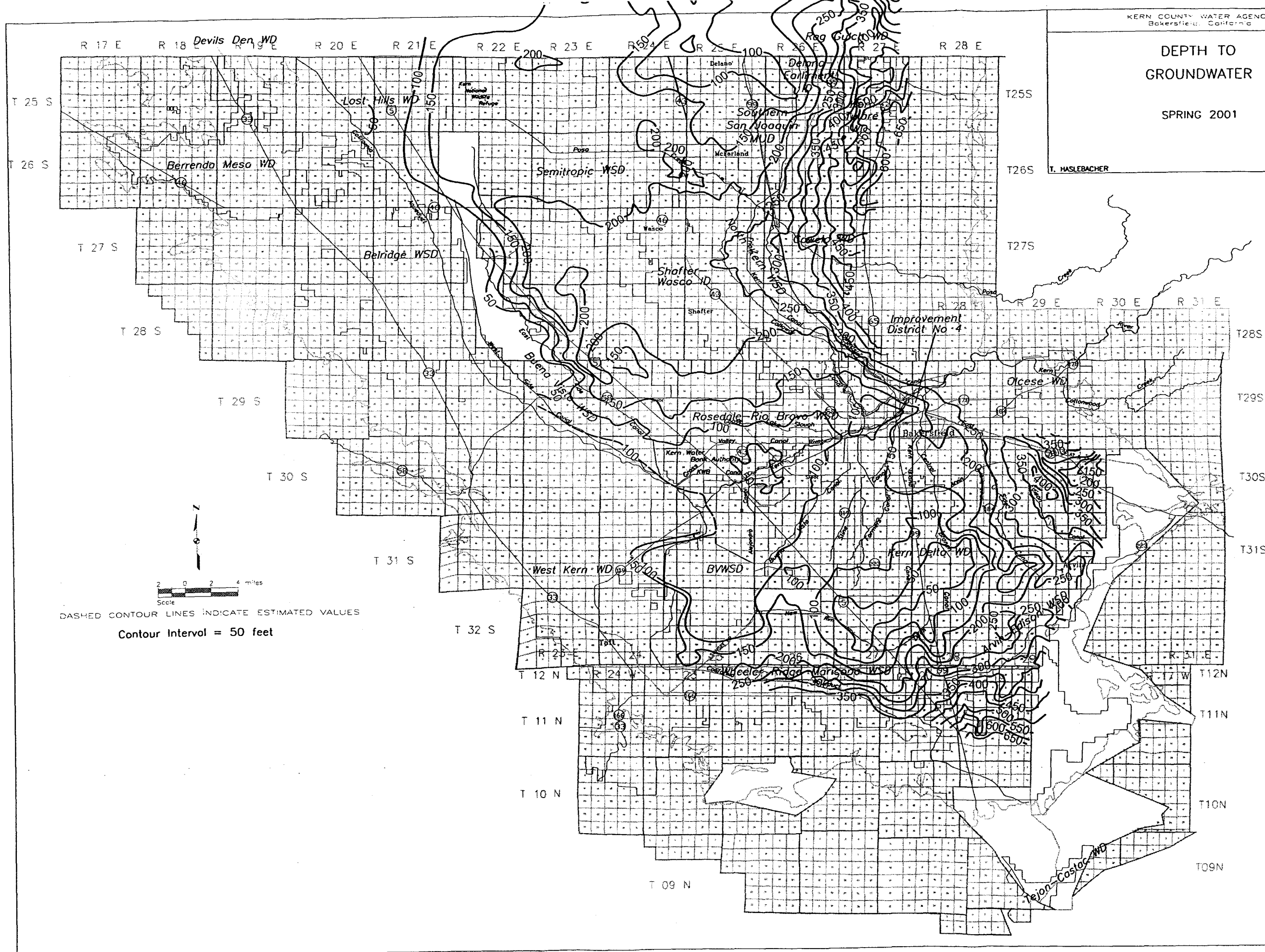
KERN COUNTY WATER AGENCY
Bakersfield, California

