



Summary Report:

1996 Ground Water Extraction Data and Agricultural and Urban Best Management Practices

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Overview of the Extraction Reporting Program

History of the Extraction Reporting Program

In February, 1993, the Monterey County Board of Supervisors adopted Ordinance No. 3663 which required water suppliers within Zones 2, 2A and 2B to report water use information for ground water extraction facilities and service connections. Ordinance No. 3717, which replaced Ordinance No. 3663, was adopted in October, 1993; it modified certain other requirements in the old ordinance but kept the ground water extraction reporting requirements in place for wells with a discharge pipe having an inside diameter of at least 3 inches.

The Monterey County Water Resources Agency (MCWRA) has collected ground water extraction data from well operators for water reporting years beginning November 1 and ending October 31, starting with the 1992-1993 water reporting year. The information received from the over 400 well operators in the above-referenced zones of the Salinas Valley is compiled by the Ground water Extraction Management System (GEMS), a computer database maintained by the MCWRA. The intent of the ground water extraction reporting program is to measure and document the amount of ground water extracted from Zones 2, 2A and 2B of the Salinas Valley Ground Water Basin each year.

The MCWRA also requires the annual submittal of Agricultural Water Conservation Plans, which outline the best management practices that are adopted each year and planned for the next year by growers in the Salinas Valley. This program has been in effect since 1991. In September, 1996, an ordinance was passed which requires the filing of Urban Water Conservation Plans. This program was developed as the urban counterpart of the agricultural water conservation plans, and it provides an overview of per capita water use and the best management practices being implemented by urban water users as conservation measures.

The purpose of this report is to summarize the data obtained from the ground water extraction reporting program for the period of November 1, 1995, through October 31, 1996 (calendar year 1996 for urban reporters). The agricultural and urban best management practices are also summarized, and reference evapotranspiration data from the California Irrigation Management Information System (CIMIS) are presented. With this information, this report is intended to present a picture of current water pumping within the Salinas Valley, including agricultural and urban water conservation improvements which are being implemented to reduce total water usage.

Explanation of Reporting Methods

The ground water extraction reporting program enables water users to report water pumpage by three different measuring methods, using calculations based on flowmeter, electrical meter, or hour meter data. The MCWRA requires pump efficiency testing in order to preserve the accuracy of the data reported. The summary of water pumpage presented in this report is compiled from data generated from all three reporting methods.

Disclaimer Regarding Quality of Data

While the MCWRA has made every effort to ensure the accuracy of the data presented in this report, it should be acknowledged that the data is submitted by the individual reporting parties and is not verified by the MCWRA. In addition, since so many factors affect the calculations, no reporting method is 100 percent reliable at all times.

The MCWRA did not receive ground water extraction reports from approximately four percent (4%) of the wells in the Salinas Valley for the 1995-1996 water reporting year.

Notes Regarding Report Format

Ground water extraction data is presented in this report by measurement in acre-feet. One acre-foot is equal to 325,851 gallons.

Ground Water Extraction Data Summary

The MCWRA has designated subareas of the Salinas Valley Ground Water Basin whose boundaries are drawn where discernible changes occur in the hydrogeologic conditions. These boundaries are shown in Figure 1.

