State of California The Resources Agency

Memorandum

Date : November 1, 1990

To : Warren Cole
Ed Huntley

Statewide Planning Program

Bob Zettlemoyer, Program Manager

From : **Department of Water Resources**

Subject: 1988 Annual Water Use - Water Supply Balances

This report is the first in a new series that will provide information between Bulletin 160s on annual population, land use, water use, surface water supply and groundwater. Data will be based on actual precipitation, temperature, etc. for the actual year rather than on normal conditions as assumed in the base year for Bulletin 160. These reports will provide timely information on changes in water use in California.

Information provided in this report will be: 1988 population by planning subareas (PSA) and county; 1988 crop acreages by PSA; 1988 net water use and supplies by PSA; and an estimate of 1988 groundwater pumping and changes in storage from the previous year.

Redirection of staff for the Loma Prieta earthquake disaster relief effort caused a delay in the preparation of this report. Normally the schedule will be for completion by the end of the following calendar year.

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BOUNDARY CHANGES

New boundaries have been incorporated in this report. The following changes from Bulletin 160-87 boundaries were made:

Region Changes

There are now 12 regions instead of 10. Regions with no boundary changes:

- SC - South Coast
- SR - Sacramento River
- SJ - San Joaquin River
- TL - Tulare Lake
- NL - North Lahontan
- SL - South Lahontan
- CD - Colorado Desert

The old Central Coast Region has been split into two new regions:

- CN - Central Coast - North
- CS - Central Coast - South

The San Francisco Bay Region has been split into two new regions:

- NB - North Bay (includes Russian River)
- SB - South Bay

The Russian River basin has been moved from the North Coast Region into the new North Bay Region:

- NC - North Coast (excludes Russian R)

PSA Changes

SJ - Foothill & Upland is now called Sierra Foothills and includes DAU 194 and 195.

Sierra Uplands is now called East Side Uplands and no longer includes DAU 194 & 195.

NC & NB
Russian River and North Bay have been reorganized into Russian River - Marin and Napa - Solano.

CN & CS
Northern and Southern PSA's are renamed Central Coast North, San Luis Obispo and Santa Barbara.

DAU Changes

NC - DAU 6, South Fork Trinity, was eliminated.

DAU 7, Trinity, was enlarged to include South Fork Trinity.

SR - DAU 168, Honcut-Gridley, is now Yuba City-Gridley and excludes the area east of the Feather River.

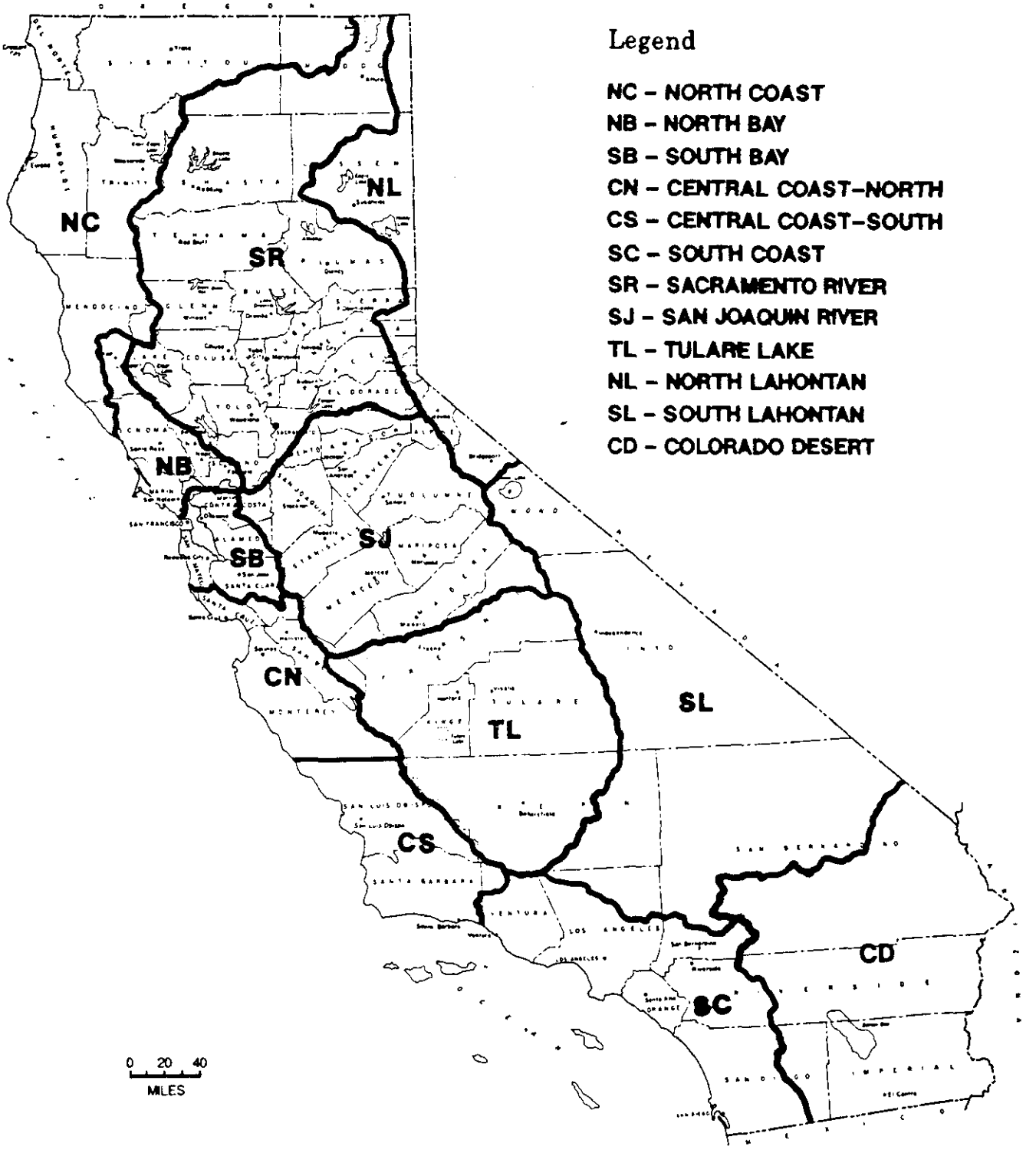
DAU 170, Honcut Valley, is new. It covers the east of Feather area from the old DAU 168.

SJ - DAU 196 & 207, the boundary between these two DAU's is now the county line.

DAU 198 & 209, the boundary between these two DAU's is now the county line.

Note: The new maps are dated Sept. 1989 and supersede the April, 1981 edition.

HYDROLOGIC REGIONS OF CALIFORNIA



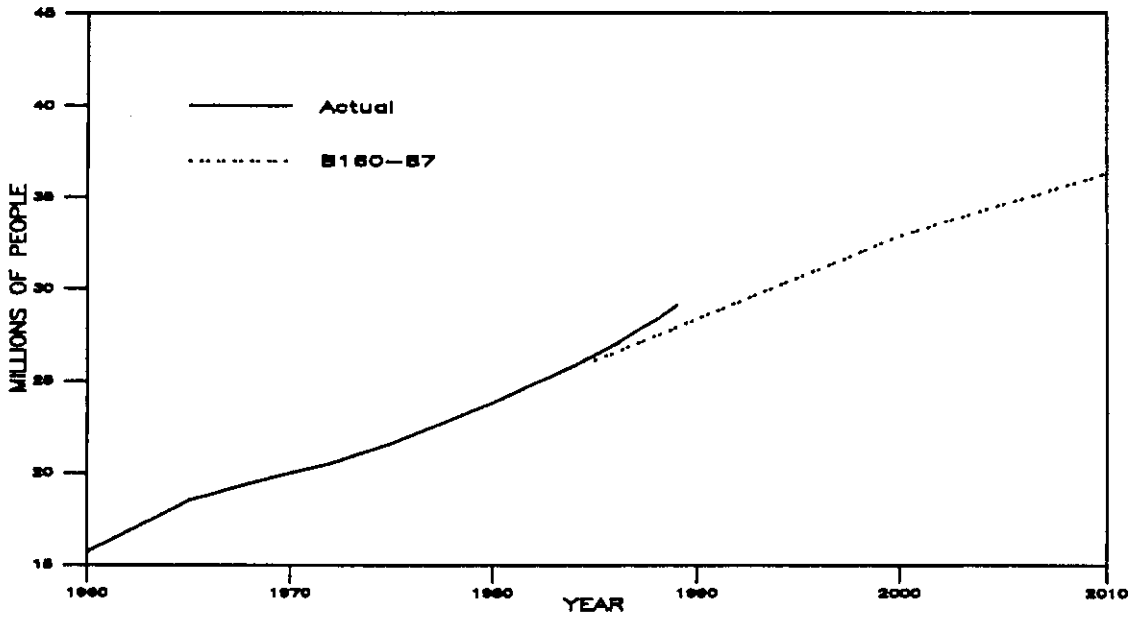
POPULATION

California population as of July 1, 1988 was 28,314,500, an increase of 661,600 or 2.4 percent over the previous year. That represents the third year in a row, beginning in 1986, that growth has been at a 2.4 percent rate. This compares with an annual average of 2.1 percent from 1980 to 1985. Since 1985, the base year for Bulletin 160-85, population has increased 2.2 million, an 8.4 percent gain. *Population growth is occurring faster than projected in Bulletin 160-87.* See Figure 1.

FIGURE 1

BULLETIN 160—87 POPULATION PROJECTION

WITH RECENT GROWTH



Of the 2.2 million increase since 1985, 1.4 million or 62 percent occurred in five Southern California counties. These counties were Los Angeles, San Diego, San Bernardino, Riverside, and Orange. County growth between 1985 and 1988 is shown in Table 1. Tables 2, 3, and 4 contain additional detail on population data.

Population data are provided by the California Department of Finance Demographic Research Unit (Report 88E-2). Population is estimated by this unit for the years between the National census using data taken from drivers licenses, school enrollment, deaths, births, immigration, Medicare, voter registration, and Federal income tax returns. The mean absolute difference of the county estimates produced by this unit for April 1, 1980 compared to the April 1, 1980 census was 2.9 percent.

TABLE 1

COUNTY POPULATION RANKED BY 85-88 CHANGE

	JUL 1988	85-88 CHANGE	85-88 % INCREASE
Los Angeles	8,604,300	573,500	7.1
San Diego	2,370,100	268,100	12.8
San Bernardino	1,284,900	221,800	20.9
Riverside	977,400	176,300	22.0
Orange	2,261,100	150,900	7.2
Sacramento	975,300	91,800	10.4
Alameda	1,242,400	56,000	4.7
Contra Costa	764,300	53,200	7.5
Ventura	646,700	52,300	8.8
San Joaquin	456,600	48,600	11.9
Kern	518,300	45,800	9.7
Solano	313,100	42,000	15.5
Fresno	611,700	40,100	7.0
Santa Clara	1,430,400	39,400	2.8
Stanislaus	340,200	39,300	13.1
Sonoma	365,800	34,100	10.3
Monterey	348,100	22,800	7.0
San Luis Obispo	207,300	22,800	12.4
Tulare	297,500	20,500	7.4
Placer	156,400	20,100	14.7
El Dorado	120,900	18,800	18.4
Santa Cruz	226,400	15,900	7.6
San Mateo	628,500	15,000	2.4
Santa Barbara	343,100	13,600	4.1
Merced	171,200	13,400	8.5
Butte	174,600	13,100	8.1
Yolo	135,000	12,600	10.3
Nevada	77,200	10,500	15.7
Kings	94,100	10,300	12.3
Shasta	139,600	10,100	7.8
San Francisco	733,000	8,600	1.2
Imperial	112,700	8,200	7.8
Madera	82,500	7,400	9.9
Tuolumne	46,300	6,700	16.9
Amador	28,000	5,150	22.5
Calaveras	31,200	4,950	18.9
San Benito	34,500	4,700	15.8
Lake	51,400	4,350	9.2
Marin	229,900	4,200	1.9
Sutter	61,700	3,900	6.7
Yuba	56,800	3,300	6.2
Humboldt	115,600	3,200	2.8
Mendocino	76,100	3,100	4.2
Tehama	46,700	2,950	6.7
Napa	106,300	2,900	2.8
Lassen	27,100	2,750	11.3
Mariposa	14,500	1,450	11.1
Del Norte	20,000	1,400	7.5
Plumas	20,000	1,100	5.8
Colusa	15,300	850	5.9
Siskiyou	43,300	800	1.9
Trinity	14,000	500	3.7
Glenn	23,300	350	1.5
Mono	9,500	250	2.7
Sierra	3,600	170	5.0
Alpine	1,200	130	12.1
Inyo	18,000	-350	-1.9
Modoc	9,200	-400	-4.2
STATE TOTAL	**28,314,500**	**2,235,200**	**8.6**

TABLE 2 - POPULATION BY COUNTY

	APR 1960	APR 1970	APR 1980	JAN 1985	JUL 1988
Alameda	908,209	1,071,446	1,105,379	1,186,400	1,242,400
Alpine	397	484	1,097	1,070	1,200
Amador	9,990	11,821	19,314	22,850	28,000
Butte	82,030	101,969	143,851	161,500	174,600
Calaveras	10,289	13,585	20,710	26,250	31,200
Colusa	12,075	12,430	12,791	14,450	15,300
Contra Costa	409,030	556,116	656,380	711,100	764,300
Del Norte	17,771	14,580	18,217	18,600	20,000
El Dorado	29,390	43,833	85,812	102,100	120,900
Fresno	365,945	413,329	514,229	571,600	611,700
Glenn	17,245	17,521	21,350	22,950	23,300
Humboldt	104,892	99,692	108,514	112,400	115,600
Imperial	72,105	74,492	92,110	104,500	112,700
Inyo	11,684	15,571	17,895	18,350	18,000
Kern	291,984	330,234	403,089	472,500	518,300
Kings	49,954	66,717	73,738	83,800	94,100
Lake	13,786	19,548	36,366	47,050	51,400
Lassen	13,597	16,796	21,661	24,350	27,100
Los Angeles	6,038,771	7,041,980	7,477,503	8,030,800	8,604,300
Madera	40,468	41,519	63,116	75,100	82,500
Marin	146,820	208,652	222,592	225,700	229,900
Mariposa	5,064	6,015	11,108	13,050	14,500
Mendocino	51,059	51,101	66,738	73,000	76,100
Merced	90,446	104,629	134,558	157,800	171,200
Modoc	8,308	7,469	8,610	9,600	9,200
Mono	2,213	4,016	8,577	9,250	9,500
Monterey	198,351	247,450	290,444	325,300	348,100
Napa	65,890	79,140	99,199	103,400	106,300
Nevada	20,911	26,346	51,645	66,700	77,200
Orange	703,925	1,421,233	1,932,709	2,110,200	2,261,100
Placer	56,998	77,632	117,247	136,300	156,400
Plumas	11,620	11,707	17,340	18,900	20,000
Riverside	306,191	456,916	663,199	801,100	977,400
Sacramento	502,778	634,373	783,381	883,500	975,300
San Benito	15,396	18,226	25,005	29,800	34,500
San Bernardino	503,591	682,233	895,016	1,063,100	1,284,900
San Diego	1,033,011	1,357,854	1,861,846	2,102,000	2,370,100
San Francisco	740,316	715,674	678,974	724,700	733,300
San Joaquin	249,989	291,073	347,342	408,000	456,600
San Luis Obispo	81,044	105,690	155,435	184,500	207,300
San Mateo	444,387	557,361	587,329	613,500	628,500
Santa Barbara	168,962	264,324	298,694	329,500	343,100
Santa Clara	642,315	1,065,313	1,295,071	1,391,000	1,430,400
Santa Cruz	84,219	123,790	188,141	210,500	226,400
Shasta	59,468	77,640	115,715	129,500	139,600
Sierra	2,247	2,365	3,073	3,430	3,600
Siskiyou	32,885	33,225	39,732	42,500	43,300
Solano	134,597	171,989	235,203	271,100	313,100
Sonoma	147,375	204,885	299,681	331,700	365,800
Stanislaus	157,294	194,506	265,900	300,900	340,200
Sutter	33,380	41,935	52,246	57,800	61,700
Tehama	25,305	29,517	38,888	43,750	46,700
Trinity	9,706	7,615	11,858	13,500	14,000
Tulare	168,403	188,322	245,738	277,000	297,500
Tuolumne	14,404	22,169	33,928	39,600	46,300
Ventura	199,138	378,497	529,174	594,400	646,700
Yolo	65,727	91,788	113,374	122,400	135,000
Yuba	33,859	44,736	49,733	53,500	56,800
STATE TOTAL	**15,717,204**	**19,971,069**	**23,667,565**	**26,079,000**	**28,314,500**

TABLE 3 - POPULATION BY PSA (SEPT 89 BOUNDARIES)

	1960	1970	1980	1985	1988
NORTH COAST REGION					
Upper Klamath	20,366	21,378	25,327	27,715	27,875
Lower Klamath-Smith	35,199	29,969	38,615	41,030	43,000
Coastal	128,965	123,069	142,139	149,670	154,475
	184,530	174,416	206,081	218,415	225,350
NORTH BAY REGION					
Russian R - Marin	317,708	437,997	551,795	589,600	629,325
Napa - Solano	172,468	213,351	269,898	300,000	330,225
	490,176	651,348	821,693	889,600	959,550
SOUTH BAY REGION					
South Bay	3,095,178	3,892,105	4,208,207	4,496,495	4,654,115
CENTRAL COAST - NORTH REGION					
Central Coast North	313,497	413,114	548,946	618,700	666,850
CENTRAL COAST - SOUTH REGION					
San Luis Obispo	79,959	102,415	151,871	180,050	202,125
Santa Barbara	170,197	267,749	302,458	334,150	348,525
	250,156	370,164	454,329	514,200	550,650
SOUTH COAST REGION					
Santa Clara	220,338	433,797	613,643	696,200	760,250
Metropolitan LA	5,955,051	6,909,378	7,293,049	7,806,600	8,325,075
Santa Ana	1,312,697	2,225,997	2,932,912	3,297,575	3,717,700
San Diego	1,061,970	1,445,077	2,066,156	2,347,775	2,655,950
	8,550,056	11,014,249	12,905,760	14,148,150	15,458,975
SACRAMENTO REGION					
Shasta-Pit	21,962	21,605	28,475	30,495	31,475
Northwest Valley	61,406	70,155	90,043	100,470	107,475
Northeast Valley	60,327	86,347	139,063	155,770	168,375
Southeast	92,077	106,568	178,853	208,480	237,985
Central Basin West	85,546	119,307	171,229	192,140	218,615
Central Basin East	617,905	783,111	962,473	1,082,120	1,196,475
Southwest	14,209	20,261	37,252	47,925	52,250
Delta Service Area	37,571	42,342	46,855	52,685	56,760
	991,003	1,249,696	1,654,243	1,870,085	2,069,410
SAN JOAQUIN REGION					
Sierra Foothills	34,434	50,008	88,808	112,855	134,080
Eastern Valley Floor	154,533	176,444	202,572	236,020	263,900
Delta Service Area	82,837	96,819	124,327	143,825	160,425
Western Uplands	22,307	37,304	51,345	57,030	64,785
East Side Uplands	12,779	15,482	31,863	36,820	40,450
Valley East Side	285,988	342,574	468,567	542,710	607,125
Valley West Side	37,016	41,194	46,028	52,600	57,075
West Side Uplands	25	25	25	25	25
	629,919	759,850	1,013,535	1,181,885	1,327,865
TULARE LAKE HSA					
Uplands	14,345	18,712	32,747	38,640	42,345
Kings-Kaweah-Tule	548,367	626,240	782,168	875,835	941,000
San Luis West Side	19,665	25,976	26,279	29,385	34,310
Western Uplands	3,438	3,345	4,096	5,180	5,645
Kern Valley Floor	243,357	269,716	326,037	381,825	416,250
NORTH LAHONTAN HSA	829,172	943,989	1,171,327	1,330,865	1,439,550
Lassen Group	12,427	14,982	18,786	21,040	23,100
Alpine Group	14,109	24,772	43,482	47,860	49,410
	26,536	39,704	62,268	68,900	72,510
SOUTH LAHONTAN HSA					
Mono-Owens	12,029	17,168	23,129	24,170	24,025
Death Valley	1,085	1,292	1,633	1,665	1,625
Indian Wells	23,119	28,978	34,074	39,825	46,500
Antelope Valley	79,390	97,532	120,828	145,540	190,575
Mojave river	59,846	89,650	128,066	157,325	191,100
	175,469	234,620	307,730	368,525	453,825
COLORADO RIVER HSA					
Twenty-Nine Palms	19,346	26,388	42,213	48,025	55,700
Chuckwalla	1,864	3,322	3,249	3,700	4,450
Colorado River	22,356	22,013	24,009	26,970	30,350
Coachella	67,714	103,553	153,036	190,900	232,375
Borrego	1,641	1,811	3,442	4,285	5,525
Imperial Valley	68,591	70,727	87,487	99,470	107,450
	181,512	227,814	313,436	373,350	435,850
STATE TOTAL	**15,717,204**	**19,971,069**	**23,667,555**	**26,079,170**	**28,314,500**