DEPTH TO GROUNDWATER

SPRING 2001

T. HASLEBACHER

APRIL 2005



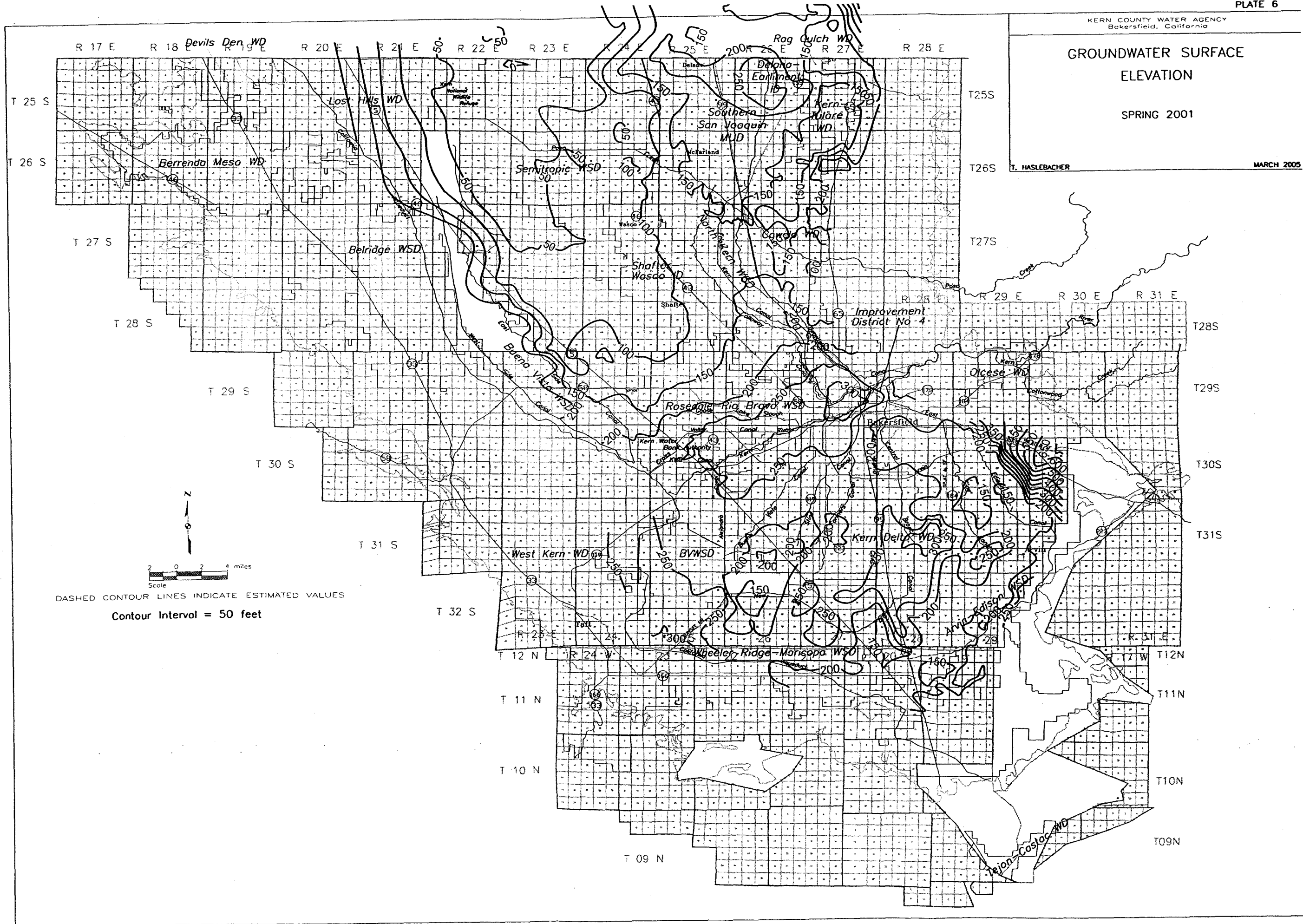
KERN COUNTY WATER AGENCY
Bakersfield, California