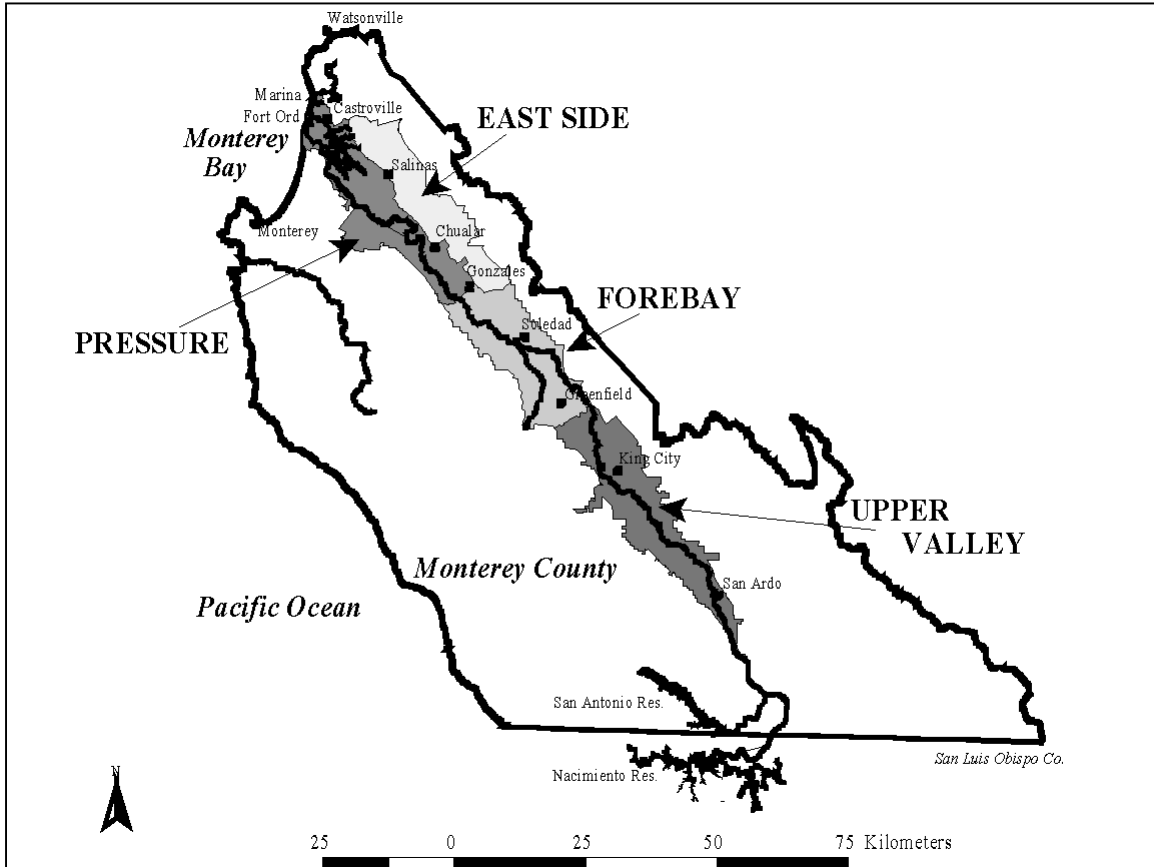


Figure 1. Salinas Valley Subareas

Summary of Methods Used for Extraction Reporting

The distribution of methods used for extraction reporting for the 1995-1996 water reporting year is shown in Table 1; a percentage distribution by volume is shown in Figure 2.

Table 1. Total extraction data by reporting method

Reporting Method	Acre-Feet per Reporting Method	Wells per Reporting Method
Flowmeter	343,367	1,229
Electrical Meter	213,674	576
Hour Meter	6,397	14
Total	563,438	1,819

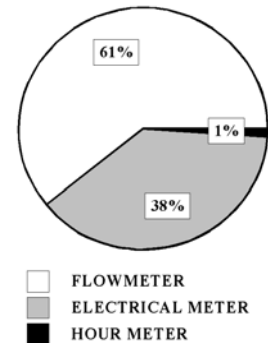


Figure 2. Percentage by volume of methods used for extraction reporting

Ground Water Extraction Data Summary

Total Extraction Data by Subarea and Type of Use

The total ground water extractions from Zones 2, 2A and 2B for the 1995-1996 water reporting year are summarized by subarea and (1) type of use (agricultural and urban) in Table 2, and (2) percentage in Figure 3.

Table 2. Total extraction data by subarea and type of use

Subarea	Agricultural Pumping (acre-feet)	Urban Pumping (acre-feet)	Total Pumping (acre-feet)
Pressure	120,633	20,810	141,443
East Side	92,723	12,991	105,714
Forebay	150,912	5,083	155,995
Upper Valley	156,536	3,750	160,286
Total	520,804	42,634	563,438

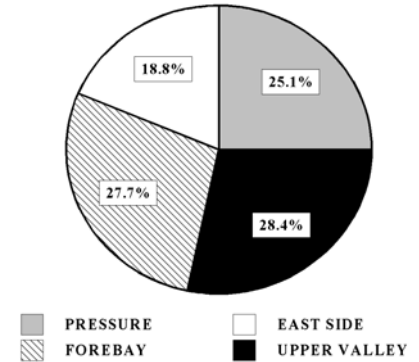


Figure 3. Percentage of total extractions by subarea

Note: the location of urban pumping by subarea has been revised for the City of Salinas, using the Geographic Information System (GIS). The 1995 Summary Report grouped all urban pumping for the City of Salinas into the Pressure Area; however, the boundary between the Pressure and East Side subareas runs through the City of Salinas. Using GIS, the MCWRA was able to more accurately reassign 49 percent of the city's pumping to the East Side subarea.