TABLE 4 - POPULATION BY PSA (APRIL 81 BOUNDARIES)

	1960	1970	1980	1985	1988
NORTH COAST HSA					
Upper Klamath	20,366	21,378	25,327	27,715	27,875
Lower Klamath-Smith	35,199	29,969	38,615	41,030	43,000
Coastal	128,965	123,069	142,139	149,670	154,475
Russian River	130,254	169,013	250,298	278,150	306,850
	314,784	343,429	456,379	496,565	532,200
SAN FRANCISCO HSA					
North Bay	359,922	482,335	571,395	611,450	652,700
South Bay	3,095,178	3,892,105	4,208,207	4,496,495	4,654,115
	3,455,100	4,374,440	4,779,602	5,107,945	5,306,815
CENTRAL COAST HSA					
Northern	313,497	413,114	548,946	618,700	666,850
Southern	250,156	370,164	454,329	514,200	550,650
	563,653	783,278	1,003,275	1,132,900	1,217,500
LOS ANGELES HSA					
Santa Clara	220,338	433,797	613,643	696,200	760,250
Metropolitan LA	5,955,051	6,909,378	7,293,049	7,806,600	8,325,075
	6,175,389	7,343,175	7,906,692	8,502,800	9,085,325
SANTA ANA HSA					
Santa Ana	1,312,697	2,225,997	2,932,912	3,297,575	3,717,700
SAN DIEGO HSA					
San Diego	1,061,970	1,445,077	2,066,156	2,347,775	2,655,950
SACRAMENTO HSA					
Shasta-Pit	21,962	21,605	28,475	30,495	31,475
Northwest Valley	61,406	70,155	90,043	100,470	107,475
Northeast Valley	60,327	86,347	139,063	155,770	168,375
Southeast	92,077	106,568	178,853	208,480	237,985
Central Basin West	85,546	119,307	171,229	192,140	218,615
Central Basin East	617,905	783,111	962,473	1,082,120	1,196,475
Southwest	14,209	20,261	37,252	47,925	52,250
Delta Service Area	37,571	42,342	46,855	52,685	56,760
	991,003	1,249,696	1,654,243	1,870,085	2,069,410
SAN JOAQUIN HSA					
Foothill & Upland	16,085	23,019	48,663	66,035	79,245
Eastern Valley Floor	154,533	176,444	202,572	236,020	263,900
Delta Service Area	82,837	96,819	124,327	143,825	160,425
Western Uplands	22,307	37,304	51,345	57,030	64,785
Sierra Uplands	31,128	42,471	72,018	83,670	95,285
Valley East Side	285,988	342,574	468,567	542,710	607,125
Valley West Side	37,016	41,194	46,028	52,600	57,075
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Death Valley	1,085	1,292	1,633	1,665	1,625
Indian Wells	23,119	28,978	34,074	39,825	46,500
Antelope Valley	79,390	97,532	120,828	145,540	190,575
Mojave river	59,846	89,650	128,066	157,325	191,100
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COLORADO RIVER HSA					
Twenty-Nine Palms	19,346	26,388	42,213	48,025	55,700
Chuckwalla	1,864	3,322	3,249	3,700	4,450
Colorado River	22,356	22,013	24,009	26,970	30,350
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Borrego	1,641	1,811	3,442	4,285	5,525
Imperial Valley	68,591	70,727	87,487	99,470	107,450
	181,512	227,814	313,436	373,350	435,850
STATE TOTAL	**15,717,204**	**19,971,069**	**23,667,565**	**26,079,200**	**28,314,500**

LAND USE

California's total irrigated acreage in 1988 was about 8.9 million acres. This compares with 9.2 million acres reported as the 1985 level in Bulletin 160-87. Of the fourteen major crop categories, grain, corn, other field and alfalfa each declined about 100,000 acres. The largest increase in acreage was in cotton, about 50,000 acres. The amount of reduction attributable to the drought is unknown. Grain and field crops typically decline in a dry year. Land use data in this report is based on the 1988 county Agricultural Commissioners reports adjusted by DWR survey data.

Counties that DWR surveyed in 1988 (aerial photographs, field identification, and cut and weigh or digitizing procedure) were:

Glenn
Kings
San Joaquin
Stanislaus
Tehama
Ventura

Agricultural price support programs and tariff restrictions implemented by the federal government have an impact on the irrigated acreage in California. It is very difficult to determine exactly what the impact is; however to give some idea of the potential impact we have tabulated the government payments to California farmers and to all U.S. farmers for the past eight years.

Government Payments
to California Farmers
(1,000 Dollars)

	Feed Grain	Wheat	Rice	Cotton	Wool Act	Conser-vation	Miscel-laneous	Total
1982	4,280	9,524	23,679	86,731	4,190	4,869	1,210	134,501
1983	4,787	12,433	52,281	71,729	6,730	4,371	200,275	352,606
1984	2,688	19,040	29,016	27,023	9,717	7,717	240,058	335,259
1985	5,925	21,711	121,362	99,972	8,091	5,325	39,131	301,517
1986	17,324	43,441	82,272	119,602	9,476	4,990	110,756	387,861
1987	36,397	60,250	87,589	168,103	8,295	10,866	90,511	462,011
1988	28,464	40,237	87,435	118,600	6,949	12,879	40,514	335,078

Government Payments
to U.S. Farmers
(1000 Dollars)

	Feed Grain	Wheat	Rice	Cotton	Wool Act	Conser-vation	Miscel-laneous	Total
1982	713,315	652,268	155,910	800,211	46,042	176,668	945,551	3,491,965
1983	1,346,033	864,179	277,627	662,289	83,550	187,532	5,873,889	9,295,099
1984	366,739	1,795,151	191,783	274,658	117,578	191,458	5,493,003	8,430,370
1985	2,860,552	1,949,621	577,234	1,106,244	97,596	188,830	924,077	7,704,154
1986	5,158,038	3,499,721	422,769	1,042,392	111,922	253,697	1,324,812	11,813,351
1987	8,489,993	2,931,266	474,853	1,204,298	143,724	1,530,927	1,971,671	16,746,732
1988	7,219,460	1,841,883	464,548	923,863	116,777	1,607,379	2,305 898	14,479,808

Source: "Economic Indicators of the Farm Sector, State Financial Summary," US Dept of Agriculture, Economic Research Unit.

NORTH COAST REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	Upper Klamath	Lower Klamath Smith	Coastal	Total
Grain	79.0	0.0	0.8	79.8
Corn	0.5	0.1	0.1	0.7
Other Field	2.2	0.1	0.4	2.7
Alfalfa	51.6	0.7	0.6	52.9
Pasture	74.1	10.6	25.0	109.7
Other Truck	16.9	0.7	1.5	19.1
Other Deciduous	0.0	0.0	1.0	1.0
Grapes	0.0	0.0	0.9	0.9
Total Crop Acres	**224.3**	**12.2**	**30.3**	**266.8**
Double Crop	**0.0**	**0.0**	**0.0**	**0.0**
Total Land Acres	**224.3**	**12.2**	**30.3**	**266.8**

NORTH BAY REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	Russian River Marin	Napa Solano	Total
Grain	0.0	0.4	0.4
Sugar Beets	0.0	0.2	0.2
Corn	0.9	0.0	0.9
Other Field	0.5	0.4	0.9
Alfalfa	0.3	0.0	0.3
Pasture	13.5	2.2	15.7
Tomatoes	0.0	0.2	0.2
Other Truck	0.9	0.5	1.4
Other Deciduous	5.9	4.1	10.0
Grapes	38.4	28.0	66.4
Total Crop Acres	**60.4**	**36.0**	**96.4**
Double Crop	**0.0**	**0.1**	**0.1**
Total Land Acres	**60.4**	**35.9**	**96.3**

SOUTH BAY REGION
1988 IRRIGATED LANDS IN 1000 ACRES

Grain	0.6
Corn	0.0
Other Field	0.1
Alfalfa	0.8
Pasture	0.4
Tomatoes	0.0
Other Truck	7.2
Almond-Pistachio	0.0
Other Deciduous	0.6
Grapes	1.5
Total Crop Acres	**11.2**
Double Crop	**0.3**
Total Land Acres	**10.9**

CENTRAL COAST NORTH REGION
1988 IRRIGATED LANDS IN 1000 ACRES

Grain	17.8
Sugar Beets	5.1
Corn	3.2
Other Field	8.1
Alfalfa	7.4
Pasture	9.0
Tomatoes	12.6
Other Truck	232.4
Other Deciduous	20.2
Citrus-Olive	0.2
Grapes	37.0
Total Crop Acres	**353.0**
Double Crop	**67.9**
Total Land Acres	**285.1**

CENTRAL COAST SOUTH REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	San Luis Obispo	Santa Barbara	Total
Grain	1.5	3.0	4.4
Sugar Beets	0.0	0.0	0.0
Corn	0.2	1.1	1.3
Other Field	1.4	8.9	10.4
Alfalfa	14.4	7.0	21.5
Pasture	6.3	7.5	13.8
Tomatoes	0.2	0.2	0.5
Other Truck	31.2	56.5	87.7
Other Deciduous	1.1	1.0	2.2
Citrus-Olive	2.4	15.4	17.8
Grapes	9.0	9.8	18.8
Total Crop Acres	**67.6**	**110.7**	**178.2**
Double Crop	**13.5**	**26.5**	**40.0**
Total Land Acres	**54.1**	**84.1**	**138.2**

SOUTH COAST REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	Santa Clara	Metropolitan Los Angeles	Santa Ana	San Diego	Total
Grain	0.1	0.1	7.2	7.0	14.4
Sugar Beets	0.0	0.0	0.0	0.0	0.0
Corn	1.4	0.3	3.0	0.6	5.3
Other Field	1.0	0.0	6.5	0.2	7.7
Alfalfa	0.3	0.0	10.6	0.4	11.3
Pasture	2.5	0.6	12.9	4.9	20.9
Tomatoes	3.3	0.0	0.8	2.6	6.7
Other Truck	43.2	4.5	23.6	12.7	84.0
Other Deciduous	0.3	0.0	1.3	0.8	2.5
Citrus-Olive	59.1	2.5	41.4	77.5	180.6
Grapes	0.0	0.0	6.2	2.4	8.6
Total Crop Acres	**111.2**	**8.0**	**113.5**	**109.1**	**342.0**
Double Crop	**18.5**	**0.0**	**13.0**	**2.8**	**34.5**
Total Land Acres	**92.7**	**8.0**	**100.5**	**106.3**	**307.4**

SACRAMENTO REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	Shasta Pit	N.W. Vly	N.E. Vly	S.E.	Cent Basin West	Cent Basin East	S.W.	Delta	Total
Grain	10.5	11.9	7.5	1.4	142.1	50.5	0.5	36.8	261.2
Rice	2.1	2.8	0.0	0.6	196.9	237.7	0.7	1.2	442.0
Sugar Beets	0.0	2.1	1.8	0.0	46.9	12.6	0.0	~~47.3~~ 17.0	75.4
Corn	0.0	2.7	2.0	0.0	39.4	16.4	0.0	~~79.5~~ 36.2	96.7
Other Field	0.0	4.0	3.3	0.0	55.3	45.9	0.1	21.4	130.0
Alfalfa	24.8	6.7	1.1	6.4	58.9	9.7	0.4	11.9	119.9
Pasture	88.1	51.2	27.7	90.5	31.1	50.1	4.4	21.3	364.4
Tomatoes	0.0	0.0	0.0	0.0	62.0	16.2	0.0	16.0	94.2
Other Truck	0.7	1.4	1.0	0.7	22.7	13.7	0.1	3.2	43.5
Almond-Pistachio	0.0	12.5	20.4	0.2	34.7	28.5	0.1	0.0	96.4
Other Deciduous	0.1	17.8	23.6	5.8	29.6	111.0	8.6	6.9	203.4
Citrus-Olive	0.0	10.2	0.4	2.1	1.3	3.1	0.0	0.0	17.1
Grapes	0.0	0.1	0.4	0.5	2.6	0.4	5.2	3.1	12.3
Total Crop Acres	**126.3**	**123.4**	**89.2**	**108.2**	**723.5**	**595.8**	**20.1**	**170.0**	**1956.5**
Double Crop	**0.0**	**0.6**	**0.0**	**0.0**	**19.8**	**14.2**	**0.0**	**3.9**	**38.5**
Total Land Acres	**126.3**	**122.8**	**89.2**	**108.2**	**703.7**	**581.6**	**20.1**	**166.1**	**1918.0**

SAN JOAQUIN REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	Sierra Foot	East Vly Floor	Delta	West Uplnd	East Side Uplnd	Vly East Side	Vly West Side	West Side Uplnd	Total
Grain	0.0	21.0	34.6	1.7	0.0	92.7	23.1	0.0	173.1
Rice	0.0	5.3	0.0	0.0	0.0	11.7	8.0	0.0	25.0
Cotton	0.0	0.0	0.0	0.0	0.0	73.3	115.9	0.0	189.2
Sugar Beets	0.0	16.6	21.6	0.3	0.0	9.5	24.4	0.0	72.4
Corn	0.0	22.8	36.5	0.0	0.0	97.8	14.6	0.0	171.7
Other Field	0.0	15.7	29.2	2.1	0.0	30.6	35.4	0.0	113.0
Alfalfa	0.0	15.8	43.9	3.3	0.0	95.9	63.3	0.0	222.2
Pasture	3.9	45.9	13.1	0.5	0.0	149.7	20.5	0.0	233.6
Tomatoes	0.0	11.6	24.5	0.2	0.0	7.6	28.4	0.0	72.3
Other Truck	0.1	8.6	32.7	0.1	0.0	15.0	58.1	0.0	114.6
Almond-Pistachio	0.0	2.2	2.4	1.9	0.0	217.8	12.2	0.0	236.5
Other Deciduous	0.8	43.7	13.6	3.6	0.0	68.6	22.3	0.0	152.6
Citrus-Olive	0.2	0.0	0.0	0.0	0.0	6.5	0.1	0.0	6.8
Grapes	1.0	55.3	1.2	0.7	0.0	127.1	0.7	0.0	186.0
Total Crop Acres	**6.0**	**264.5**	**253.3**	**14.4**	**0.0**	**1003.8**	**427.0**	**0.0**	**1969.0**
Double Crop	**0.0**	**4.1**	**6.1**	**0.1**	**0.0**	**33.3**	**3.8**	**0.0**	**47.4**
Total Land Acres	**6.0**	**260.4**	**247.2**	**14.3**	**0.0**	**970.5**	**423.2**	**0.0**	**1921.6**

TULARE LAKE REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	Kings Kaweah Tule	Kern Valley Floor	San Luis Westside	Uplands	Western Uplands	Total
Grain	154.6	51.6	85.3	0.0	0.0	291.5
Rice	0.3	0.7	0.0	0.0	0.0	1.0
Cotton	505.1	326.8	309.2	0.0	0.0	1141.1
Sugar Beets	7.5	14.9	8.3	0.0	0.0	30.7
Corn	94.6	8.7	0.5	0.0	0.0	103.8
Other Field	60.0	23.6	17.6	0.2	0.0	101.4
Alfalfa	207.4	88.3	25.9	1.1	0.0	322.7
Pasture	34.3	3.7	1.3	4.0	0.0	43.3
Tomatoes	1.0	2.3	66.9	0.0	0.0	70.2
Other Truck	20.9	65.4	75.9	0.2	0.0	162.4
Almond-Pistachio	44.5	103.6	15.9	0.0	0.0	164.0
Other Deciduous	157.9	22.2	1.8	1.6	0.0	183.5
Citrus-Olive	130.5	51.7	1.4	1.7	0.0	185.3
Grapes	311.5	90.0	6.5	0.0	0.0	408.0
Total Crop Acres	**1730.1**	**853.5**	**616.5**	**8.8**	**0.0**	**3208.9**
Double Crop	**29.9**	**30.0**	**12.0**	**0.0**	**0.0**	**71.9**
Total Land Acres	**1700.2**	**823.5**	**604.5**	**8.8**	**0.0**	**3137.0**

NORTH LAHONTAN REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	Lassen Group	Alpine Group	Total
Grain	8.6	0.0	8.6
Rice	0.2	0.0	0.2
Corn	0.3	0.0	0.3
Alfalfa	38.5	3.4	41.9
Pasture	57.2	37.5	94.7
Other Truck	1.5	0.0	1.5
Total Crop Acres	**106.3**	**40.9**	**147.2**
Double Crop	**0.0**	**0.0**	**0.0**
Total Land Acres	**106.3**	**40.9**	**147.2**

SOUTH LAHONTAN REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	Antelope Valley	Death Valley	Indian Wells	Mojave River	Mono Owens	Total
Grain	0.4	0.0	0.0	0.5	0.0	0.9
Other Field	0.2	0.0	0.0	0.8	0.0	1.0
Alfalfa	9.0	1.6	2.7	13.1	11.1	37.6
Pasture	0.7	0.1	0.1	1.2	16.4	18.4
Other Truck	3.0	0.0	0.0	0.0	0.1	3.2
Other Deciduous	2.0	0.1	0.6	0.6	0.0	3.3
Total Crop Acres	**15.4**	**1.9**	**3.5**	**16.2**	**27.6**	**64.6**
Double Crop	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Land Acres	**15.4**	**1.9**	**3.5**	**16.2**	**27.6**	**64.6**