GROUNDWATER SURFACE ELEVATION

SPRING 2001

T. HASLEBACHER

MARCH 2005



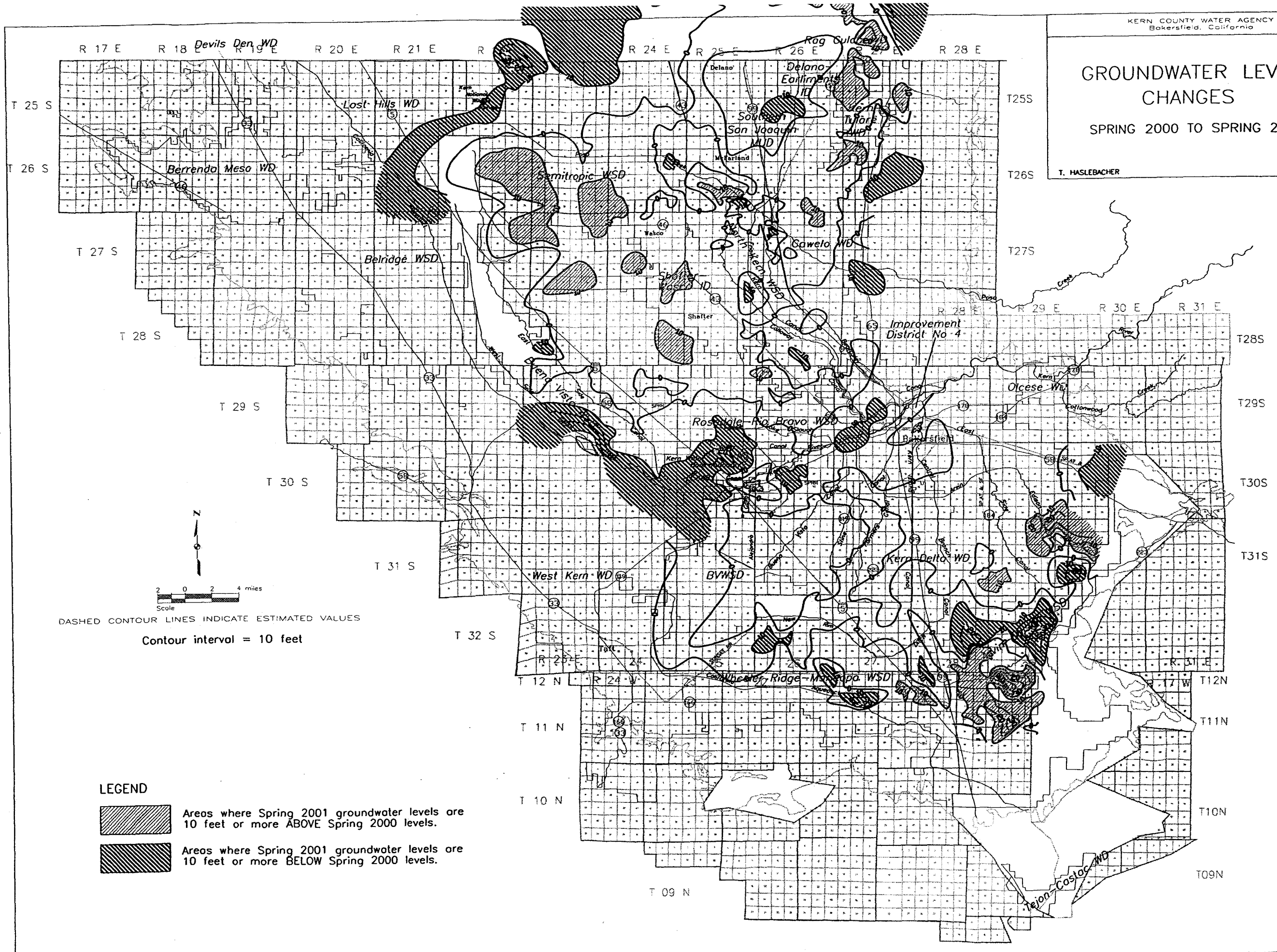
KERN COUNTY WATER AGENCY
Bakersfield, California

GROUNDWATER LEVEL CHANGES

SPRING 2000 TO SPRING 2001

T. HASLEBACHER

APRIL 2005



DASHED CONTOUR LINES INDICATE ESTIMATED VALUES

Contour interval = 10 feet

LEGEND

-  Areas where Spring 2001 groundwater levels are 10 feet or more ABOVE Spring 2000 levels.
-  Areas where Spring 2001 groundwater levels are 10 feet or more BELOW Spring 2000 levels.