Urban Extraction Data by City or Area

The total ground water extractions attributed to urban (residential, commercial/institutional, industrial, and governmental) pumping for the 1995-1996 water reporting year are summarized by city or area in Table 3.

Table 3. Urban extraction data by city or area

City or Area	Urban Pumping (acre-feet)	Percentage of Total
Castroville	798	1.9%
Chualar	145	0.3%
Fort Ord	2,490	5.8%
Gonzales	1,298	3.0%
Greenfield	1,539	3.6%
King City	3,408	8.0%
Marina Coast Water District	2,119	5.0%
Salinas	21,936	51.5%
San Ardo	123	0.3%
San Lucas	51	0.1%
Soledad	2,809	6.6%
Other Unincorporated Areas	5,918	13.9%
Total	42,634	100.0%

Summary of Agricultural Irrigation Methods

The Agricultural Water Conservation Plans include information about irrigated acreage, irrigation method, and crop category. This information reflects the changing trends in irrigation methods in the Salinas Valley. Tables 4, 5, and 6 show the distribution of irrigation methods by crop type for 1993, 1996, and 1997, respectively.

This information shows a trend of increased acreage in drip irrigation, in both vegetable crops and vineyards, since 1993.

Table 4. 1993 distribution of irrigation methods by crop type

1993	Furrow (acres)	Sprinkler & Furrow (acres)	Hand Move Sprinklers (acres)	Solid Set Sprinklers (acres)	Linear Move (acres)	Drip (acres)	Other ¹ (acres)	Total (acres)
Vegetables	2,349	84,060	30,764	6,607	3,827	3,682	0	131,289
Field Crops	575	2,173	2,236	90	50	48	0	5,172
Berries	1	0	0	0	0	4,158	0	4,159
Grapes	261	0	0	13,347	0	15,976	0	29,584
Tree Crops	0	0	122	251	0	1,216	10	1,599
Forage	41	202	1,327	0	48	0	189	1,807
Total	3,227	86,435	34,449	20,295	3,925	25,080	199	173,610

Table 5. 1996 distribution of irrigation methods by crop type

1996	Furrow (acres)	Sprinkler & Furrow (acres)	Hand Move Sprinklers (acres)	Solid Set Sprinklers (acres)	Linear Move (acres)	Drip (acres)	Other ² (acres)	Total (acres)
Vegetables	4,209	77,925	33,160	6,434	4,093	6,546	0	132,367
Field Crops	529	740	1,358	310	39	422	0	3,398
Berries	0	0	0	0	0	4,374	0	4,374
Grapes	0	0	0	8,155	0	21,240	0	29,395
Tree Crops	0	0	12	131	0	1,195	0	1,338
Forage	186	690	249	20	0	0	1,141	2,286
Total	4,924	79,355	34,779	15,050	4,132	33,777	1,141	173,158

Table 6. 1997 distribution of irrigation methods by crop type

1997	Furrow (acres)	Sprinkler & Furrow (acres)	Hand Move Sprinklers (acres)	Solid Set Sprinklers (acres)	Linear Move (acres)	Drip (acres)	Other ³ (acres)	Total (acres)
Vegetables	3,264	82,114	21,085	5,620	3,278	12,061	0	127,422
Field Crops	267	1,598	1,245	241	39	72	0	3,462
Berries	0	0	0	0	0	3,977	0	3,977
Grapes	12	550	0	6,245	0	27,734	0	34,541
Tree Crops	0	0	10	433	0	1,679	0	2,122
Forage	121	46	171	179	0	48	298	863
Total	3,664	84,308	22,511	12,718	3,317	45,571	298	172,387

^{1, 2 & 3} "Other" may include different combinations of irrigation systems or areas that were not irrigated.