COLORADO DESERT REGION
1988 IRRIGATED LANDS IN 1000 ACRES

	Colorado River	Imperial	Anza Borrego	Coachella	29 Palms Lanfair	Chuckwalla	Total
Grain	12.4	60.4	0.3	0.8	0.0	0.0	73.9
Cotton	30.7	20.8	0.0	0.9	0.0	0.0	52.4
Sugar Beets	0.7	41.1	0.0	0.0	0.0	0.0	41.8
Corn	0.8	3.1	0.2	3.9	0.0	0.0	8.0
Other Field	5.0	37.4	0.0	0.7	0.5	4.4	48.0
Alfalfa	40.0	185.9	2.7	2.5	3.3	0.0	234.4
Pasture	5.0	23.4	0.1	1.5	0.0	0.0	30.0
Tomatoes	0.0	4.8	0.3	0.4	0.0	0.0	5.5
Other Truck	26.1	109.4	5.3	15.6	0.0	1.0	157.4
Other Deciduous	0.0	0.3	0.2	0.4	0.1	0.0	1.0
Citrus-Olive	4.0	2.0	1.1	19.9	0.0	0.0	27.0
Grapes	0.0	0.0	0.0	19.6	1.2	0.0	20.8
Total Crop Acres	**124.7**	**488.6**	**10.2**	**66.2**	**5.1**	**5.4**	**700.2**
Double Crop	**15.9**	**60.3**	**0.0**	**6.3**	**0.0**	**0.0**	**82.5**
Total Land Acres	**108.8**	**428.3**	**10.2**	**59.9**	**5.1**	**5.4**	**617.7**

CALIFORNIA STATE TOTALS
1988 IRRIGATED LANDS IN 1000 ACRES

	North Coast	North Bay	South Bay	Central Coast North	Central Coast South	South Coast
Grain[1]	79.8	0.4	0.6	17.8	4.4	14.4
Rice	0.0	0.0	0.0	0.0	0.0	0.0
Cotton	0.0	0.0	0.0	0.0	0.0	0.0
Sugar Beets	0.0	0.2	0.0	5.1	0.0	0.0
Corn	0.7	0.9	0.0	3.2	1.3	5.3
Other Field[2]	2.7	0.9	0.1	8.1	10.4	7.7
Alfalfa	52.9	0.3	0.8	7.4	21.5	11.3
Pasture	109.7	15.7	0.4	9.0	13.8	20.9
Tomatoes	0.0	0.2	0.0	12.6	0.5	6.7
Other Truck[3]	19.1	1.4	7.2	232.4	87.7	84.0
Almond-Pistachio	0.0	0.0	0.0	0.0	0.0	0.0
Other Deciduous[4]	1.0	10.0	0.6	20.2	2.2	2.5
Citrus-Olive	0.0	0.0	0.0	0.2	17.8	180.6
Grapes	0.9	66.4	1.5	37.0	18.8	8.6
Total Crop Acres	**266.8**	**96.4**	**11.2**	**353.0**	**178.2**	**341.9**
Double Crop	**0.0**	**0.1**	**0.3**	**67.9**	**40.0**	**34.5**
Total Land Acres	**266.8**	**96.3**	**10.9**	**285.1**	**138.2**	**307.4**

CALIFORNIA STATE TOTALS
1988 IRRIGATED LANDS IN 1000 ACRES

	Sacto	San Joaquin	Tulare Lake	North Lahontan	South Lahontan	Colorado Desert	Total
Grain[1]	261.2	173.1	291.5	8.6	0.9	73.9	926.6
Rice	442.0	25.0	1.0	0.2	0.0	0.0	468.2
Cotton	0.0	189.2	1141.1	0.0	0.0	52.4	1382.7
Sugar Beets	75.4	72.4	30.7	0.0	0.0	41.8	225.6
Corn	96.7	171.7	103.8	0.3	0.1	8.0	391.9
Other Field[2]	130.0	113.0	101.4	0.0	1.0	48.0	423.1
Alfalfa	119.9	222.2	322.7	41.9	37.6	234.4	1072.9
Pasture	364.4	233.6	43.3	94.7	18.4	30.0	953.9
Tomatoes	94.2	72.3	70.2	0.0	0.0	5.5	262.2
Other Truck[3]	43.5	114.6	162.4	1.5	0.0	157.4	914.5
Almond-Pistachio	96.4	236.5	164.0	0.0	0.0	0.0	496.9
Other Deciduous[4]	203.4	152.6	183.5	0.0	3.3	1.0	580.2
Citrus-Olive	17.1	6.8	185.3	0.0	0.1	27.0	434.9
Grapes	12.3	186.0	408.0	0.0	0.1	20.8	760.4
Total Crop Acres	**1956.5**	**1969.0**	**3208.9**	**147.2**	**64.6**	**700.2**	**9293.9**
Double Crop	**38.5**	**47.4**	**71.9**	**0.0**	**0.0**	**82.5**	**383.1**
Total Land Acres	**1918.0**	**1921.6**	**3137.0**	**147.2**	**64.6**	**617.7**	**8910.9**

[1] Wheat, barley, oats
[2] Sorghum, safflower, sunflower, beans, and others
[3] Lettuce, melons, carrots, cauliflower, celery, broccoli, and others
[4] Peaches, prunes, pears, apricots, cherries, and others

1988 ACTUAL LAND USE
COMPARED WITH BULLETIN 160-87 1985 LEVEL

	1988 Actual	1985 Level	Change	%
Grain	926.6	1059.4	-132.8	-13
Rice	468.2	460.8	+7.4	+2
Cotton	1382.7	1333.3	+49.4	+4
Sugar Beets	225.6	211.1	+14.5	+7
Corn	391.9	535.0	-143.0	-27
Other Field	423.1	509.0	-85.9	-17
Alfalfa	1072.9	1152.0	-79.1	-7
Pasture	953.9	987.3	-33.4	-3
Tomatoes	262.1	269.8	-7.6	-3
Other Truck	914.5	875.3	+39.2	+4
Almond-Pistachio	496.9	483.5	+13.4	+3
Other Deciduous	580.2	584.9	-4.7	-1
Citrus-Olive	434.9	386.1	+48.8	+13
Grapes	760.4	755.6	+4.8	+1
Total Crop Acres	**9293.9**	**9603.1**	**-309.2**	**-3**
Double Crop	**383.1**	**447.3**	**-64.2**	**-14**
Total Irrigated Acres	**8910.9**	**9155.8**	**-244.9**	**-3**

Note: The Sacramento River Index for 1988 was a critically dry year.

1988 WATER DEMANDS AND SUPPLIES
IN TAF

NORTH COAST REGION

DEMANDS	Upper Klamath	Lower Klamath Smith	Coastal	Total
Agriculture	624	27	64	715
M & I	7	7	28	42
Wildlife	337	0	2	339
Recreation	0	0	0	0
Cooling	0	0	0	0
HWUI	2	1	56	59
Total Demand	970	35	150	1155
NET WATER DEMAND	834	35	150	1019
SUPPLIES				
Local Surface	225	20	15	260
Imports by Local	2	0	0	2
Colorado River	0	0	0	0
Ground Water	131	10	66	207
Surface M&I	4	5	67	76
CVP	0	0	0	0
Other Federal	471	0	0	471
SWP	0	0	0	0
Waste Water Recl	1	0	2	3
Total Supply	834	35	150	1019

NORTH BAY REGION

DEMANDS	Russian River Marin	Napa Solano	Total
Agriculture	114	57	171
M & I	126	81	207
Wildlife	0	100	100
Recreation	1	1	2
Cooling	0	0	0
HWUI	0	0	0
Total Demand	241	239	480
NET WATER DEMAND	226	239	465
SUPPLIES			
Local Surface	48	125	173
Imports by Local	16	17	33
Colorado River	0	0	0
Ground Water	86	46	132
Surface M&I	0	0	0
CVP	0	0	0
Other Federal	76	33	109
SWP	0	15	15
Waste Water Recl	0	3	3
Total Supply	226	239	465

1988 WATER DEMANDS AND SUPPLIES
IN TAF

SOUTH BAY REGION

DEMANDS	Total
Agriculture	30
M & I	882
Wildlife	0
Recreation	1
Cooling	2
HWUI	0
Total Demand	915
NET WATER DEMAND	915
SUPPLIES	
Local Surface	13
Imports by Local	488
Colorado River	0
Ground Water	117
Surface M&I	0
CVP	143
Other Federal	0
SWP	147
Waste Water Recl	7
Total Supply	915

CENTRAL COAST NORTH

DEMANDS	Total
Agriculture	807
M & I	149
Wildlife	0
Recreation	2
Cooling	0
HWUI	0
Total Demand	958
NET WATER DEMAND	716
SUPPLIES	
Local Surface	17
Imports by Local	0
Colorado River	0
Ground Water	582
Surface M&I	0
CVP	116
Other Federal	0
SWP	0
Waste Water Recl	1
Total Supply	716

1988 WATER DEMANDS AND SUPPLIES
IN TAF

CENTRAL COAST SOUTH

DEMANDS	San Luis Obispo	Santa Barbara	Total
Agriculture	159	246	405
M & I	41	75	116
Wildlife	0	0	0
Recreation	1	0	1
Cooling	0	0	0
HWUI	0	12	12
Total Demand	201	333	534
NET WATER DEMAND	146	251	397
SUPPLIES			
Local Surface	15	5	20
Imports by Local	0	0	0
Colorado River	0	0	0
Ground Water	124	194	318
Surface M&I	0	0	0
CVP	0	0	0
Other Federal	5	49	54
SWP	0	0	0
Waste Water Recl	2	3	5
Total Supply	146	251	397

SOUTH COAST REGION

DEMANDS	Santa Clara	Metro Los Angeles	Santa Ana	San Diego	Total
Agriculture	254	20	333	237	844
M & I	174	1715	915	516	3320
Wildlife	0	0	0	5	5
Recreation	0	0	5	3	8
Cooling	0	3	5	0	8
HWUI	3	15	1	0	19
Total Demand	431	1753	1259	761	4204
NET WATER DEMAND	361	1717	1081	762	3921
SUPPLIES					
Local Surface	7	22	93	50	172
Imports by Local	0	460	0	0	460
Colorado River	0	333	376	396	1105
Ground Water	215	370	474	90	1149
Surface M&I	0	0	0	0	0
CVP	0	0	0	0	0
Other Federal	25	0	0	0	25
SWP	101	490	98	213	902
Waste Water Recl	13	42	40	13	108
Total Supply	361	1717	1081	762	3921

1988 WATER DEMANDS AND SUPPLIES
IN TAF

SACRAMENTO REGION

DEMANDS	Shasta Pit	N.W. Vly	N.E. Vly	S.E.	Cent Basin West	Cent Basin East	S.W.	Delta	Total
Agriculture	417	509	342	441	2787	2821	68	507	7892
M & I	10	37	51	54	63	421	10	19	665
Wildlife	17	0	0	0	50	16	0	238	321
Recreation	0	0	0	0	0	0	0	1	1
Cooling	0	0	0	0	0	0	0	0	0
HWUI	1	22	0	0	0	1	0	0	24
Total Demand	445	568	393	495	2900	3259	78	765	8903
NET WATER DEMAND	409	623	389	473	2785	3236	78	759	8752
SUPPLIES									
Local Surface	348	26	135	389	348	1135	21	739	3141
Imports by Local	0	0	0	9	0	0	0	0	9
Colorado River	0	0	0	0	0	0	0	0	0
Ground Water	56	287	204	28	877	1333	51	20	2856
Surface M&I	5	0	8	10	0	3	3	0	29
CVP	0	220	42	30	1368	765	1	0	2426
Other Federal	0	84	0	0	189	0	0	0	273
SWP	0	0	0	7	0	0	0	0	7
Waste Water Recl	0	6	0	0	3	0	2	0	11
Total Supply	409	623	389	473	2785	3236	78	759	8752

SAN JOAQUIN REGION

DEMANDS	Sierra Foot	East Vly Floor	Delta	West Upl.	East Side Upl	Vly East Side	Vly West Side	West Side Uplnd	Total
Agriculture	27	1067	804	53	23	2894	1470	0	6338
M & I	38	81	46	23	25	280	14	0	507
Wildlife	0	0	5	0	0	15	253	0	273
Recreation	0	0	0	0	9	0	2	0	11
Cooling	0	15	0	0	0	0	0	0	15
HWUI	0	0	0	0	0	0	0	0	0
Total Demand	65	1163	855	76	57	3189	1739	0	7144
NET WATER DEMAND	65	1163	855	71	52	2942	1495	0	6643
SUPPLIES									
Local Surface	36	97	747	9	50	1485	0	0	2424
Imports by Local	10	0	0	0	0	0	0	0	10
Colorado River	0	0	0	0	0	0	0	0	0
Ground Water	8	1006	20	3	0	1256	85	0	2379
Surface M&I	0	0	0	0	0	0	0	0	0
CVP	10	23	60	59	0	186	1405	0	1743
Other Federal	0	32	0	0	0	0	0	0	32
SWP	0	0	28	0	0	0	4	0	32
Waste Water Recl	1	5	0	0	2	15	1	0	24
Total Supply	65	1163	855	71	52	2942	1495	0	6643

1988 WATER DEMANDS AND SUPPLIES
IN TAF

TULARE LAKE REGION

DEMANDS	Kings Kaweah Tule	Kern Valley Floor	San Luis Westside	Uplands	Western Uplands	Total
Agriculture	5410	2597	1798	30	0	9835
M & I	346	160	10	9	1	526
Wildlife	31	17	0	0	0	48
Recreation	1	0	0	6	0	7
Cooling	0	0	0	0	0	0
HWUI	0	0	0	0	0	0
Total Demand	5788	2774	1808	45	1	10416
NET WATER DEMAND	4666	2204	1446	32	1	8349
SUPPLIES						
Local Surface	919	319	0	15	0	1253
Imports by Local	21	0	0	0	0	21
Colorado River	0	0	0	0	0	0
Ground Water	2830	461	123	13	1	3428
Surface M&I	0	0	0	0	0	0
CVP	559	330	1262	0	0	2151
Other Federal	193	50	0	0	0	243
SWP	103	1006	60	3	0	1172
Waste Water Recl	41	38	1	1	0	81
Total Supply	4666	2204	1446	32	1	8349

NORTH LAHONTAN REGION

DEMANDS	Lassen Group	Alpine Group	Total
Agriculture	313	168	481
M & I	7	15	22
Wildlife	10	0	10
Recreation	0	1	1
Cooling	0	0	0
HWUI	1	0	1
Total Demand	331	184	515
NET WATER DEMAND	305	172	477
SUPPLIES			
Local Surface	193	159	352
Imports by Local	3	0	3
Colorado River	0	0	0
Ground Water	102	8	110
Surface M&I	4	0	4
CVP	0	0	0
Other Federal	0	0	0
SWP	0	0	0
Waste Water Recl	3	5	8
Total Supply	305	172	477

1988 WATER DEMANDS AND SUPPLIES
IN TAF

SOUTH LAHONTAN REGION

DEMANDS	Antelope Valley	Death Valley	Indian Wells	Mojave River	Mono Owens	Total
Agriculture	70	10	18	84	152	334
M & I	62	1	12	57	13	145
Wildlife	0	0	0	0	3	3
Recreation	5	1	0	6	6	18
Cooling	0	0	0	6	0	6
HWUI	0	0	0	0	0	0
Total Demand	137	12	30	153	174	506
NET WATER DEMAND	118	11	24	124	154	431
SUPPLIES						
Local Surface	4	0	0	0	40	44
Imports by Local	0	0	0	0	0	0
Colorado River	0	0	0	0	0	0
Ground Water	69	11	23	120	113	336
Surface M&I	0	0	0	0	0	0
CVP	0	0	0	0	0	0
Other Federal	0	0	0	0	0	0
SWP	41	0	0	1	0	42
Waste Water Recl	4	0	1	3	1	9
Total Supply	118	11	24	124	154	431

COLORADO DESERT REGION

DEMANDS	Colorado River	Imperial	Anza Borrego	Coachella	29 Palms Lanfair	Chuck-walla	Total
Agriculture	695	2564	39	347	26	24	3695
M & I	13	33	2	215	16	1	280
Wildlife	0	17	0	0	0	0	17
Recreation	3	0	0	1	1	0	5
Cooling	0	0	0	0	0	0	0
HWUI	0	0	0	0	0	0	0
Total Demand	711	2614	41	563	43	25	3997
NET WATER DEMAND	579	2976	40	522	35	24	4176
SUPPLIES							
Local Surface	0	0	0	4	0	0	4
Imports by Local	0	0	0	0	0	0	0
Colorado River	569	2976	38	331	0	0	3914
Ground Water	9	0	2	128	34	24	197
Surface M&I	0	0	0	0	0	0	0
CVP	0	0	0	0	0	0	0
Other Federal	0	0	0	0	0	0	0
SWP	0	0	0	55	0	0	55
Waste Water Recl	1	0	0	4	1	0	6
Total Supply	579	2976	40	522	35	24	4176

1988 WATER DEMANDS AND SUPPLIES
IN TAF

STATEWIDE SUMMARY

	NORTH COAST	NORTH BAY	SOUTH BAY	CENT COAST NORTH	CENT COAST SOUTH	SOUTH COAST	SACTO	SAN JOAQUIN	TULARE	NORTH LAHON	SOUTH LAHON	COLO DESERT	TOTAL
DEMANDS													
Agriculture	715	171	30	807	405	844	7892	6338	9835	481	334	3695	31547
M & I	42	207	882	149	116	3320	665	507	526	22	145	280	6861
Wildlife	339	100	0	0	0	5	321	273	48	10	3	17	1116
Recreation	0	2	1	2	1	8	1	11	7	1	18	5	57
Cooling	0	0	2	0	0	8	0	15	0	0	6	0	31
HWUI	59	0	0	0	12	19	24	0	0	1	0	0	115
Total	1155	480	915	958	534	4204	8903	7144	10416	515	506	3997	39727
Net H2O dmnd	1019	465	915	716	397	3921	8752	6643	8349	477	431	4176	36261
SUPPLIES													
Local Surface	260	173	13	17	20	172	3141	2424	1253	352	44	4	7873
Imports by local	2	33	488	0	0	460	9	10	21	3	0	0	1026
Colorado River	0	0	0	0	0	1105	0	0	0	0	0	3914	5019
Ground Water	207	132	117	582	318	1149	2856	2378	3428	110	336	197	11810
Surface M & I	76	0	0	0	0	0	29	0	0	4	0	0	109
CVP	0	0	143	116	0	0	2426	1743	2151	0	0	0	6579
Other Federal	471	109	0	0	54	25	273	32	243	0	0	0	1207
SWP	0	15	147	0	0	902	7	32	1172	0	42	55	2372
Waste Water Rec	3	3	7	1	5	108	11	24	81	8	9	6	266
Total Supply	1019	465	915	716	397	3921	8752	6643	8349	477	431	4176	36261

1988 STATE WATER PROJECT DELIVERY SUMMARY

	NORTH BAY	SOUTH BAY	CENTRAL COAST-SOUTH	SOUTH COAST	SACTO	SAN JOAQUIN	TULARE	SOUTH LAHONTAN	COLORADO DESERT	TOTAL
Napa County FC&WCD	5,392									5,392
Solano County FC&WCD	9,726									9,726
Alameda County FC&WCD		25,830								25,830
Alameda County WD		33,464								33,464
Santa Clara Valley WD		87,961								87,961
San Luis Obispo Co FC&WCD			0							0
Santa Barbara County FC&WCD			0							0
San Bernardino Valley MWD				21,386						21,386
San Gabriel Valley MWD				8,948						8,948
San Gorgonio Pass WD				0						0
Ventura County FCD				0						0
Castaic Lake WA				18,904						18,904
Metropolitan WD				902,564						902,564
City of Yuba City					303					303
County of Butte					385					385
Plumas County FC&WCD					523					523
Oak Flat WD						4,412				4,412
Empire West Side ID							3,475			3,475
Tulare Lake Basin WSD							94,316			94,316
Dudley Ridge WD							47,994			47,994
Kern County WA							1,009,518			1,009,518
Devils Den WD							11,534			11,534
County of Kings							4,000			4,000
Littlerock Creek ID								419		419
Crestline Lake Arrowhead								2,006		2,006
Antelope Valley East Kern WA								34,079		34,079
Mojave WA								9		9
Palmdale WD								1,770		1,770
Coachella Valley WD									20,652	20,652
Desert WA									34,000	34,000
TOTAL	**15,118**	**147,225**	**0**	**951,802**	**1,211**	**4,412**	**1,170,837**	**38,283**	**54,652**	**2,383,570**

Note: Taken from TABLE B-5B, Bulletin 132-89.
Values are for the calendar year and do not include SWP system losses.

1988 USBR DELIVERY SUMMARY

	AG	M&I	WATERFOWL	TOTAL
Shasta Lake	0	903	0	903
Toyon Pipeline	0	2,151	0	2,151
Clear Creek South	7,732	1,459	0	9,191
Spring Creek Conduit	0	792	0	792
Cow Creek Unit	14,542	2,198	0	16,740
Corning Canal	43,050	0	0	43,050
Black Butte Unit	1,559	357	0	1,916
Tehama Colusa Canal	270,850	2	0	270,852
Colusa Basin Drn	737	1,602	0	2,339
Sacramento River	1,620,664	61,126	37,541	1,719,331
Putah South Canal	172,602	46,012	0	218,614
Lake Berryessa	0	261	0	261
Folsom Lake	13,732	68,072	0	81,804
Folsom South Canal	9,253	16,622	0	25,875
Sly Park Unit	18,218	1,830	0	20,048
Upper American River	0	822	0	822
Lower American	0	54,475	0	54,475
Contra Costa Canal	1,017	126,023	0	127,040
Delta Mendota Canal	378,020	6,216	0	384,236
San Luis Canal	165,618	464	774	166,856
Delta	0	597	0	597
New Melones Unit	0	4,832	0	4,832
San Felipe Div	13,874	75,065	0	88,939
San Luis Canal	1,868,520	13,543	0	1,882,063
Friant-Kern Canal	509,451	43,866	0	553,317
San Joaquin Valley	26,469	0	0	26,469
Cross Valley Canal	3,662	0	0	3,662
Madera Canal	118,054	0	0	118,054
Millerton Lake	0	192	0	192
Mendota Pool	110,751	0	0	110,751
Buchanan Dam	0	0	0	0
Hidden Unit	0	0	0	0
Exchange Contracts	852,868	0	0	852,868
Tulelake-P-Canal	11,226	0	0	11,226
Clear Lake	68	0	0	68
Cachuma Dam	16,171	11,406	0	27,577
Waterfowl Conservation	0	0	86,845	86,845
Waterfowl Dist	0	0	52,717	52,717
TOTAL	**6,248,708**	**540,888**	**177,877**	**6,967,473**

Source: USBR Repayments Section, 2800 Cottage Way, Sacramento, Microfiche, "Water Deliveries and Revenues, Fiscal Year 1988, Oct 1, 1987 Thru Sep 30, 1988, Run Date 88/10/17".

GROUND WATER CHANGES
NORTHERN DISTRICT
FALL 1987 TO FALL 1988

PSA	DAU	BASIN	CHANGE IN FEET	CHANGE IN AF STORAGE
Upper Klamath	Butte Valley	Siskiyou	-2.0	-43,000
	Scott Valley	Scott River Valley	0.2	+700
	Shasta Valley	Shasta Valley	1.5	+22,800
Lower Klamath	Lower Klamath	Klamath River Mouth	3.8	
		Prairie Creek	0.4	
	Smith River	Smith River Plain	0.9	+2,800
Coastal	Lower Eel	Eel River	0.0	0
	Van Duzen	Eel River	0.0	0
	S. F. Eel	Laytonville	-3.1	-1,700
	Upper Eel	Covelo Round Valley	-1.2	
		Little Lake Valley	-1.1	
	Redwood Creek	Prairie Creek	0.4	
		Redwood Creek	1.1	
	Mad-Trinidad	Mad River Valley	1.2	
		Humboldt Big Lagoon	-0.6	
	Eureka Plain	Eureka Plain	2.4	+6,500
Shasta Pit	Goose-Alturas	Alturas	-0.3	-1,200
		Goose Lake	0.6	+1,100
	Big Valley	Big Valley	-1.8	-12,900
		Round Valley	0.7	+2,900
	MacArthur-Hat	Fall River Valley	0.7	+3,800
Northwest Valley	Clear Cottonwd			
	Stony-Elder			
	Redding West	Bowman Road	2.9	+25,900
		Cottonwood-Enter	-0.4	-2,000
		Sacto Valley	-3.2	-2,700
	Red Bluff-Orland	Sacto Valley	-2.6	-111,500
Northeast Valley	Redding East	Cottonwood-Enter	-0.4	-3,000
	Los Molinos	Sacto Valley	-2.7	-36,700
	Cow-Battle Cr			
	Eastside Creek Gr			
Southeast	Feather R	Almanor Lake	-4.2	-40
		Mohawk Valley	0.1	+40
		Sierra Valley	0.6	+1,900
Central Basin W	Willows-Arbuckle	Sacto Valley	-0.3	-16,200
	Glenn-Knights Land	Sacto Valley	-0.1	-700
Central Basin E	Durham Sutter	Sacto Valley	-2.0	-27,600
	Butte City	Sacto Valley	-0.7	-4,600
	Yuba City-Gridley	Sacto Valley	-2.1	-14,700
	Honcut Valley	Sacto Valley	-2.1	-6,600
Southwest	Cache Creek	High Valley	-2.4	-6,200
		Lower Lake	0.4	+90
		Scotts Valley	4.1	+700
		Kelseyville Valley	0.9	+1,200
		Upper Lake	6.7	+4,500
	Putah Creek	Coyote Valley	-0.7	-2,200
		Middletown-Collayom	-1.1	-300

GROUND WATER CHANGES
CENTRAL DISTRICT
FALL 1987 TO FALL 1988

PSA	COUNTY	DAU	BASIN	CHANGE IN FEET
Central Basin E	Sutter	Meridian-Robbins, Durham-Sutter, Yuba City-Gridley, & Placer	Sacramento Valley	-2.4
	Yuba	Yuba	Sacramento Valley	+0.3
	Placer	Placer	Sacramento Valley	-4.2
	Sacramento	Placer, Sacramento	Sacramento Valley	-2.3
Eastern Vly Flr	Sacramento	Elk Grove	Sacramento Valley	
Central Basin W	Solano	Vacaville	Sacramento Valley	-0.4
	Yolo	Lower Cache, Willows-Arbuckle, & Glenn-Knghts Lndg	Sacramento Valley	+0.3
	Yolo	Lower Cache	Capay Valley	-0.8
Eastern Vly Flr	San Joaquin	Lodi,	San Joaquin Valley	-4.0
Valley East Side	San Joaquin	S San Joaquin ID,		
	San Joaquin	& Modesto-Oakdale		
Alpine Group	El Dorado	Truckee-Tahoe	South Lake Tahoe Vly	-1.8
Western Upland	Contra Costa	Antioch-Coral Hlw	E Contra Costa Area	+0.5
Russian R-Marin	Mendocino	Coyote	Potter Valley	+0.8
	Mendocino	Forsythe, & Upper Russian	Ukiah Valley	+1.2
	Mendocino	Upper Russian	Sanel Valley	-1.2
	Sonoma	Middle Russian	Alexander Valley	-0.4
	Sonoma	Middle Russian, & Dry Creek	Healdsburg Area	0
	Sonoma	Santa Rosa	Santa Rosa Area	-1.8
	Sonoma	South Marin	Petaluma Valley	+0.9
	Sonoma	South Sonoma	Sonoma Valley	-0.6
Napa-Solano	Napa	Napa	Napa Valley	-2.3
	Solano	Solano	Suisun-Fairfield	-0.2
South Bay	Contra Costa	Walnut Creek	Pittsburg	-1.5
	Contra costa	Walnut Creek	Clayton Valley	-0.4
	Contra Costa	Walnut Creek	Ygnacio Valley	-0.9
	San Mateo	San Mateo Coast	Half Moon Bay	-2.1
			San Gregorio Valley	+1.7
			Pescadero Valley	+0.2
	Santa Clara	San Jose	Santa Clara Valley	-19.0
		S Santa Clara Vly	Coyote	-10.0
			Llagas	-18.6

GROUND WATER CHANGES
SAN JOAQUIN DISTRICT
FALL 1987 TO FALL 1988

PSA/DAU	Change in Feet	Change in Storage (AF)
Valley East Side	-3.7	-633,100
206 Modesto-Oakdale	-2.8	-71,600
207 Modesto Reservoir	-4.9	-38,600
208 Turlock	-4.6	-132,800
209 Turlock Lake	-3.6	-38,300
210 Merced	+0.8	+21,200
211 Merced Stream Group	-0.8	-3,800
212 El Nido-Stevinson	-2.8	-37,700
213 Madera-Chowchilla	-6.0	-122,100
214 Adobe	-4.8	-79,000
215 Gravelly Ford	-7.4	-130,400
Valley West Side	-1.5	-124,300
216 West Side	-1.5	-124,300
Kings-Kaweah-Tule	-4.7	-1,227,300
233 Fresno	-3.2	-110,700
234 Academy	-1.8	-5,500
235 Ralson	-0.1	-15,800
236 Consolidated	-6.0	-173,100
237 Lower Kings River	+1.3	+19,900
238 Hanford-Lemoore	-4.3	-89,700
239 Alta	-7.3	-100,200
240 Orange Cove	-7.4	-10,000
241 Tulare Lake	-8.9	-94,900
242 Kaweah Delta	-8.8	-409,000
243 Tule Delta	-5.5	-238,500
San Luis West Side	+1.2	+204,500
244 Westlands	+4.0	+207,500
245 South Tulare Lake	-1.6	-3,000
Kern Valley Floor	-2.0	-344,500
254 Kern Delta	-4.5	-222,300
255 Semitropic	+1.7	+49,600
256 North Kern	-7.1	-172,700
257 Northeastern Kern	-2.8	-10,700
258 Arvin-Edison	+2.7	+23,800
259 Antelope Plain	-2.1	-18,900
260 Buena Vista Valley	-5.8	-3,500
261 Wheeler Ridge-Maricopa	+1.6	+10,100

GROUND WATER CHANGES
SOUTHERN DISTRICT
FALL 1987 TO FALL 1988

County	Basin	Change in Feet
Los Angeles	Central	-8
	West Coast	Unchanged
	Montebello Forebay	-7
	Main San Gabriel	-5
	Raymond	-1
	San Fernando	-4
Los Angeles/San Bernardino	Chino	-12
	Antelope Valley	-1
San Bernardino	City of San Bernardino	-4
Riverside	Corona	-10
	Eastern MWD	-4
San Diego	City of San Diego	-2
Orange	Orange Co WD	-8
Ventura	United CWD	-4
	Santa Maria	-2
	Ventura and Oxnard	-15
San Luis Obispo	San Luis Obispo	-5

SACRAMENTO RIVER WATER QUALITY

Water quality problems of the Sacramento River include temperature, dioxins, and heavy metals. Maintenance of stream biota is dependent on suitable temperatures. For example, some releases from Shasta Dam to the Sacramento River are too warm for the successful reproduction of some runs of salmon. Dioxins are a closely related group of highly toxic compounds produced as byproducts of various industrial processes. High levels of dioxins are discharged with mill wastes into the Sacramento River near Anderson (Shasta County) by paper mills. The Department of Health Services has issued an advisory not to eat resident fish from the Sacramento River between Keswick and Red Bluff. The Central Valley Regional Water Quality Control Board has issued orders for the paper companies to reduce the dioxin concentrations in the discharges.

Water discharging from mines (many are abandoned) is acidic and laden with heavy metals. Abandoned mine leachate flowing into Spring Creek eventually flows into the Sacramento River near Keswick. Copper, zinc, and cadmium have been found in high concentrations. Numerous fish kills have occurred in the Sacramento River due to heavy metals. The Central Valley Board and the United States Environmental Protection Agency (EPA) are attempting to implement remedial measures to reduce heavy metal concentrations in mine effluent.

COLUSA BASIN FLOODING AND DRAINAGE

The Colusa Basin, including parts of Glenn, Colusa, and Yolo Counties, is a leading agricultural area, as well as one of the most notable waterfowl hunting areas in the State. It has long been plagued with shallow flooding of large areas from tributary runoff. Similar problems occur during the late spring in part due to irrigation return flows.

The Department studied these problems in the early 1960's and reported on them in Bulletin 109, published in 1962. That report recommended that an improved drainage channel and levee system be reevaluated in the future when increased land use and potential flood damages could make flood protection economically justified.

The Department's latest investigation (1990), recommends the adoption of a basin management plan to handle drainage and flood control problems. A new tri-county basin-wide drainage district met for the first time in 1988 to deal with the problems of the basin. The Colusa Basin Drainage's board of directors is busy composing a draft management plan for approval by its voters.

BUTTE AND SUTTER BASINS

The many water related problems of the Butte and Sutter Basins include fish passage and habitat degradation, herbicide contamination, flooding and drainage problems, and water rights. The issues are complex due to competing uses and the maze like pattern of water flow in the wetland and irrigated areas. Spring salmon runs in the watershed have decreased from around 20,000 in 1960 to less than 500 at present. The work done under SB1086 toward a Sacramento River Fisheries Management Plan identified Butte Creek as a watershed with an urgent need for fisheries mitigation work.

The Department has concluded a Memorandum of Understanding with a majority of Butte and Sutter Basin districts for a study of water resources. A fuller understanding of the complex system could lead to: (1) more dependable water supplies for local users, (2) benefits for fish and wildlife, (3) additional water supplies, and (4) improved water quality. Under the MOU, DWR will conduct the study and the participating districts will cooperate in furnishing data and serve on a study advisory committee. These participants will be afforded the opportunity to review all reports in draft form. A three-year study effort is anticipated, depending on funding priorities. The precise direction the study will take is not certain at this time.

FOOTHILL WATER SUPPLIES

Many foothill communities on both sides of the Sacramento Valley do not have ready access to either ground water or dependable surface water supplies, and have water supply problems during dry periods. The Butte County communities of Paradise, Magalia, Forest Ranch, and Cohasset represent significant populations vulnerable to the effects of drought. Paradise, the largest of these communities, has managed to meet its water demands to date by staged water developments of Little Butte Creek with two dams and reservoirs. Strict rationing was required in 1977 and some rationing has occurred during the drought. The smaller communities rely mainly on individual wells and hauling in water. The Department is studying the ground water in the Butte County foothills to determine if dependable supplies can be generated using deep wells. On the west side of the Valley, Stonyford, Elk Creek, and Century Ranch have similar problems. The Century Ranch residents are considering suing Colusa County for approving a subdivision without sufficient water supply.

CLEAR LAKE

Inadequate discharge capacity of Clear Lake's five mile long outlet channel is the primary cause of flooding on the lake rim. In 1979, the Corps recommended enlarging the outlet channel and a one mile bypass around the highly developed portion. Yolo County interests objected, claiming that this plan would aggravate the flooding and erosion problems downstream in the Capay Valley. As recently as 1990, the Corps has concluded that no structural project is economically justified.

Another problem is the excess algae production in Clear Lake which results in taste and odor complaints about this source of drinking water, unpleasant aesthetics, and fish kills. Presently, a Coordinated Resource Management Program has been initiated to develop solutions to the algae problem and other resource problems in the basin.

GROUND WATER CONTAMINATION

Several ground water contamination problems exist in the Northern District. In the Chico area, high nitrate levels have been found in the developing area around the city. The Department studied the problem in 1983 and concluded that septic tanks and urban runoff drainage wells are the most widespread sources. It was recommended that the unsewered areas be encouraged to connect to the existing sewage system as soon as feasible and that all drainage wells be eliminated as soon as possible.

Other Chico area ground water problems have resulted from industrial activities. Heavy metal contamination was discovered after a site previously used as a metal recycling scrapyard was purchased to develop a children's playground. Solvents used for equipment cleaning and laundry dry cleaning (primarily trichloroethylene) were found in the ground water.

In Tehama County, officials have long been concerned about high bacterial counts and nitrate levels in the Antelope area just east of Red Bluff. In 1985-87, the Department studied the problem and concluded that it was related to septic tanks and agricultural practices. The Department recommended that the minimum depth for surface seals on domestic wells be increased from 20 to 50 feet, and that the feasibility of extending the city water supply and/or sewer system into the Antelope area be determined.

In the Oroville area, the Koppers Company, Inc. and predecessors contaminated the ground water with pentachlorophenol and other hazardous compounds from 1948 to 1973. DWR studied the problem for the Regional Board in 1973 to verify the existence of the problem and its approximate extent. The EPA started a Superfund investigation in 1986. In the meantime, Koppers has agreed to furnish the residents directly affected with domestic water. This was first done with bottled water (to 45 households) and is now accomplished by connections with the Oroville-Wyandotte Irrigation District water line.

Dioxin contamination of soils and ground water has been discovered south of Oroville. The dioxins were determined to have formed as a result of several chemical fires at a wood treatment plant. The EPA has listed the area as a Superfund site and is initiating cleanup efforts.

The Department is currently investigating ground water contamination from septic tanks at Spaulding Tract near Eagle Lake in Lassen County (under State Water Resources Control Board contract). High nitrate levels in areas such as Chico and Spaulding tract have resulted in septic tanks prohibitions by the Central Valley and Lahontan Regional Water Quality Control Boards.

High levels of boron occur naturally in many areas of Northern California, restricting certain beneficial uses of ground water such as agricultural irrigation. Both the Clear Lake (lake County) and Hornbrook (Siskiyou County) areas are known to contain high boron levels in ground water. Historically, boron has also been found at high levels in the Dye Creek and Mill Creek areas south of Red Bluff. Water quality analysis of a well that was recently constructed in this area determined that the well water contained boron levels unsuitable for long term use on crops.

Ground water contamination has also occurred in the Smith River plains (Del Norte County) from use of Aldercarb and dichloropropane for agriculture and illegal dumping of pesticides. A Superfund site was created to deal with ground water contamination from pesticide dumping near the Smith River.

BIG VALLEY

Big Valley (Lassen and Modoc Counties) problems include flooding, inadequate drainage, agricultural irrigation and wildlife refuge supply shortages, and a depressed economy. The Bureau of Reclamation studied the Allen Camp project for many years as a possible solution to many of problems, but finally concluded that it was not economically justified. Local interests are now urging studies of two smaller projects - the Ostram Point project and raising Roberts Reservoir. The Department is beginning a study this year to reappraise the water supply, flooding, and drainage problems in Big Valley. The potential for multipurpose reservoir storage on the Pit River is being reconsidered. The study is to be completed by June 1992.

SACRAMENTO RIVER SEEPAGE AND EROSION

The importance of seepage and erosion along the Sacramento River was indicated by numerous letters and phone calls received by legislators, public officials and agencies; critical press coverage; and frequent complaints at public meetings. The state has previously been sued for over $30 million regarding seepage problems, although these suits were eventually dismissed.

The Department is conducting studies of these problems, with long range objectives of development and implementation of proposals to stabilize erosion and sediment deposition and to reduce or eliminate damage due to seepage along the Sacramento River. Any water storage projects north of the Delta could change the seepage flow regime and mitigation could be required. The short range goal is to evaluate erosion, deposition, and seepage sites to determine the relationship between river stages, erosion, deposition, seepage, and site characteristics. The last four years have provided an abundance of low flow data, but little high flow data. Most problems are related to higher flows.

WATER RIGHTS AND NEVADA

The limited surface water resources in arid northeastern California along the Nevada border have been extensively developed. In many instances, water rights have been adjudicated and watermaster service areas established. Recent development has been and future development will be dependent on limited ground water resources.