Agricultural Best Management Practices

For the past seven years, Salinas Valley growers have submitted Agricultural Water Conservation Plans to the MCWRA. Table 7 shows the number of acres, by year, on which selected best management practices have been implemented.

Table 7. Agricultural best management practices implemented from 1991 through 1997

Best Management Practices	1991 Acres	1992 Acres	1993 Acres	1994 Acres	1995 Acres	1996 Acres	1997 Acres
12 Months Set Aside	4,705	4,810	6,586	6,096	5,064	3,123	3,508
Summer Fallow / Other Fallow	1,480	6,546	5,953	4,081	6,486	6,208	2,241
Flowmeters	31,702	26,404	39,206	127,971	122,054	126,031	122,475
Time Clock / Pressure Switch	131,237	131,237	142,162	134,985	121,645	137,297	135,954
Soil Moisture Sensors	39,549	39,549	51,348	43,883	43,188	51,428	56,936
Pre-Irrigation Reduction	92,865	112,290	117,899	108,454	104,937	99,429	104,203
Reduced Sprinkler Spacing	64,613	72,226	81,736	74,409	75,451	78,925	78,142
Sprinkler Improvements	70,035	97,233	104,160	107,626	102,053	116,809	110,523
Off-Wind Irrigation	100,274	109,050	115,984	101,765	94,810	113,381	111,076
Leakage Reduction	96,672	109,589	117,455	112,135	110,973	119,727	125,334
Micro Irrigation System	18,120	22,952	24,408	25,506	29,307	37,991	42,367
Surge Flow Irrigation	9,334	18,230	22,588	37,866	15,202	19,772	20,507
Tailwater Return System	20,357	25,034	21,020	20,994	15,101	22,707	21,121
Land Leveling / Grading	55,186	60,563	59,413	58,963	57,749	64,164	65,143

Note: Since different practices may be applied to the same acreage, "total acreage" is not a meaningful figure.

Agricultural Irrigation Management Survey

The 1997 Agricultural Water Conservation Plans requested feedback regarding irrigation management practices being used. This input helps the MCWRA develop water management programs for the Salinas Valley. The following responses were received from the 241 growers who submitted Agricultural Water Conservation Plans. Not all growers answered all questions.

Have you had an irrigation system evaluation? 75 (36%) of the growers stated that they have had their irrigation system evaluated, and 136 (64%) stated that they have not.

Do you use soil moisture sensors? 84 (39%) of the growers stated that they use soil moisture sensors, and 129 (61 %) stated that they do not.

Do you use crop water use or evapotranspiration (ET) estimates? 55 (26%) of the growers stated that they use crop water use or ET estimates, and 155 (74%) stated that they do not.

*Do you attend the **Irrigation and Nutrient Management Conference** held each February?* 75 (37%) of the growers stated that they have attended one or more of the conferences, and 130 (63%) stated that they have not.

What other types of services would be useful to you and your farming operation? 54 (32%) of the growers stated that they would like *individual training*, and 114 (68%) stated that they would not; 70 (41 %) of the growers stated that they would like *workshops for farm managers*, and 101 (59%) stated that they would not; 70 (42%) of the growers stated that they would like *workshops for other personnel*, and 95 (58%) stated that they would not.

Agricultural Investment in Water Conservation

The Agricultural Water Conservation Plans (summarized in Table 7) include information regarding how best management practices have been adopted by agricultural water users and applied to farming operations in the Salinas Valley (by acre). These practices range from significant capital investments to recurring operational considerations. The implementation of these best management practices represents a significant financial investment by the agricultural community in long-term water conservation measures. Table 8 estimates the investment in agricultural water conservation since 1991.