Recent growth and increased water demands in Reno and adjacent areas of Washoe County, Nevada, have led to a search for additional water. One alternative under consideration is to import ground water from basins along the California border in northern Washoe County. Where these ground water basins extend across the border, there is fear that ground water extractions in Nevada will include movement of ground water from California into Nevada.

As Honey Lake, Long Valley, and Surprise Valley ground water basins all have limited water supplies, local residents have opposed any large scale development that proposes exporting ground water from the Nevada portions of these basins. Ground water management districts have been formed in Long Valley and Honey Lake Valley. California and Nevada are jointly supporting a ground water study by the U.S. Geological Survey in Honey Lake Basin to determine potential impacts caused by increased extractions of ground water in the Nevada portion of Honey Lake Basin. In Surprise Valley, ground water use has resulted in lowering water levels. The formation of a ground water management district is also being considered in this basin.

SIERRA VALLEY GROUND WATER

Increasing summer water shortages in Sierra Valley and the concern that out of state interest would tap the water resources of the valley for export prompted Plumas and Sierra Counties to ask for protective legislation in 1980. SB1391, the Sierra Basin Ground Water Act, was passed that year. During an overdraft or when significant water quality problems occur, the Sierra Valley Ground Water Management District has the power to use a permit system for ground water management. The Department made an initial ground water study in 1980-83 and has subsequently prepared an annual update. Overdraft has started in the eastern half of the basin. The District has enacted an ordinance and is also considering ways to increase ground water recharge.

TRINITY RIVER FISHERIES

Since 1965, the Northern District has been involved in helping to solve the Trinity River fishery problems occurring since construction of the federal Trinity and Lewiston Dams. The Department was a major participant in constructing fishery restoration projects, planning the Buckhorn Mountain Sediment Control Dam, preparing the Trinity River Management Plan, and formulating federal legislation authorizing both the sediment control dam and the management program. The Department provided the chairman for the Trinity River Task Force Action Group for approximately 10 years. Presently, DWR is a member of the Task Force Technical Coordinating Committee (TCC) and is responsible for constructing sediment control pools on State property near the mouth of Grass Valley Creek. DWR is providing 7-1/2 percent of the funding for the 10 year management program which will total around $70 million. The Department will continue to play a major role in this program by funding a portion of the program, constructing restoration projects, and serving on the TCC.

KLAMATH RIVER FISHERY

The large Klamath River chinook salmon and steelhead trout fisheries have decreased in recent years due to water diversions, dam construction, timber harvest activities, and overfishing. Recent fishing closures and restoration work on the Trinity River have resulted in increases which can be augmented with additional restoration work on the Klamath River.

Starting in 1984, the Northern District helped prepare a Klamath River Fisheries resource plan patterned after the Trinity River Management Plan. The Klamath River Plan was authorized by Congress in 1986 and funded at a level of $21 million over 20 years. Funding is to be provided equally by the federal and State governments. The Klamath River Basin Fisheries Task Force was established by HR4712. Although the Department is not a designated member of this task force, Northern District staff do expect to participate in an advisory capacity on various restoration projects and may perform some planning and construction work. Initial funding for this program has been appropriated.

LAKE COUNTY WATER SUPPLY

Availability of inexpensive developable water supplies is diminishing due to growth in Lakeport and other areas around Clear Lake. The City of Lakeport previously relied on Scott Valley ground water supplies but has now turned to lake water which requires additional treatment. County officials are considering ground water management districts for the Scott Valley and Big Valley areas and have sought advice from the Department.

HUMBOLDT BAY WATER SUPPLIES

Humboldt Bay Municipal Water District is the largest water supplier in the North Coast area. In 1988, the district supplied an average 52 million gallons per day. The Humboldt Bay area includes Eureka, Arcata, McKinleyville, and the Louisiana Pacific and Simpson lumber mills. All of the District's yield from Ruth Reservoir on the Mad River is contracted for. Additional firm supply to meet future demands or allow for mitigation measures in periods of drought is not currently available. The District has been considering enlarging Ruth Reservoir for about 10 years. Currently, all users (particularly the lumber mills) are requested to conserve water during drought periods. The mill deliveries had to be cut back somewhat in 1977.

NORTH COAST WATER SUPPLIES

Although water supply problems are not common in the North Coast, they do occur in various areas, largely because of a limited economic base to support water development costs. The most acute problem is Siskiyou County is Hornbrook, where in 1977 most people had to either haul water or share well water with those who still had operable wells. Hayfork, in Trinity County, is served mainly from Ewing Reservoir and diversion from Big Creek. The local district has twice barely escaped shortages because of low reservoir levels. Future water supplies will eventually need to be developed, possibly by raising Ewing Dam or increasing diversion capacities. Trinidad, in Humboldt County, relies on Luffenhols Creek and did ration water in 1977. The community has had a moratorium on new hookups for several years because of inadequate supplies.

The City of Willits has had a problem with turbidity, taste, and odor in its Morris Reservoir supply and high arsenic, iron, and manganese levels in its well supply. The Department completed studies of these problems last year. Recommendations included watershed management and alternative treatment methods.

CVP WATER MARKETING

In December 1988, the Bureau released three draft Environmental Impact Statements for public review, analyzing the impacts of marketing additional Central Valley Project water in the Sacramento River Service Area, the American River Service Area, and the Delta Export Service Area. The Bureau anticipated marketing up to 1.5 million acre-feet of available but uncontracted yield from existing facilities of the CVP. The proposal sparked a furor of protests, mostly from environmental and fishery organizations concerned about impacts on fish and wildlife and resort owners concerned about low water levels in the major CVP reservoirs. Currently (March 1990), the draft EIS's have been withdrawn and the marketing program put on hold while the comments are considered.

SACRAMENTO RIVER FISHERIES

The salmon and steelhead fishery in the upper Sacramento River has been greatly depleted in the last few decades. Some groups attribute this decline to the construction of Shasta Dam, Keswick Dam, and the Red Bluff Diversion Dam. SB1086, enacted in 1986, called for preparation of a riparian habitat inventory and an upper Sacramento River Fisheries and Riparian Habitat Management Plan to be submitted to the legislature by January 1, 1989. The Wildlife Conservation Board prepared the Riparian Habitat Inventory, and an Advisory Council and an Action Team developed the management plan. Problems identified on the main stem include: limited spawning gravels, an outdated Coleman Hatchery, fish passage at the Red Bluff Diversion Dam, poor productivity from the Tehama-Colusa Fish Facility, habitat loss from Sacramento River bank protection, and fish losses at the Glenn-Colusa Irrigation District diversion. Problems were also identified on several tributaries including Clear, Cow, Battle, Cottonwood, Mill, Deer, and Butte Creeks. The final management plan proposed restoration actions, indicated priorities, and estimated costs, benefits, and potential funding sources. Federal legislation (HR3613 and S1857) to implement the plan has been introduced. The State has begun to pay for its 25 percent share of the costs by using Delta Fish Protection Funds to implement the Mill Creek and Sacramento River spawning gravel proposals described in the plan, and by budgeting for additional funds from the Environmental License Plate Fund.

NEED FOR NEW LOCAL WATER SUPPLIES

The State will need about 2 million acre-feet of additional supply by 2010. In addition, there is a current need for another 2 million acre-feet to correct ground water overdraft. The increase in demand for SWP supplies is anticipated to be met primarily by conservation with about 600,000 acre-feet being supplied by new projects. It is evident that areas of shortage will continue to exist within the State, and little reserve will be available for drought emergencies. Within Central district, many local agencies are anticipating shortages and several surface water projects are being explored to meet these shortages. The projects include:

Extension of the Tehama-Colusa and Folsom South Canals
Additional supplies for Marin County by sea water desalination
Construction of a multipurpose Auburn Dam
Devil's Nose Project in Amador County
Clavey River Project in Tuolumne County
Enlargement of Lyon's Reservoir in Tuolumne County
Elements of SOFAR Project for El Dorado County

WATER SUPPLY PROJECTIONS

Increasingly, the adequacy of the discussion in environmental documentation for potential water projects is critically evaluated on three basic issues: the environmental impacts, the availability of alternate water sources, and the clear demonstration of water need. Many agencies do not have the basic data and expertise to make projections of their water needs which will withstand the critical scrutiny of EPA and others. DWR could assist in making these projections, and might be perceived as being more neutral than a consultant hired by the local agency would be, but DWR has lacked adequate resources to preform this work.

SAFE DRINKING WATER ACT IMPACTS

The 1986 amendments to the SDWA generally impose stricter treatment and monitoring requirements on water purveyors. The amendments are in the process of being implemented via regulation by EPA and by the Department of Health Services. Small water purveyors in the foothills and other semirural areas are particularly adversely affected by the new requirements to their systems. Two results of implementation of the amendments are already being seen among the small systems in the Central District: water purveyors are switching from surface to ground water sources to avoid the stricter requirements placed on treatment of surface water, and small water systems are merging with other systems to broaden their capital base. The District could, in coordination with AWWA's small water systems program, assist these water purveyors in the identification of other sources of supply, and in identification of areas in which the water resources could most efficiently be managed by combining systems. The District could also assist small purveyors in other areas of SDWA compliance, such as the watershed protection surveys referenced by the Act.

UNCERTAINTY REGARDING EXISTING WATER RIGHTS

Such issues as the uncertainty of the outcome of the Bay-Delta hearings and application of the public trust doctrine to existing water rights have created a climate of uncertainty as to the security of existing water rights and available supplies, particularly in times of drought. There is an obligation to consider this uncertainty factor when determining whether or not EPA's current emphasis that a clear need for water must be demonstrated by new water supply projects. An example of the uncertainty of existing rights is the SWRCB's decision to reconsider most water rights on the American River, partly in response to EDF v. EBMUD.

AREA OR COUNTY OF ORIGIN WATER RIGHTS

In some areas and counties of origin, development is occurring which is now or soon will cause their water supply needs to exceed their available supplies. Downstream areas have already preempted the least costly reservoir sites, and a number of State and federal mandates have been imposed in recent years, including: wilderness designations, allotments for instream uses, and designations of wild and scenic rivers. Financial and other local agency constraints make it virtually impossible for these regions to develop supplies on their own, resulting in great frustration at the local government level and a growing sense of perceived injustice and ineffectiveness of the current laws governing area or county of origin water rights.

WASTE WATER RECLAMATION

Areas of water need are being pressured by the SWRCB and others to maximize waste water reclamation to extend available supplies. However, the Department of Health Services strictly regulates and frequently changes the rules for the use of reclaimed waste water. There is a need to resolve this conflict so that water managers can have a greater degree of certainty in evaluating the portion of their water needs which can be met using waste water.

LACK OF FINANCIAL RESOURCES FOR WATER RESOURCES PLANNING AND DEVELOPMENT

Rapid growth in much of California is taxing its infrastructure, including its water supply and waste disposal systems. In the developing Central Valley and mountain county regions, the revenue base to construct new facilities is largely insufficient. Local funding sources are limited and securing State or federal funds appears to be more and more difficult. Stricter standards for water treatment required by the Safe Drinking Water Act are requiring water purveyors to upgrade their water supply and treatment systems, imposing additional costs on already stressed local agencies.

GROUND WATER INFORMATION

In many areas, information about local ground water resources (safe yield, rate of recharge, source of recharge, and potential water quality problems) is not available. There is a corresponding tendency to discount the value of ground water as a source of supply, together with a reluctance on the part of local agencies to explore fully the potential conjunctive use of surface and ground water supplies. The lack of information about the resources also frustrates local officials who are considering following the increasing trend to form ground water management districts in order to impose some form of regulation on extractions from a basin. Central District is presently developing basic information on the ground water resources of the Truckee Basin as part of the California-Nevada program, but it is also expected that this information will be used in the legislative formation of a ground water management district among the three affected counties. Information about local hydrogeology is also needed to evaluate the potential for ground water recharge programs, to help make more efficient use of limited supplies.

GROUND WATER CONTAMINATION

Ground water contamination is increasingly becoming a concern in the development of new water supplies and the maintenance of existing supplies. This problem is exacerbated by the implementation of the 1986 amendments to the federal Safe Drinking Water Act, whose water treatment requirements have the result of encouraging small water systems to switch from surface supplies to ground water supplies. Ground water quality problems in the Central District can generally be divided into the following categories: nonpoint source pollution (e.g., nitrates and pesticides), local problems associated with septic tanks, intrusion of brackish or saline ground water due to overdrafting aquifers, and toxics associated with industrial uses.

San Joaquin County is one example of an area where ground water quality has been affected by a variety of sources. The County has one of the highest concentrations of State and federal Superfund and prospective Superfund sites in the Central Valley, including the site of a former pesticide formulator of DBCP where a long term pump and treat ground water remediation project is underway. Another major pump and treat operation for contaminated ground water is being conducted at Sharpe Army Depot. Part of the County is also affected by a regional ground water contamination problem associated with agricultural soil fumigants including DBCP. Overpumping is some aquifers has caused the intrusion of brackish ground water into aquifers used for domestic supply, and intrusion of saline ground water is a problem in the western portion of the County. Another example of an area affected by large scale contamination problems is the greater San Jose area, where the extensive semiconductor manufacturing industry has resulted in another high concentration of Superfund sites. This region has also suffered the saline ground water intrusion problems associated with overdrafting some aquifers.

Many of the foothill and mountain counties are now beginning to be concerned about radionuclide contamination of ground water, particularly radon in wells located in the granodiorite formations of the Sierras. EPA is presently engaged in the regulatory process of setting MCLs for these naturally occurring contaminants

MOUNTAIN COUNTIES GROUND WATER

With many people relocating to rural foothill and mountain regions, there is increasing concern about the availability of ground water in hard rock areas and the potential for contaminating these supplies with discharges from the growing number of septic systems. In many mountain counties, homes are built away from regional sewer systems and municipal water supplies, and are being constructed on smaller and smaller parcels of land. Most of these homes rely on a single well for their potable water supply and a septic system to dispose of their sewage. If this trend continues, there is a real potential for overdrafting the local ground water supply, especially during dry periods.

In many areas where this development is occurring, there is no readily available alternate water supply should the ground water become depleted or contaminated. There is also an increased potential for ground water pollution from the additional septic systems. There has been little attention given in the past to the availability of ground water and the proper spacing of septic systems in hard rock regions (each Regional Water Quality Control Board normally develops its own criteria for permitting septic systems). Moreover, there is no systematic monitoring program in each county to evaluate long term trends in ground water levels or quality.

SOUTHWEST SACRAMENTO VALLEY GROUND WATER SUPPLIES

Much of the water supply for the southwestern Sacramento Valley is provided by ground water. Pumping to provide this supply has resulted in a dramatic decline of ground water from historical levels throughout much of Sacramento County and western Placer County. Although the rate of decline has diminished over the past few years, the water level trend is still generally down. The depressed ground water levels are resulting in increased seepage from the Sacramento, American, and Cosumnes Rivers, and is providing a favorable gradient for the migration of poorer quality ground water from the western margin of Sacramento County and the Sacramento-San Joaquin Delta. As more development occurs in Sacramento County and the southwestern portion of Placer County, ground water levels are expected to further decline unless supplies are augmented with surface water.

CALIFORNIA-NEVADA WATER MANAGEMENT

There continues to be an ongoing effort to equitably allocate interstate surface and ground water resources along the state line. If enacted, S1554 will make such an allocation of surface and ground water in the Tahoe and Truckee Basins, and of surface water in the Carson Basin. Activities associated with the implementation of this bill include studies of conjunctive use of surface and ground water in the Carson Basin, and negotiation of a major agreement to reoperate the Truckee River. The Truckee River Operations Agreement would also include a separate mitigation agreement among the parties and preparation of a joint State-federal EIR/EIS. If the bill is not enacted, a policy decision would have to be made on the choice

between attempting to negotiate another legislative settlement or to resume the existing litigation and additionally to bring an apportionment suit in the U.S. Supreme Court.

The Walker River Basin has been excluded from the S1554 negotiations at the request of the affected parties; however, the operation of the River is governed by an interstate decree and issues have been raised over the ultimate allocation of the resource. It is anticipated that another piece of congressional settlement legislation will be negotiated for the Walker Basin if S1554 is enacted. No decision has yet been made on the allocation of the Basin's interstate ground water resources, nor is there any significant information available on the extent of the resources. An investigation of hydrogeology of the basin has been scheduled to begin after the Truckee Basin ground water study has been completed.

The remaining interstate issue with Nevada centers on the applications filed by the Las Vegas Valley Water District for unappropriated ground water in a number of northern Nevada basins. Local agencies in California (e.g., Mono County) are concerned that the proposed extractions from the Nevada basins may adversely affect the availability of ground water in California. There is presently little information to be had on the hydrogeology of the area.

Other work in the Cal-Nevada program will arise as part of the negotiated settlements with Nevada and federal interests. If S1554 is enacted, State legislation will be necessary to implement several provisions of the bill, and it is expected that a local ground water management district will also be formed. The District expects to work with local agencies in the area to develop the legislation and assist in formation of the ground water management district, and also to work with the SWRCB in developing the water rights administration and reporting procedures that will be required by the bill.

WATER TRANSFER ISSUES

Water transfers are increasingly being explored as tools to improve the efficiency of water management for a variety of beneficial uses including municipal, agriculture, and fish and wildlife. Typically, however, local agencies in the area from which the water would be transferred often oppose the transfer on the basis of environmental or third party impacts. The Department has a role to play both in facilitating transfers as directed by recent legislation, and in evaluating potential impacts to the economy and environment of the area of origin and potential injury to existing water rights. One aspect of the department's role in this activity could be to prepare an analysis of the available interconnections between the larger water purveyors' and wholesalers' systems, under emergency as well as routine conditions.

CONSERVATION V. PROTECTION OF WETLANDS AND WILDLIFE

In many areas, particularly in the foothill regions, surface water distribution systems utilize old mining ditches and water systems. These systems are often inefficient and have high loss rates. Attempts to conserve the available water by reducing the losses are sometimes thwarted because the leakage supports wildlife and wetlands. Water conservation is thus often on a collision course with preservation of habitat. This issue is further complicated by the recent federal goal of no net loss of wetlands, and methods to address mitigation need to be developed.

FLOOD CONTROL SUBVENTIONS

During the 1990 budget process, the Legislature failed to include local assistance monies for the State's Flood Control Program. The deletion of funds will require funding of these items by a bond issue on the November ballot The failure by the legislature to include flood funds means that the Department cannot make payments on claims submitted by the local agencies between July 1, 1990 and the effective date of the ballot measure in November. The Department normally reimburses local agencies 90 percent of the amount approved in engineering reports within a few weeks of receipt of claims. The remaining 10 percent of the amount due is payable upon our receipt of an audit report by the State Controller's Office. The normal backlog of the Controller's work load in the last few years has resulted in approximately 80

claims with an outstanding value of about $1.3 million to the local agencies (Central District only). Delays in returning monies to the local agencies has resulted in serious financial strain. Agencies are already securing high interest rate loans in advance to fund projects with the presumption that repayment would occur as soon as State funds become available. They are also investigating the possibility of funding Controller's Office personnel in order to have audits performed quicker. Local Districts may also participate in federal construction costs beyond their normal requirements in order to assist the government in constructing projects faster so that repayment periods are shortened.

DELTA LEVEE SUBVENTIONS

The Delta Levee Subventions Program provides financial assistance to reclamation districts for the maintenance and rehabilitation of local (i.e., privately owned) levees in the Delta. Since the passage of "The Delta Flood Protection Act of 1988" (SB34) in March 1988, the Subventions Program has been in the state of transition to incorporate the provisions of SB34 into this ongoing program. These provisions include:

- Increase in funding from $2 million to $6 million
- Increase in State reimbursement ratio from 50 percent to 75 percent
- Provision for advances
- Provision for reimbursement of disaster related work denied by FEMA
- Provision for acquisition of easements
- Specific review authority by DFG to ensure no net long term loss of fisheries, riparian, or wildlife habitat
- Competitive bidding and increased documentation requirements resulting from the passage of SB1893 in September 1988

In December 1988, Preliminary Procedures for administration of the program under SB34 were approved by the Reclamation Board. Since then, six addenda have been adopted specifically for administering the provisions regarding reclamation district work contracts, on-island borrow material, acquisition of easements, carrying over of claims reimbursed at less than the full 75 percent ratio, and general eligibility of maintenance work items.

SB34 requires no net long term loss of riparian, fisheries, and wildlife habitat. DWR is working with DFG to develop a methodology for determining impacts associated with the maintenance and rehabilitation of levees. In addition a mitigation plan is being formulated.

DESALINATION

Desalination is increasingly being investigated as a supplement to water supplies in areas which must import water. There are two reasons for this. First, desalination technology has improved dramatically in the last ten years in performance and, therefore, cost of water. The rise in number of reverse osmosis desalting plants is particularly dramatic. It has become a dependable technology. Second, the cost of developing and transporting new water supplies is rising, making desalination economically justifiable is certain circumstances in California.

Desalination of ground water of impaired quality is increasingly being done in Southern California. The Arlington (in operation) and Irvine (in planning and design stage) desalters are prime examples. The use of desalination as part of waste water reclamation, such as at Water Factory 21, will increase. Orange County Water District is planning to increase the plant's current 5 mgd desalting capacity to 10 mgd. Brackish water desalting increasingly competitive in cost with importing water into Southern California. This is the lowest cost desalting and will likely increase in use over the next twenty years.

Seawater desalting will be more limited in the near future due to its higher cost than brackish water desalting. Seawater desalting will occur only where there are no other alternatives. Santa Barbara, Santa Catalina Island, San Simeon State Historical Monument (Hearst Castle), and Marin County are actively pursuing seawater desalting. In the case of Santa Catalina Island, a seawater desalting unit will become part of their permanent water supply system. In the case of Santa Barbara and San Simeon, seawater desalting facilities will provide water as needed to meet drought conditions. Marin County is investigating a similar option. Population growth in Santa Barbara and Marin County are likely to make such systems part of their base supply in the distant future.

MWD is investigating retrofitting existing thermal power plants with thermal seawater desalting systems. This kind of desalting plant draws excess heat from thermal power plants and will provide fresh water at a much lower cost than conventional seawater desalting plants. Presently, thermal power plants on the coast are operated principally as peaking plants. Should power demands increase, which they will, they will increasingly be used for base load, thereby making excess heat available for seawater desalting.

GROUND WATER QUALITY MONITORING PROGRAM

The objective of the program is to access existing ground water quality conditions in the San Joaquin and Central Coast areas within the San Joaquin District. This assessment focuses primarily on organic and inorganic chemicals occurring in unconfined and shallow producing aquifers. The study has a total resource evaluation approach and does not focus on point source of contamination since evaluations of that type are conducted under the direction of regulatory or local agencies. The results of this study are useful in providing a more thorough understanding of current ground water quality conditions and the human and natural factors affecting those conditions.

The tasks completed to date include the establishment of a well monitoring network, the determination of what chemical constituents should be analyzed, the development of a quality assurance/quality control program for collection and handling of samples, and the completion of one round of sampling throughout the study areas. An evaluation findings report is near completion and is expected to be published by the end of 1990.

The results of the first round of sampling which included analyses for 20 inorganic chemicals and about 110 organic chemicals showed nitrate to be by far the chemical most frequently detected. In the San Joaquin Valley, an average of about 21 percent of the 115 wells sampled showed nitrate levels above primary safe drinking water (SDW) limits. In the coastal areas it was about 44 percent of the 27 wells sampled. Other inorganic chemicals were detected that exceeded primary SDW limits, but far less frequently. They include selenium, arsenic, and chromium in the San Joaquin Valley and none in the coastal areas. Organic chemicals that showed some level of

detection include dibromochloropropane (DBCP) (13 wells), simazine (2 wells), monuron (1 well), toluene (1 well), 2-4-dichlorophenol (1 wells), and 2-chlorophenol (1 well) in the San Joaquin Valley and tetrachloroethylene (TCE) (1 well) in the coastal areas.

The occurrence of high levels of nitrate in ground water has been identified as a major ground water quality concern for some time. One area in the San Joaquin Valley where these levels are particularly high is the City of Delano. In 1967, the San Joaquin District conducted a ground water study for nitrate and other inorganics and reported the findings in Bulletin 143-6, "Delano Nitrate Investigation," dated August 1968. High nitrates were found, thereby mandating the City of Delano to deepen and modify its supply of wells in order to meet SDW standards. In 1987, the San Joaquin District initiated a study to reexamine the levels of nitrate found by the previous study. These findings were published in the memorandum report, "Delano Nitrate Investigation", dated 1988. The followup study showed that the nitrate levels have increased and the area of concern has become larger. The study identified the long term and expanded agricultural practices in the area as the principal contributor of nitrate found in the ground water.

Two areas in the coastal region where nitrate has been identified as a major concern are the Salinas Valley and Watsonville. The Department and cooperating agencies conducted a nitrate in ground water investigation during 197[illegible] which identified nitrate problem areas. Local agencies have since done extensive ground water quality investigative work for the purpose of locating aquifers still suitable for public water supplies. The District is currently corresponding with the Bureau, Monterey County Flood Control and Water Conservation District, and the Salinas Valley Water Advisory Commission regarding the possibility of a joint pilot project for the demonstration of a new treatment method developed by the Bureau for reducing nitrate in ground water.

RADIOACTIVITY IN GROUND WATER IN THE SIERRA NEVADA

Natural uranium is found naturally in granitic rocks, and this element as well as radium and radon have been detected in high concentrations in several wells in the foothills and mountains of the Sierra Nevada in recent years. In a 1990 water quality study of 49 privately owned wells in the mountains and foothills of the San Joaquin District, the Department found two wells containing water with uranium concentrations above the State maximum contaminant level (MCL) of 20 picocuries per liter. Ten other wells contained water with concentrations of gross alpha (a screening mechanism for alpha particle activity) above the drinking water standard. These findings along with the growing concern over the environmental effects of radon gas in homes and offices - effects that may be attributable to the presence of radon in ground water - merit further investigation of the occurrence of radioactivity in ground waters of the State. Since the alluvial aquifers of the San Joaquin Valley are comprised of sediments from the Sierra Nevada, wells in these aquifers should be included in such studies.

GROUND WATER CONTAMINATION IN THE VICINITY OF OLIVE BRINE DISPOSAL PONDS

In the San Joaquin Valley, the use of surface impoundments for the disposal of olive brine waste water is common practice. The processing of olives entails the use of large quantities of highly mineralized brine and lye solutions. Past practices of discharging olive brine waste water to unlined ponds have resulted in ground water contamination at sites in Madera and Tulare Counties.

The Department should provide technical assistance to the Regional Water Quality Control Boards in their effort to evaluate the impact to ground water from these discharges and provide the Boards with information that may assist in formulating waste discharge requirements for these industries.

SAN JOAQUIN RIVER SYSTEM FISHERIES

Salmon fisheries in the San Joaquin River system have declined rapidly since the construction of Friant Dam and other dams on the system. In addition to loss of salmon populations due to dams, outmigrating salmon are lost at State and federal water project pumping facilities in the Delta. Large runs in the early 1940's in the main stem San Joaquin River near Fresno were predominately spring run fish.

Today, San Joaquin River tributaries support only fall run chinook salmon. Chinook salmon population in the San Joaquin system historically averaged 150,000 adult salmon; by the 1970s populations were less than 11,000. Efforts are being undertaken to increase salmon production in the San Joaquin River system by improving flows, nursery habitat, and spawning gravel. DFG and DWR entered into the Two-Agency Fish Agreement in December 1986. Under this agreement, DWR is designing, funding, and constructing habitat restoration projects and is constructing or improving hatcheries. Spawning gravel restoration projects have been completed on the Tuolumne and the Merced Rivers. Other restoration and hatchery projects on the San Joaquin River system are in various stages of development from preliminary design to bidding.

SAN JOAQUIN RIVER MANAGEMENT PROGRAM

Existing conditions on the San Joaquin River system are less than satisfactory for many uses of the system, including water supply, water quality, flood protection, fisheries, wildlife habitat, and recreation. Continuation of the status quo will mean further deterioration in the river system, adversely impacting all users. The objective of the San Joaquin River Management Program (SJRMP), formally established by AB3603, is to develop compatible solutions to problems on the San Joaquin River system. The SJRMP advisory council is in the process of identifying actions which can be taken to benefit legitimate uses of the system. The council is made up of representatives from local, federal, and State agencies, irrigation districts, cities, counties, and other water user interests within the study area. A SJRMP action team serves as a working group to develop proposed elements. The area of study is the San Joaquin River from Friant Dam downstream through the South Delta Water Agency including the North Fork Kings River from James Reclamation District to Mendota Dam and all other tributaries of the San Joaquin River up to the first major dam.

EVAPORATION POND ISSUES

In the southern San Joaquin Valley, evaporation ponds are used extensively to dispose of agricultural drain water. Many aspects of evaporation ponds and pond management still need to be addressed. Some pond complexes are known to have extremely high levels of selenium, arsenic, uranium, molybdenum, and/or other trace elements. Selenium induced embryonic deformities such as those found at Kesterson Reservoir nave been documented at a few pond complexes. This conflicts with the Federal Migratory Bird Treaty Act and may force closure of these ponds. The DFG has required hazing programs at the pond complexes where high selenium levels are known, but use by migratory birds is still apparent. Studies supported by the DWR have suggested possible design and management options that could reduce impacts to wildlife are extremely expensive or untested and, as such, cannot be recommended to pond operators. The impacts of other trace elements found at high levels at the ponds are not well understood and could be as serious as selenium in some of the complexes.

A complicating feature of the evaporation ponds is that they do provide some benefits to the same group of birds that they adversely affect. The ponds provide a type of habitat that has been greatly reduced in the southern San Joaquin Valley. If the evaporation ponds are closed, this habitat would no longer be available and any beneficial impacts associated with the ponds would be eliminated. It has also been shown by the U.S. Fish and Wildlife Service that preirrigation, a major source of drain water to ponds, is quite beneficial to some of the same species of birds that are adversely impacted by the ponds.

AGROFORESTRY

Agroforestry is playing an increasingly important role in helping to minimize drainage water disposal problems. Highly recommended by the San Joaquin Valley Drainage Program (SJVDP) as a potential solution to some of the drainage problems, agroforestry encompasses the use of halophytic trees and shrubs to concentrate and reduce the volume of drainage water necessary for ultimate disposal in a much smaller evaporation pond.

Currently, there are several sites in the San Joaquin Valley where eucalyptus trees and atriplex (a native, salt tolerant shrub) have been planted and irrigated with drainage waters. The water coming from the atriplex is highly concentrated, and the low volume of water remaining can be can be stored in an evaporation pond or possibly used in a solar pond to generate electricity.

The Department has recently entered into a cooperative agreement with Tulare Lake Drainage District for a test program to determine if an agroforestry system can be used to reduce drainage water and thereby reduce the volume currently going to evaporation ponds. DWR is very interested in obtaining information on both the water and salt balance of the system as well as developing design criteria for a state-of-the-art evaporation pond. As a result of the SJVDP recommendations, the likelihood of additional agroforestry sites is great. The Department is expected to play a major role in implementation, research, and monitoring of these systems throughout the San Joaquin Valley.

SAN JOAQUIN VALLEY DRAINAGE PROBLEMS

The San Joaquin Valley is bounded on its west side by the Coast Range, which was formed by uplifting of the sea floor. The parent material of the Coast Range, marine sediments, contains high concentrations of salts and trace elements. Alluvial deposits from this range, which cover the western portion of the San Joaquin Valley, also carry these high concentrations of salts and trace elements.

Agricultural development of the San Joaquin Valley has been highly dependent on the acquisition of water for irrigation. Early irrigation development was limited to redirecting water already available in the San Joaquin and Kings Rivers. Later, with the development of more efficient pumps which could lift water from hundreds of feet below ground, overdraft of ground water and subsidence occurred in some areas. To counter the falling water tables and maintain viable farming operations in the area, the CVP and SWP imported water into the Valley, but again problems with high water tables in many parts of the Valley developed. This shallow ground water is heavily laden with salts and trace elements and greatly reduces or eliminates crop production. In the last few decades, farmers have installed underground drains in the problem areas to lower the water table below the root zone of their crops. In the San Luis Unit of the CVP, drain water was collected into the San Luis Drain and transported to Kesterson Reservoir. Some drain water was transported to local duck clubs and wildlife areas to supplement their water supplies used to produce wetland habitat. In the Tulare Basin, which is a hydrogeologically closed system, evaporation ponds were constructed to dispose of drain water.

In 1983, the discovery of selenium induced deformities and deaths of aquatic birds at Kesterson compounded the problems of drainage disposal in the San Joaquin Valley. Kesterson closed, other wildlife areas and duck clubs curtailed much of their use of drain water, and evaporation basins came under close scrutiny. Many federal and State agencies are studying the problem, but few answers are being found. The interagency San Joaquin Valley Drainage Program that ended in September 1990 offered interim management options to deal with the drainage problems, but implementation of these recommendations is very complex and problematic. Drainage treatment, though promising for the future, is still impractical at present. The California Regional Water Quality Control Boards may not be able to permit drainage discharge into evaporation ponds if the associated problems with wildlife are not eliminated. The final option, land retirement, may cause severe economic problems for many parts of the San Joaquin Valley.

WILDLIFE REFUGE WATER SUPPLIES

Wetlands in the San Joaquin Valley are an integral part of the Pacific Flyway and are used extensively for migratory birds and resident wildlife. Probably the most critical problem facing the wetland issues is development of dependable water supplies for the wildlife refuges in the San Joaquin Valley (and Central Valley).

In the San Joaquin Valley, five national wildlife refuges, three State wildlife management areas, and one locally managed wetland area collectively have needs of over 526,000 acre-feet of water. Currently, only a firm water supply of 121,713 acre-feet is available to these nine wetland areas. The Department is among several State, federal, and local agencies that are currently planning for the development of adequate water supplies for these areas throughout the Central Valley (as well as San Joaquin Valley). The District has been and will continue to be involved in these planning efforts and will assist the local agencies with implementation and monitoring activities associated with the water deliveries.

POPULATION GROWTH VERSUS DEMAND

As growth and development continue in the State, so do water use and the need for additional water supplies. Growth and population are expected to rapidly escalate in the San Joaquin Valley due to relatively low living costs and close proximity to larger metropolitan areas.

In many areas in the San Joaquin Valley, the foothill and mountain areas of the Sierra Nevada, and in coastal areas, the ground water table is declining - slowly in some areas and rapidly in others. The fourth and possibly fifth consecutive year of the drought has contributed to this decline due to increased pumping, inadequate precipitation, and insufficient surface water supplies. As growth and development continue, the ground water table is expected to further decline, unless alternative water supplies are developed.

Many areas in the District will be impacted due to rapid growth and development. Suggested investigations and projects include:

- Additional M&I supplies to Los Banos and surrounding areas from the California Aqueduct
- Construction of a pipeline from the Merced River to Mariposa
- Water banking at Raisin City
- Desalination of seawater for the Monterey peninsula
- Waste water reclamation for the Monterey peninsula area
- Enlargement of Pine Flat Reservoir

MARIPOSA COUNTY WATER SUPPLY/DEVELOPMENT

Many foothill and mountain communities in the Sierra Nevada do not have ready access to either a dependable ground water supply or surface water supply. These communities develop severe water supply shortages during critical water years and must rely more and more upon water rationing, conservation, and trucking water to the communities. These measure are adequate for the present, but with the continued rapid growth and development of mountain communities, alternative water supplies must be developed.

These communities have a high percentage of retired individuals, and employment is virtually nonexistent. The median income is very low.

Many of these communities are financially incapable of developing new water supplies.

The community of Mariposa has undergone rapid growth and development and has outgrown its water supply. Presently, Mariposa relies on individual wells with a limited ground water supply and a small surface water reservoir. Mariposa is currently investigating the potential of piping surface water from the Merced River to the community, but the costs may be prohibitive.

The District is presently sampling the water quality in the Merced River for Mariposa and will be proposing an investigation of land use, ground water, and surface water in Mariposa County.

GROUND WATER OVERDRAFT

Ground water overdraft in the San Joaquin Valley was estimated at 1.3 million acre-feet at 1985 levels for Bulletin 160-87. This represented a continuation of overdraft conditions in the San Joaquin Valley since at least the 1920s. The overdraft can be expected to cause large declines in ground water levels in the Valley, resulting in increased pumping costs, land subsidence, and degradation of ground water quality. Because overdraft creates many problems, the quantity of overdraft represents an amount that either must be replaced with other, renewable water supplies or eliminated through reductions in water usage.

Until the onset of the current drought, water levels in the San Joaquin Valley had not dropped significantly in some parts of the Valley since the late 1960s. This lapse in steep water level declines occurred in a period of great change in water supply and use. First, large-scale increases in surface water supplies from the California Aqueduct began in the late 1960s Second, agricultural usage in the Valley expanded considerably during the 1970s and early 1980s, before contracting somewhat in the late 1980s. Finally, local and imported water supply conditions were fortuitously far wetter than average. This last factor, a temporary water supply abundance, is the primary reason for the moderation in water level declines between 1967 and 1986. The deliveries and water use changes - are both factored into the computation of overdraft and to a great extent cancelled each other out. Overdraft, although large in absolute numbers, amounts to about 10 percent of total water supply in the San Joaquin Valley, and its effects are modified significantly by relatively small, temporary increases in the Valley's water supply.

Since 1986, ground water levels have fallen throughout most of the San Joaquin Valley.

WATER BANKING

To supplement the State's firm water supply, ground water banking in various locations is being investigated. Water banking is a new twist on an old concept - ground water conjunctive use. The basic goal of water banking and conjunctive use is to recharge surplus surface water in wet years. Water banked in wet years is then available for use in later dry years. This type of conjunctive use has been practiced in the San Joaquin Valley for decades by local water districts to maximize their use of available surface water supplies. The difference between conjunctive use and water banking is that water banking is a more formal operation with the potential for supplying water users outside of the ground water basin.

The Department is currently working with Kern County Water Agency to develop a large scale water banking program in Kern County - the Kern Water Bank. This project includes several elements, which are distinct components of the water bank. The Kern Fan Element, which is scheduled for first stage implementation in 1992, includes direct recharge and extraction on 20,000 acres purchased by the Department in 1988. Other proposed elements of the Kern Water Bank use a combination of direct and in-lieu recharge to store water in the service areas of several Kern County water districts. These other elements include either direct extraction of banked water through ground water pumpage or indirect extraction through State Water Project entitlement reductions. The other Kern Water Bank elements are being developed in coordination with the individual water districts.

Other water agencies are also pursuing development of water banking programs. The Metropolitan Water District of Southern California is developing a ground water banking program in Kern County in coordination with Arvin-Edison Water Storage District. Westlands Water District has expressed interest in a ground water banking program in western Madera County to store surplus floodwaters in wet years. Ultimately, the greatest potential for water banking may lie in the Mid-Valley service area in the central San Joaquin Valley, which has the advantage of large amounts of available storage capacity and high quality recharge areas.

SAN LUIS REY INDIANS WATER SETTLEMENT

On November 17, 1988, the U.S. Congress enacted the San Luis Rey Settlement Act aimed at resolving the long-standing conflict between the City of Escondido and the Vista Irrigation District, on the one hand, and the five Mission Indian bands, on the other, over water rights in the San Luis Rey River Valley.