Table 8. Agricultural investment in water conservation since 1991

Capital Improvements	Average Cost/Acre (\$/acre) ¹	Capital Investment (\$)
1997 Investments		
Flowmeters	40	3,630,920
Soil Moisture Sensors	10	173,870
Time Clock / Pressure Switch	2	9,434
Micro Irrigation System	1,200	29,096,400
Tailwater Return System	200	152,800
Subtotal	-	33,063,424
On-Going Practices		
12 Months Set Aside	700	23,724,400
Summer Fallow / Other Fallow	300	9,898,500
Reduced Sprinkler Spacing	75	39,412,650
Off-Wind Irrigation	25	18,658,500
Leakage Reduction	10	7,918,850
Land Leveling / Grading	70	29,482,670
Subtotal	-	129,095,570
Capital Improvements / On-Going Practices		
Sprinkler Improvements	15	10,626,585
Surge Flow Irrigation	5	717,495
Subtotal	-	11,344,080
Total		173,503,074

Summary of Reported Unit Agricultural Water Pumped by Subarea

Table 9 presents the average acre-feet / acre (unit water pumped) by subarea, calculated using the reported acreage and agricultural water pumped for the 1995-1996 water reporting year. The data used for Table 9 represent a subset of the totals shown in Table 2, since not all agricultural extraction data were submitted with acreage information.

Table 9. Reported unit agricultural water pumped by subarea

Subarea	Pressure	East Side	Forebay	Upper Valley	Overall Average
Unit Water Pumped (acre-feet/acre)	2.50	2.55	3.16	3.45	2.92

Please note that weather patterns and soil types affect the amount of water needed for irrigation. Even during a normal rain year, pumping rates will vary by crop type and location.

¹These estimates were developed with the consensus of the MCWRA Agricultural Water Advisory Committee (December 1997).

Urban Best Management Practices

This is the first year of data collection for the Urban Water Conservation Plan program. Table 10 shows the implementation of best management practices, for 1996 and 1997, as a percentage of total acreage reported.

Table 10. Urban best management practices implemented in 1996 and 1997

Best Management Practices	1996	1997
Provide speakers to community groups and media	21%	52%
Use paid and public service advertising	42%	51%
Provide conservation information in bill inserts	56%	90%
Provide individual historical water use information on water bills	82%	85%
Coordinate with other entities in regional efforts to promote water conservation practices	30%	82%
Work with school districts to provide educational materials and instructional assistance	51%	52%
Implement requirements that all new connections be metered and billed by volume of use	66%	91%
Establish a program to retrofit any existing unmetered connections and bill by volume of use	38%	62%
Offer free interior and exterior water audits to identify water conservation opportunities	35%	35%
Provide incentives to achieve water conservation by way of free conservation fixtures (showerheads, hose end timers) and/or conservation "adjustments" to water bills	50%	50%
Enforcement and support of water conserving plumbing fixture standards, including requirement for ultra low flush toilets in all new construction	35%	35%
Support of State/Federal legislation prohibiting sale of toilets using more than 1.6 gallons/flush	74%	76%
Program to retrofit existing toilets to reduce flush volume (with displacement devices)	52%	82%
Program to encourage replacement of existing toilets with ultra low flush (through rebates, incentives, etc.)	20%	20%
Provide guidelines, information, and/or incentives for installation of more efficient landscapes and water saving practices	86%	94%
Encourage local nurseries to promote use of low water use plants	52%	56%
Develop and implement landscape water conservation ordinances pursuant to the "Water Conservation in Landscaping Act"	3%	3%
Identify and contact top industrial, commercial, and/or institutional customers directly; offer and encourage water audits to identify conservation opportunities	3%	3%
Review proposed water uses for new commercial and industrial water service, and make recommendations for improving efficiency before completion of building permit process	4%	27%
Complete an audit of water distribution system at least every three years as prescribed by AWWA	22%	55%
Perform distribution system leak detection and repair whenever the audit reveals that it would be cost-effective	66%	93%
Advise customers when it appears possible that leaks exist on customer's side of water meter	68%	68%
Identify irrigators of large landscapes (3 acres or more) and offer landscape audits to determine conservation opportunities	11%	33%
Provide conservation training, information, and incentives necessary to encourage use of conservation practices	51%	51%
Encourage and promote the elimination of non-conserving pricing and adoption of conservation pricing policies	24%	24%
Implementation of conservation pricing policies	24%	25%
Enact and enforce measures prohibiting water waste as specified in MCWRA Ordinance No. 3539 or as subsequently amended, and encourage the efficient use of water	53%	78%
Implement and/or support programs for the treatment and reuse of industrial waste water/storm water/ waste water	48%	48%

CIMIS Data Summary

Evapotranspiration - Climatic Demand for Agricultural Water Use

Yearly changes in agricultural water use are influenced by many variables, with changes in weather, irrigation practices and cropping patterns being the most significant. Reference evapotranspiration (ET_0) is a standard measure of the evaporative power of the atmosphere. ET_0 represents the theoretical water use of a four to seven inch tall cool season grass that is not water stressed. To estimate crop water use, ET_0 must be factored with a "crop coefficient."

The California Irrigation Management Information System (CIMIS) is a network of automated weather stations located throughout the state. CIMIS calculates ET_0 from a variety of weather parameters including solar radiation, air temperature, humidity and wind speed. In the Salinas Valley, CIMIS is a cooperative program of the California Department of Water Resources (DWR) and the MCWRA. Two original DWR CIMIS stations near Salinas and Castroville have been in operation since the 1980s. In 1993, in cooperation with DWR, the MCWRA expanded the coverage of the CIMIS system in the Salinas Valley to provide improved data coverage for the varied micro-climatic regions in the valley. There are six CIMIS stations located in the Salinas Valley from Castroville to King City (Figure 4). ET_0 data from these

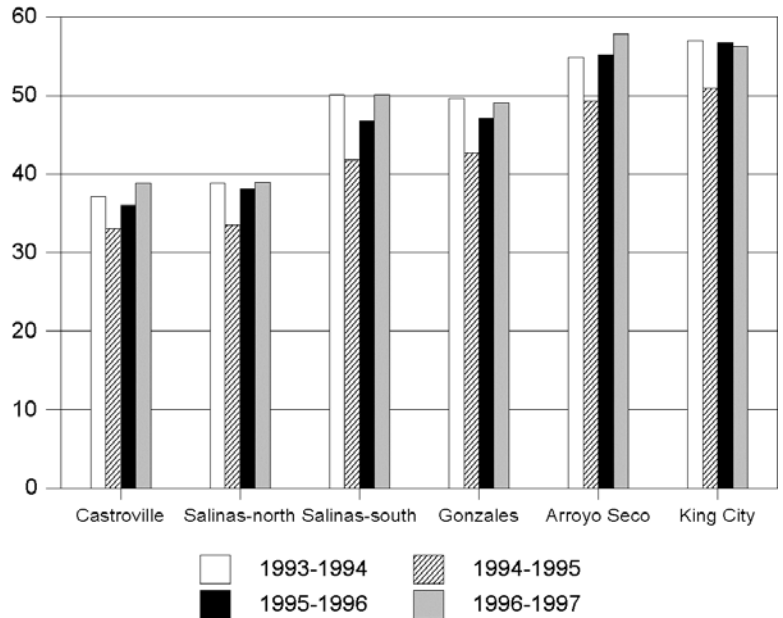


Figure 4. Average annual ET_0 for water reporting years 1993-1994 through 1996-1997

stations provide insight into relative water demands throughout the valley. The largest change in ET_0 occurs just south of the city of Salinas (between Salinas-north and Salinas-south), where the summer fog frequently clears early in the day.

Total reported agricultural pumping increased by 13 percent from the 1994-1995 to the 1995-1996 water reporting year. However, accounting for the two percent fewer wells reporting this year, this increase in pumping may actually be more in the range of 15 percent.

As illustrated by Figure 5, 1995 was an unusually cool year throughout the Salinas Valley, with ET_0 being eight to ten percent lower than the 1993-1997 four-year average of available data. Although during the 1995-1996 water reporting year, ET_0 was 11 to 12 percent greater throughout the Salinas Valley (compared to the previous water reporting year), this period most closely resembled that of an "average" year, differing by only one to three percent (depending on subarea) from the four-year average.