The roots of this conflict date back to before the turn of the century. While the Indian reservations in the San Luis Rey River Valley were being established, Escondido's predecessor was appropriating water rights under State law and building a 13-mile canal, known as the Escondido Canal, across portions of four of the Indian reservations to Lake Wohlford. Thirty years later, Vista's predecessor purchased the Warner Ranch and built a dam and reservoir at its eastern boundary. After that, these two entities combined their resources and, since 1922, have controlled about 30 percent of the water in the San Luis Rey watershed. To protect their water rights, they obtained federal licenses and permits and entered into contracts with the Secretary of the Interior, who acted on behalf of the Indians. However, the Indians have filed suit to have these agreements nullified and to seek adjudication of the water rights they claimed under the Winters doctrine. Under that doctrine, so named after the 1908 ruling of the U.S. Supreme Court in Winters vs. United States, Indian reservations have a right to all the water that they needed as of the time they were created, regardless of when or whether the water was first put to use.

When implemented, the Settlement Act, which constitutes Title I of the law authorizing lining of the All-American Canal, will make available up to 16,000 acre-feet of water per year to the Indian bands. Under the Act, such a supply could be developed from (1) public lands within the State of California outside the service area of the Central Valley Project, (2) conserved by lining the All-American Canal or Coachella Branch, or (3) made available through contract with Metropolitan Water District of Southern California. Water will be wheeled to the Indian bands through the facilities of Metropolitan, San Diego County Water Authority, and SDCWA's member agencies.

Metropolitan has transmitted a draft contract for the sale of up to 16,000 acre-feet of water per year to representatives of the Indian bands for their consideration. The water would be sold to the United States at a negotiated rate for use by the San Luis Rey Indian Water Authority or the City of Escondido and Vista Irrigation District in accordance with a settlement agreement that is being negotiated. Sales would not commence until water is available to Metropolitan from lining the All-American Canal.

Last November, the Secretary of the Interior submitted to the interested Congressional Committees, his recommendations for arranging for supplemental water. Among the sources considered are:.

(1) the Lower Colorado Water Supply Project, which involves the pumping of ground water for users of Colorado River water who have insufficient present perfected rights;

(2) an East Mesa ground water recharge and recovery program in Imperial County; and

(3) purchase of ground water rights on the West Mesa of Imperial County or lease of agricultural land in the Palo Verde Valley

With respect to the use of water from the Lower Colorado Water Supply Project, the City of Needles has expressed willingness to permit utilization temporarily of a portion of the capacity for which it will contract. Under such an arrangement, the City would determine the amount of water and the time period over which it would be made available.

Further study would be necessary to determine the feasibility of a recharge and ground water recovery program on the East Mesa of Imperial County.

A person holding land on the West Mesa has expressed interest in selling 2,000 acres of his holdings to the State Department of Parks and Recreation, and the associated ground water rights to the settlement parties. About one-fourth of this land is currently being irrigated. To make available the water not used on this land, it would be necessary to gain the approval of the Palo Verde Irrigation District and other California contractors for Colorado River water.

In return for furnishing funds needed to develop these projects, Metropolitan has proposed that it be allowed to store the water developed and, through a reduction in its diversions, bank its own Colorado River water supplies in Lake Mead. Because of the Federal Government's interest in facilitating this settlement, Metropolitan hopes that the development of contractual arrangements to permit the water banking can be expedited.

UNTREATED SEWAGE FROM MEXICO

Tijuana's excess sewage has been a problem that has plagued the City of San Diego and its beautiful South Bay beaches since the 1930s. During frequent failures of Tijuana's inadequate, antiquated sewage treatment system, millions of gallons of raw sewage have been carried across the border through the Tijuana River to its estuary in San Diego County and onto South Bay beaches via ocean currents.

San Diego's first attempt to handle this nuisance was in 1965, when the city agreed to treat Tijuana's waste on an emergency basis. Recognizing this to be a temporary solution, President Reagan and Mexican President Miguel de la Madrid came to a decision in 1983, the outgrowth of which was Mexico's agreement to modernize and expand Tijuana's sewage and water supply system and to build a 34 mgd sewage treatment plant. Mexico received a $46.4 million grant from the Inter-American Development Bank to help finance the expansion and was to spend an additional $11 million to build the waste water treatment plant to be situated 5 miles south of the International Border. The plant, consisting of six aerated lagoons, would provide primary treatment of the sewage and be built in two phases of 17 mgd capacity each. The resulting facility was intended to stop the chronic 13 mgd discharges toward the San Diego Point Loma Sewage Treatment Plant and periodic uncontrolled discharges from Tijuana's dilapidated sewers.

In looking to deal with future growth, especially the tremendous expansion occurring within the eastern sections of Tijuana, the Mexican government also proposed to build a 40 mgd upstream secondary treatment plant (the Rio Alamar Plant), below the Rodriguez Dam in Tijuana. Proposal of this second plant was not viewed favorably by U.S. officials. The treatment level as planned would be inadequate in comparison with United States standards, creating substandard water quality in the Tijuana River and eventually San Diego's coast.

While implementing Phase I of the above plan, Mexico ran into a series of problems, which resulted in a reevaluation and relocation of the project.

Phase I of the 34 mgd waste treatment facility was completed in January of 1987. The plant became fully operational in September of that year, only to break down a month later. In May of 1988, the facility was again operational. This was only the first of a series of serious breakdowns.

In 1989, coincidental with the above problems, San Diego was forced to cancel its contract with the International Boundary and Water Commission to treat Tijuana's emergency waste flows. San Diego's 190 mgd Point Loma Facility, which handles sewage treatment for San Diego and 15 neighboring communities, simply ran out of capacity to treat Mexico's emergency flows.

These problems, in conjunction with continual insistence of the United States officials that the level of primary treatment proposed by Mexico was substandard, proved an effectual leverage in bringing the Inter-American Development Bank to agree to relocate a future facility to a place at the border between the two countries, within the United States' boundary, and to upgrade the proposed degree of waste treatment from primary to secondary level.

The future facility will be built in lieu of Phase II of the 34 mgd facility and the Rio Alamar Plant. It will be funded jointly by the Mexican and US governments. A cost of $192 million is estimated for the first phase of the new facility, which will include a plant capacity of 25 mgd plus an ocean outfall. Additional phases will be added as needed, with an ultimate capacity of 100 mgd. The outfall will also be built within US borders. The effluent will be discharged just north of the Mexican border and will meet US standards.

SAN BERNARDINO GROUND WATER

Although, as late as the 1940s, the lowest portion of the Bunker Hill Basin in the San Bernardino Valley was composed mainly of springs and marshlands, it now boasts a thriving urban complex and industrial center. Yet studies show that currently the ground water levels remain high.

In the 1870s, test drilling revealed that the aquifer underlying the basin was under artesian pressure and that, in some places, wellhead pressure was sufficient to pressurize a household water distribution system. In several areas, shallow wells of 50 to 100 feet in depth yielded flowing water. However, by the mid 1950s, extractions exceeded the natural recharge and ground water levels began to decrease. Water levels dropped more than 100 feet in the lower portion of the basin.

In 1954, the San Bernardino Valley Municipal Water District (SBVMWD) was established under the Municipal Water District Act of 1911 to plan for a long-range water supply for the approximately 325 square miles within its boundaries. With several extremely wet years, additional artificial recharge of native water by the San Bernardino Valley Water Conservation District, and importation of State Water Project water by SBVMWD, ground water levels in the basin reversed their downward trend and began recovering in the early 1970s. The resulting rise in the ground water levels has created several problems in the Bunker Hill Pressure Subarea, including a potential for soil liquefaction caused by seismic shaking.

A judgment rendered in 1969 to a suit filed by the Western Municipal Water District of Riverside County against the East San Bernardino County Water District in the Superior Court of Riverside County limits the amount of water that can be produced and/or exported from the San Bernardino Basin area. In addition, the judgment requires SBVMWD to incur replenishment obligations of imported water when the San Bernardino Basin area production by non-plaintiffs exceeds a stipulated amount.

Water agencies have identified possible solutions to alleviate the high ground water problem by diverting inflow to the basin, additional pumping and/or export from the basin, or using some combination of the two. However, many water agencies have an interest in the basin, and there is no single basin management plan in effect.

However, construction of a pipeline and wells that would deliver water from the Bunker Hill Pressure area to the Colton-Rialto basin has been completed by SBVMWD. This pipeline, called the Baseline Feeder, will transfer approximately 10,000 acre-feet per year from the San Bernardino Basin area to the Colton-Rialto area. Pumping and export will begin shortly.

VENTURA COUNTY GROUND WATER

Ground water has been the principal water supply for irrigation and urban uses over much of the Oxnard Plain in Ventura County. As a result of increasing water demand in the Oxnard Plain, the ground water aquifers underlying the plain have been overdrafted. The overdraft within the United Water Conservation District (UWCD) averaged 18,900 acre-feet per year during 1976-85. The estimated annual overdraft in UWCD for 1985-86 and 1986-87 was 25,000 acre-feet and 30,000 acre-feet, respectively. The continuing overdraft of the basin has resulted in the loss of ground water storage to intruding sea water and the loss of fresh water by an increase in salinity.

As a result of pressure from the State Water Resources Control Board, the County of Ventura and United have developed a water management plan to alleviate the problem. The plan calls for increased diversion of surface water from the Santa Clara River, additional pumping of Lower Aquifer System wells, and delivery of this water to an

area where pumping has created a trough that causes sea water intrusion. It involves United's constructing a pipeline, called the Pumping Trough Pipeline, the Lower Aquifer System wells, and a permanent Freeman Diversion structure across the Santa Clara River near the community of Saticoy.

The Pumping Trough Pipeline, Lower Aquifer System wells, a permanent diversion canal, and a desilting basin are all complete and operational. Construction of the pipeline and Lower Aquifer System wells cost $15 million. A State grant provided $8 million and $7 million came from local funds. The plan will be fully implemented in fall 1990 when construction of the permanent Freeman Diversion structure is completed. This facility's construction cost is $28 million. Financing included a $11.5 million Bureau of Reclamation loan, $7 million Bureau loan, $5 million Proposition 44 loan, and $4.5 million in local funds. In addition to these projects, drilling of new Upper Aquifer System wells in the Oxnard Plain in areas which would increase overdraft is now prohibited. These measures have helped. Yield has increased and monitoring indicates that sea water has not moved inland significantly in the past six years.

On the other hand, there is now evidence of sea water intrusion in one of the deeper aquifers underlying the Oxnard Plain -- the Fox Canyon aquifer zone. This aquifer extends from offshore to and beyond the Oxnard Plain. During winter 1989, in conjunction with a U.S.G.S. modeling study, five monitoring wells were constructed along the coast. One well, located on the southern side of the Port Hueneme Harbor jetty, indicated that sea water had intruded onshore. The Fox Canyon aquifer zone is also in an overdraft condition.

The Fox Canyon Ground Water Management Agency was formed to manage the ground water resources that underlie the geographical boundary of the Fox Canyon aquifer zone. To eliminate the overdraft in all aquifer zones, the agency has adopted ordinances to require installation of meters on all wells pumping more than 50 acre-feet per year, to limit the amount of ground water that can be pumped, and to restrict the drilling of new wells in the North Las Posas Basin.

In addition to these measures, a study and preliminary EIR to determine the pipeline alignment and facilities needed for the importation of the 20,000 acre-feet of State Water Project entitlement will soon be initiated. This project, if constructed will enhance water quality and help relieve the ground water overdraft.

In the meantime, UWCD has ordered its 5,000 acre-feet allotment for 1990 from the Department of Water Resources. UWCD is proposing to use the Santa Clara River for conveyance on an interim basis until the permanent delivery system can be built. The State Water Project water would be artificially recharged into the ground water basin.

COLORADO RIVER WATER RIGHTS

As a result of the 1964 U.S.Supreme Court decree in Arizona vs. California, California's apportionment to Colorado River water was reduced and the five lower Colorado River Indian tribes were awarded either 905,496 acre-feet of diversions annually or the water necessary to supply the consumptive use required for irrigation of 136,636 acres, whichever is less.

In 1978, the tribes asked the Court to grant them additional water rights, alleging that the United States failed to claim a sufficient amount of irrigable acreage (the so-called "omitted" lands) in the earlier litigation. The tribes also raised claims for more water because the Department of the Interior and favorable court decrees had enlarged the boundaries of the Indian reservations after 1964 ("boundary" lands).

In 1978, the Special Master appointed by the Supreme Court to hear these claims recommended that additional water rights be granted to the Indian tribes. In 1983, however, the Court rejected the claims for omitted lands from further consideration but ruled that the claims for boundary lands could be the subject of future considerations. Litigation now pending before the U.S. District Court in San Diego could resolve this issue. Any claims granted would probably be charged against the fourth priority of MWD under the 1931 California Seven Party Agreement, which

established priorities for California's entitlement, because this is the lowest priority that would fall within California's basic apportionment of 4.4 million acre-feet.

The City of Needles, the community of Winterhaven, the U.S. Bureau of Land Management, and others have also been attempting to obtain a secure supply of additional water for municipal, industrial, and recreational purposes. On November 14, 1986, the President signed legislation authorizing the Secretary of the Interior to construct, operate and maintain a project consisting of a series of wells capable of providing up to 10,000 acre-feet of water annually from a bank of ground water created by leakage from the All-American Canal. Under this legislation, P.L. 99-655, the Lower Colorado River Water Supply Act, the Imperial Irrigation District (IID) and the Coachella Valley Water District (CVWD) would exchange a portion of their rights to divert water from the Colorado River in return for an equivalent quantity and quality of ground water to be pumped from the well field into the canal. Before implementation, the plan would require concurrence of the members of the 1931 Seven Party Agreement. Pending development of this long-term supply, MWD and CVWD entered into an agreement in 1985 to provide the City of Needles with an interim supply over the next five years. With the water supply project not expected to be completed until December 1992, a two year extension of the 1985 agreement is being negotiated among the parties.

The most recent development affecting the apportionment of Colorado River water is the Central Arizona Project. The project, which started delivering water in 1985, is expected to have all of its aqueduct facilities completed by 1992. By 1993 to 1995, the Central Arizona Project is projected to divert 1.5 million acre-feet a year for municipal, industrial, and agricultural uses in central Arizona, including Tucson and Phoenix.

The reduced delivery of Colorado River water to California will directly affect California's future water supply. In years without surplus flows, all the loss will probably have to be borne by MWD because it has a lower priority than agricultural agencies with rights to Colorado River water. If MWD were to absorb all losses, by the year 2000, its total allotment would be 472,400 acre-feet, a reduction of 60 percent of what MWD would receive under its full contract entitlement (1.2 million acre-feet). The Colorado River Basin Project Act of 1968 does provide that, in the event of a water shortage in the Colorado River Basin, California's yearly share of 4.4 million acre-feet per year has priority over the Central Arizona Project. So, although MWD's share may be cut by more than half, that supply would be dependable in dry years.

To compensate for that loss and for the probable deficiencies in the yield of the SWP, MWD is pursuing a number of programs to augment its supplies. Measures designed to maximize Colorado River supplies include: (1) the banking of surplus supplies of Colorado River water in Lake Mead for use in dry years; (2) the use of unused water to which agricultural agencies are entitled; (3) the use of Arizona's and Nevada's unused apportionments; and (4) the transfer of salvaged agricultural water. In December 1988, MWD and the IID signed the first in a series of historic water conservation agreements, which will make 106,000 acre-feet of water available to MWD annually (by 1934) through the implementation of 16 water conservation projects in IID. The Secretary of the Interior, under legislation P.L.100-675 adopted in 1988, is authorized to line portions of the All-American Canal and the Coachella Canal, using funds provided by California agencies. If both canals are lined, an additional 100,000 acre-feet of water would be made available for use in Southern California. MWD is also leaning toward the State Water Project to make up for much of the reduction of its Colorado River water supply. As the population continues to increase, MWD will become more dependent on water from northern California.

COLORADO RIVER SALINITY

The Colorado River system is subject to highly variable flows. Consequently, salinity varies from year to year. From 1983 to 1986, releases from reservoir storage in the lower Colorado River as a result of above normal water supply were two to three times greater than releases required for beneficial uses. These record high flows reduced salinity in the lower Colorado River to historic lows. However,

since 1987, with the return to normal water supply and increased water use within the upper basin, salinity levels are increasing.

Like most western rivers, the Colorado increases in salinity from its headwaters to its mouth, carrying a salt load of about 9 million tons annually. Approximately half of the salt loading to the river is attributed to "natural causes" and half is "human-caused". Natural causes include salt contribution from saline springs, erosion and dissolution of sediments, and concentration by evaporation and transpiration. Among the human activities increasing the salinity in the river, irrigated agriculture is the major source, accounting for about 37% of the salt concentration. Salts dissolved from the underlying saline solids and geologic formations by deep percolation are transported to the river by irrigation return flows. Further increases of the salt load to the river come in part from the development of irrigation projects. Out-of-basin exports, development of the vast energy resources in the Upper Colorado River Basin, and other municipal and industrial uses contribute about 5% to the river's salinity problem.

In 1972, the seven basin states adopted a policy of maintaining the salinity concentrations in the lower mainstem of the Colorado River system at or below the flow weighted averages of 1972 while continuing to develop their compact-apportioned waters. The Federal Water Pollution Control Act Amendments of 1972 required the establishment of numeric standards for salinity in the Colorado River. In 1973, the seven basin states created the Colorado River Basin Salinity Control Forum to establish numeric salinity criteria and to develop a plan of implementation for salinity control.

In 1975, all the basin states adopted the salinity standards set forth in the report "Water Quality Standards for Salinity, Including Numeric Criteria, and Plan of Implementation for Salinity Control, Colorado River System", as recommended by the Forum. The State adopted- and EPA-approved standards call for maintenance of the average annual flow-weighted salinity (TDS) concentrations of 723 mg/L below Hoover Dam, of 747 mg/L below Parker Dam, and of 879 mg/L at Imperial Dam.

Because of changes in hydrologic conditions and water use within the Colorado River Basin, the Forum reviews its plan of implementation every three years. The recommended revisions to the plan for 1990 appear in "Review, Water Quality Standards for Salinity, Colorado River System". The revised plan of implementation is designed to control enough salt to maintain the numeric salinity criteria adopted in 1975 under a long-term mean water supply of 15 million acre-feet per year.

The 1990 proposed plan of implementation includes:

1. Completion of Bureau of Reclamation, Bureau of Land Management, and Department of Agriculture salinity control measures. Current remaining federal construction costs for the activities are approximately $669 million.

2. Imposition of effluent limitations, principally under the National Pollutant Discharge Elimination System (NPDES) permit program of industrial and municipal discharges.

3. Implementation of various Forum-recommended policies on such subjects as use of brackish and/or saline waters for industrial purposes, NPDES standards for intercepted ground water, and NPDES standards for fish hatcheries.

The Forum reports that current salinity concentrations are 582 mg/L below Hoover Dam, 594 mg/L below Parker Dam, and 682 mg/L at Imperial Dam, all of which are below the numeric criteria. The Forum also says there is no reason to believe that the numeric criteria will be exceeded during the next three years. In fact, projections appearing in the 1990 review claim that "except for deviations caused by factors beyond human control, average annual salinity levels will be maintained through 2010 at or below the 1972 levels with the recommended plan of implementation."

WATER DIVERSIONS TO THE CITY OF LOS ANGELES

Currently, during a "normal year", (which is based on a running average), the City of Los Angeles derives about 70 percent of its water supply from the Owens Valley and Mono Basin. In addition, the City gets low-cost energy generated by the falling water along the gravity-fed line importing this water, - the LA Aqueduct.