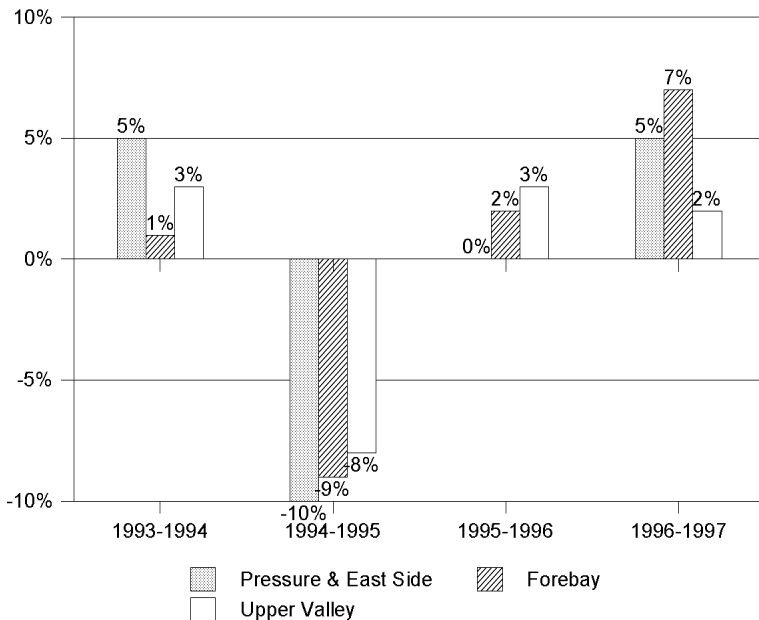


Figure 5. Average annual Et_0 variance from four-year average

CIMIS Data Summary

Although 1994-1995 was the first water reporting year that a nearly complete set of extraction reporting data was available, ETo for that year was below the four-year average. Therefore, it may be expected that the following years with higher ETo will likely show corresponding increases in water use.

ETo information can provide insight into *relative* changes in ground water extractions that can be expected. Ground water extractions during the 1995-1996 water reporting year were 13 to 15 percent greater than the previous year. Although ETo for 1995-1996 was 11 to 12 percent greater than for 1994-1995 (Figure 6), it was fairly close to an "average" year.

1997 was an unusually warm year throughout the Salinas Valley, resulting in ETo of five to seven percent greater than the average (depending on location). This unseasonably warm weather was also apparent in that crops matured faster than normal. Ground water extractions, therefore, are likely to be even greater in 1996-1997 than in 1995-1996, the year of this report.

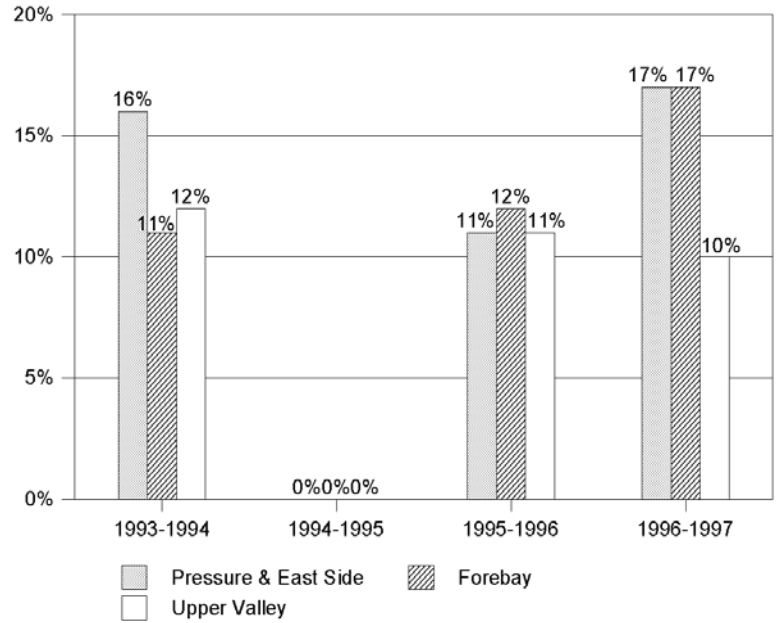


Figure 6. Average annual ET₀ variance from water reporting year 1994-1995

CIMIS Data Access

Now you can access ET₀ and rainfall data on the World Wide Web! This "address" will take you directly to the data selection screen:

http://www.dpla.water.ca.gov/cgi-bin/cimis/cimis/data/input_form

For easy daily access, remember to list it as one of your "Favorites" or "Bookmark" it!

C C C

ET₀ and rainfall data are also available via computer modem. For more information on this service, please call the Department of Water Resources at 1-800-92-CIMIS.

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