The last four years of drought and a Court order applying to Mono Basin have set limitations upon Los Angeles diversions from the Owens Valley and Mono Basin. The City has agreed not to pump any ground water from the Owens Valley during the drought, and is under Court order to reduce diversions from the Mono Basin. This reduction in supplies forces Los Angeles to rely more heavily upon MWD, which is already feeling the constraints of its own State Water Project and Colorado River water entitlements.

An example of how the drought and Court order has affected the city's reliance upon MWD can be seen by comparing a "normal year's" supply with the fiscal year ending June of 1990: During a normal year, 70% of Los Angeles' water comes from its LA Aqueduct, 16% from ground water from the San Fernando Valley, and 14% from MWD. This past fiscal year shows that 30% came from the LA Aqueduct, 13% from the San Fernando ground water, and 57% from MWD. The City's reliance upon the MWD supply has jumped 43% from a normal year, and is projected to increase to 70% during the next fiscal year.

WATER SUPPLY INITIATIVES OF METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Many are the problems and pressures behind the creative drive of the Metropolitan Water District of Southern California to seek additional water supplies for its member agencies. Political and legal factors include (1) voter and legislative rejection of measures needed to augment the yield of the State Water Project, (2) loss of 650,000 acre-feet of Metropolitan's annual Colorado River water entitlement following the startup of the Central Arizona Project, and (3) possible decrease in SWP imports resulting from the State Water Resources Control Board's Bay/Delta water rights hearing on terms and conditions for Delta water export.

In addition to the above items relating to Metropolitan's water supplies, other factors have contributed to a growing demand for its water. Water use in Metropolitan's service area has increased from 2.8 MAF in 1970 to 3.0 MAF in 1980 and to about 3.8 MAF in 1989. The increase during the 1970s was nearly 10 percent, but the increase in the first nine years of the 1980s was 25 percent. This big jump in the 1980s reflects a large population growth and the below-normal precipitation levels in the late 1980s. Moreover, the City of Los Angeles is increasing its reliance upon Metropolitan's water to make up for its loss of imported water from Owens River-Mono Basin. Last fiscal year alone, Los Angeles has increased its dependence upon Metropolitan water by 140,000 acre-feet.

The following table highlights major Metropolitan water supply and demand management programs:

EXISTING SUPPLY MANAGEMENT PROGRAMS

Type of program	Program name and description
Supply Enhancement	Imperial Irrigation District Water Conservation Agreement - (Phase I) Implementation of this program began in January 1990. In return for financing specific conservation projects, Metropolitan will be entitled to the amount of water saved. Such projects include lining of existing canals, construction of local reservoirs and spill interceptor canals, installation of non-leak gates and automation equipment, and institution of a distribution system and on-farm management activities. The total amount of conserved water

yielded through Phase I is estimated to be 106,000 acre-feet per year. About 20,000 to 25,000 of this should be available to Metropolitan by the end of this year.

Desert Water Agency and Coachella Valley Water District

Exchange Agreement

Because there are no facilities to convey water from the SWP to the Coachella Valley, neither the Desert Water Agency nor Coachella Valley Water District is able to take delivery of its SWP entitlements. Under this agreement with Metropolitan, the two agencies exchange their SWP entitlements for a like amount of Colorado river water.

Advance Delivery Agreement

The terms of this agreement provide that Metropolitan make advance deliveries of Colorado River water (conditions permitting) to the two agencies for recharging Coachella Valley ground water basin. Metropolitan may also use the SWP entitlements of the two agencies (61,200 acre-feet per year) and suspend deliveries of Colorado River water for recharge. During periods of such suspension, water stored in the basin can be used by the two agencies, enabling Metropolitan to maximize its use of the Colorado River Aqueduct.

As a result of the recent drought, Metropolitan has suspended its delivery of Colorado River water to the two agencies while continuing to receive the agencies SWP entitlements. The Coachella ground water account has since been drawn down from its peak of 552,000 acre-feet in April 1986 to 419,500 acre-feet on December 31, 1989.

Cyclic Storage/ Groundwater Management

Chino Basin and San Gabriel Basin Cyclic Storage Agreement.
This agreement provides for the delivery and storage of imported waters to Chino and San Gabriel Basins. When water supplies are abundant, advance deliveries of Metropolitan's ground water replenishment supplies are provided for later use. When imported supplies are limited, Metropolitan has the option of meeting the replenishment demands of the agencies managing these basins through surface deliveries or a transfer of the stored water. Metropolitan's maximum storage entitlements are 100,000 acre-feet in the Chino Basin and 142,000 acre-feet in the San Gabriel Basin. As of July 1990, it had 28,000 acre-feet stored in the Chino Basin and 58,000 acre-feet in the San Gabriel Basin.

Conjunctive Storage Management

Interruptible Water Service Program of 1981.
This program was designed to provide economic incentives to encourage Metropolitan's member agencies to store imported water in either surface reservoirs or ground water basins for use during times of temporary deficiency in imported supplies (such as periods of peak use or drought). Current water deliveries under interruptible service represent about 1/3 of all Metropolitan's deliveries.

Conjunctive Storage Management	Seasonal Storage Program of 1989. This program provides member agencies with an economic incentive to store imported water during the economic demand and plentiful supply months of winter. Water so stored can then be withdrawn by the local agency in either the summer peak-demand period or during droughts.
Water Reclamation	Local Projects Program 1981. Through this program, Metropolitan provides economic incentives to local agencies to encourage the development of water reclamation and desalination projects that otherwise would not be economically feasible. (Metropolitan contributes $154 for each acre-foot of "new water" from a local project that replaced a firm demand for Metropolitan supplies). Thus far, Metropolitan has participated in 17 local projects, having a combined ultimate yield of 41,600 acre-feet per year. Currently, 12 additional projects, with an estimated combined yield of 36,000 acre-feet per year, are in various stages of review.

FUTURE OR POTENTIAL PROGRAMS:

Supply Enhancement	IID Conservation Agreement (Phase II) Through negotiations with IID, an additional 150,000 acre-feet per year of conserved water may become available.
Conservation/ Supply Enhancement	Palo Verde Irrigation District Land Fallowing Program. Under this concept, Metropolitan would pay landowners in the Palo Verde Valley to leave land fallow in exchange for use of about 100,000 acre-feet per year of water they would not be using. (A similar concept is being considered for the Imperial Valley.)
Supply Enhancement	Lining of All-American Canal and Coachella Canal. Up to 70,000 acre-feet per year of water may be conserved if about 30 miles of the All-American Canal are lined. Similarly, lining 38 miles of the Coachella Canal may conserve up to 30,000 acre-feet per year. Metropolitan is currently working out agreements with other water agencies to fund canal linings in exchange for the water saved.
Desalination/ Supply	Desalination Pilot Plant. Metropolitan has authorized preliminary studies for a 5 mgd desalination pilot plant (distillation method). Although the location of the plant has yet to be decided, it will be located near an existing power plant on the coast. Ultimate capacity of the plant is planned at 100 million gallons per day.
Exchange Agreement	Colorado River Banking Plan. The concept behind this plan is to create an additional supply of water, for an interim period, by making use of SWP water in place of Colorado River water. The plan calls for Metropolitan to adjust its Colorado River deliveries in accordance with the availability of water from the SWP. In years when SWP supplies are adequate, Metropolitan would take more SWP water and correspondingly less of its

Colorado River entitlement. The difference between Metropolitan's Colorado River entitlement and its actual diversions would remain in Lake Mead and be credited to Metropolitan's account. Any water lost by spills, evaporation, or seepage resulting from the additional stored water would be deducted from Metropolitan's account. As needed, Metropolitan would draw on its accumulated net water credits in Lake Mead. About 200,000 acre-feet per year may eventually be made available through this program.

Exchange Agreement

Arvin-Edison Water Exchange Program
This proposal between Metropolitan and the Arvin-Edison Water Storage District is expected to be finalized by early next year, with construction also commencing sometime in 1991. Arvin-Edison is a Central Valley Project contractor in southeastern Kern County. Its CVP water is delivered through the California Aqueduct by arrangement with the State. Through the proposed contract, Metropolitan would assist in constructing Arvin-Edison's partially completed distribution system and deliver a portion of its SWP water in wet years for use in Arvin-Edison's replenishment programs. In return, Metropolitan would receive some of Arvin-Edison's CVP water during dry years.

Through this proposed agreement, Metropolitan expects to store as much as 135,000 acre-feet per year of SWP water in the southern San Joaquin Valley. During wet periods, Metropolitan could accumulate a storage account of up to 800,000 acre-feet. In dry periods. the program, would make approximately 100,000 acre-feet per year available for use in the Metropolitan service area.

FUTURE WATER SUPPLY FOR SANTA BARBARA

In 1963, Santa Barbara County entered into an agreement with the State of California to receive water from the California Aqueduct. Because local supplies were adequate at that time, the entitlement was "put on hold." A bond issue to build local distribution facilities was defeated. The City of Santa Barbara has remained solely dependent upon local supplies.

The recent drought, 1986-1990, has had a severe effect upon Santa Barbara's water supply. Gibraltar Reservoir, which supplies 50% of the City's demand, is dry and a second reservoir, Cachuma, is at less than 21% of capacity and is predicted to be dry by the start of the 1992-93 water year if the drought continues.

On May 15, 1990, the Santa Barbara City Council declared a local emergency and determined that, even with water conservation, the City must have a minimum of 2,500 to 5,000 acre-feet of additional water. The needs have been identified as those for three different time periods:

1. Immediate
2. Short range (1992 for possibly five years)
3. Long range

To meet the short-range need, the Council issued a Request for Proposals to supply water to the City beginning in late 1991 and continuing for possibly five years.

Various methods have been suggested to meet the needs. Among the means of supplying water that have been proposed are: bringing in State Water Project water by exchange with other agencies, completing the Coastal Branch of the California Aqueduct, enlarging Bradbury Dam to increase the capacity of Lake Cachuma, treating reclaimed water for ground water injection, and desalinating sea water. Each option

has distinct advantages and disadvantages. Both citizens and politicians in Santa Barbara are concerned with the possible economic, environmental, and political effects of the proposals.

Most recently, the Santa Barbara City Council announced that it will negotiate a contract with Ionics, Inc., a Massachusetts company which proposed the construction of a desalter to meet the short-range need. Meanwhile, many others, including the Department of Water Resources, are continuing to study alternative plans for providing an ample water supply for Santa Barbara.

FUTURE WATER SUPPLY FOR SAN LUIS OBISPO

The last four years of drought have sharply focused San Luis Obispo County's attention of its need for additional water. The county has no imported water supply. It relies primarily on its ground water and on the surface runoff impounded within Salinas Reservoir (Santa Margarita Lake), Whale Rock Reservoir, and Lopez Lake.

Many of the ground water basins within the county are overdrafted. The Paso Robles Basin although extremely large in capacity (26,500,000 acre feet), is being overdrafted by approximately 30,000 acre-feet per year. The Santa Maria Basin is in modest overdraft. Cayucas Basin, however, is one of the 13 most critically overdrafted basins in the State, with water levels subsiding eight to ten feet per year.

The Cities of Arroyo Grande, Pismo Beach, and Grover City rely upon ground water and Lopez Lake water. These three cities have growth rates that are predicted to reach the safe yield of their supplies by 1992. That portion of the county where these three cities are located has fared reasonably well in the drought; Lopez Lake, the waters of which are used for ground water recharge and surface deliveries, has had a surplus, even with the recent drought. The City of Morro Bay is suffering severely from the drought. The city, which has been very active in water conservation measures, has undergone harsh rationing for the last 2-1/2 years. It has leased desalters to use in restoring its ground water (which had become brackish) to a usable quality.

The City of San Luis Obispo, which has succeeded in reducing its water usage by more than 50 percent, has still exceeded its dependable supply and has recently had to supplement its surface supplies by drilling new wells. Ground water now makes up approximately 30 percent of the city's water supply, but previously the city relied upon Salinas Reservoir, with Whale Rock Reservoir as a back-up water source.

Agriculture, which accounts for 80 percent of the county's total usage, relies upon ground water. It too has felt the effect of the drought. Dry-lot farmers are, of course, feeling the most effect. Those farmers who can still irrigate are switching to crops with low-water usage. Cattlemen have simply gone out of business during the drought.

Since 1963, San Luis Obispo has held a contract for an entitlement to 25,000 acre-feet per year of SWP water. Although it has not yet taken any of this water, it has borne its share of the aqueduct construction and maintenance costs for the past 27 years. The first 15 miles of the Coastal Branch of the California Aqueduct (leading to San Luis Obispo and Santa Barbara Counties) have been built and in place since the late 1960s, but the remainder of the Coastal Branch has yet to be built because of the lack of popular support. The area, in effect, has become polarized to inaction on the subject. On the one hand, there is no doubt that the region needs this high quality water to supplement its natural water supply and enhance the quality of its ground water. On the other hand, there is the fear, that an increase in dependable water supply will bring with it further growth, urbanization, and all the associated problems.

The Department has recently finished writing the final EIR for completion of the Coastal Branch into Santa Barbara and San Luis Obispo Counties. After the final EIR is out, the San Luis Obispo County Flood Control and Water Conservation District will be legally able to contract with interested agencies for SWP water. The City of San Luis Obispo, for one, is contemplating an advisory election to poll residents' views on the importation of SWP water. The results of such an election

are not binding on the City Council, but they are influential. Although the area's need for an additional water supply is evident, strong antigrowth sentiment within the county leaves its SWP tie-in a matter yet to be determined.

FUTURE WATER SUPPLY FOR MOJAVE WATER AGENCY

In March of this year, the Mojave Water Agency requested that its 1990 entitlement water deliveries be increased from 360 acre-feet to 44,700 acre-feet so it can initiate a ground water recharge program for the Mojave River Ground Water Basin, which is experiencing significant overdraft. The Department of Water Resources temporarily denied the request because the present Statewide drought has limited the Department's ability to approve entitlement delivery requests for 1990. A postponement of the deliveries should not adversely affect Mojave Water Agency's overall ground water program. The Department did consider Mojave's request for this year's increase as right to future delivery under the terms of its water supply contract. The Agency in turn has requested its full entitlement delivery of 50,800 acre-feet for 1991.

Water problems within the Mojave Water Agency's service area are prompting many concerned parties to focus attention on the need to devise a regional plan for using the Agency's hitherto untapped 50,800 acre-foot entitlement from the California Aqueduct. Without such a plan, the rapidly growing communities along the Mojave River and in the Morongo Basin may end up in skirmish after skirmish over a diminishing underground supply of water.

In what may be a precursor of things to come, the City of Barstow filed a suit early this year requesting that the Superior Court guarantee it an annual supply of 30,000 acre-feet of Mojave River water (to be received at a particular stream gaging station downstream of Barstow). It is Barstow's allegation that this was the natural river flow to the city in 1950, before Victor Valley's growth began to cause overdrafting of the Mojave River Basin's underground water. Barstow further alleges that it now receives less than half of the flow it did 40 years ago. In yet another suit, this one between Barstow and the City of Hesperia, the Court's ruling has emphasized the necessity for Mojave Water Agency to exercise its authority as a key agent in settling the region's long-term water problems.

FUTURE WATER SUPPLY FOR SAN GORGONIO PASS WATER AGENCY

San Gorgonio Pass Water Agency is currently in the process of planning and constructing the facilities to allow delivery of the 17,300 acre-feet per year of State Water Project water to which it holds entitlement. The agency expects to take delivery of its entitlement water within four to five years.

The Agency is also pursuing the possibility of a State Water Project conjunctive use program with the Department of Water Resources. The Department has estimated that as much as 1,000,000 acre-feet of evacuated space is available within the San Gorgonio ground water basins. At present, the Agency is gathering the necessary hydrogeologic information to prepare a prefeasibility study. A 1,000-foot deep exploration well has been completed in the potential recharge area, and a second well is now being drilled.

THE EFFECT OF POTENTIAL WATER CONSERVATION EFFORTS ON CONDITIONS AT SALTON SEA

The Salton Sea is a 35-mile-long, 12-mile-wide, shallow, salty sea which lies 228 feet below sea level in the desert of Imperial and Riverside counties. In 1980, a Salton Sea shore landowner went to the State Water Resources Control Board accusing the Imperial Irrigation District of wasting water which went into the Sea and flooded his land. In 1988, the Board ordered that the IID save 100,000 acre-feet of water per year by 1994. To achieve this, IID was required to make water delivery and irrigation practices more efficient. Also included in the order is an eventual goal of saving 368,000 acre-feet annually. The IID has reached an agreement with Metropolitan wherein MWD will pay for conservation devices, such as concrete lining of irrigation ditches, and MWD in turn will get most of the conserved water. Yet there is concern since the conservation may be harmful to the Sea.

The Salton Sea has become increasingly saline in recent years because of salty agricultural runoff, high evaporation, and reduced inflow of fresh water. According to IID, 60% or more of the water that would be saved, currently pours into the Salton Sea as fresh water. Irrigation return flows and a rainfall of less than 3 inches per year are the only freshwater supplies to the Sea. Conservation measures could cause the surface level of the Sea to drop by as much as 17 feet and cause an increase in salinity. Salinity levels in the Salton Sea are over 40,000 parts of salt per million parts of water - more salty than the ocean, which averages 34,000 ppm.

An increase in salinity will hurt fish and other wildlife and the recreational resources in the area. In addition, the drop in the sea level could expose salt flats, which can contain selenium, pesticides, and other toxins, to wind erosion,

Since 1987, the Salton Sea Task Force has been studying the problems at Salton Sea, including salinity. This federal-state-local group's current objective is to find a way to conserve water in the Salton Sea area while stabilizing the Sea's salinity and its water level. Currently, the task force is seeking congressional approval of $10 million in federal funds to research the process of pumping water out of the Salton Sea, using the sun to evaporate the water and separate the salt, and then recovering the fresh water. In addition, a coordinated effort between the task force and a U.S. Bureau of Reclamation planning team will study the biological and environmental effects of the "Pumpout/Evaporation/Solar Initiative,"

INCREASED USE OF RECLAIMED WATER

The City of Los Angeles has established a water reclamation office and hired a director for that office. A plan is in the works to use reclaimed water produced by Tillman Wastewater Treatment Plant and the upgraded Hyperion plant. Among the uses planned are ground water recharge, irrigation of green belts and golf courses, cooling towers, and injection into sea water intrusion barriers.

Orange County Water District has established a similar position of Director of Water Reclamation and is making additional reuse of water. Currently, a green acres project is in progress (golf course, parks, and lakes).

Chino Basin Municipal Water District is also planning reuse of water for irrigation and ground water recharge,

San Diego County Water Authority plans to reuse 100,000 acre-feet annually by 2000. Its Director of Water Reclamation is busy coordinating projects with member water agencies.

Metropolitan Water District recently increased its subsidy for water reuse projects from $75/acre-foot to $152/acre-foot, because they reduce demands on its imported supplies.

NITRATES IN GROUND WATER BASINS

This is a problem in many basins in Southern California. It has been caused by agricultural fertilization, unsewered and sewered domestic waste water discharges, and dairies and feedlots.

TOXIC ORGANICS IN GROUND WATER

Several contaminated areas have been detected in Southern California. They are either large Superfund sites such as those in the San Gabriel and San Fernando Valleys and City of San Bernardino or smaller sites. Such ground water basins may not be dependable to provide water for domestic use; therefore, they could not be counted on to meet municipal needs.

DESALINATION OF WATER IN SOUTHERN CALIFORNIA

Desalination plants are planned, under construction, or in operation at a number of locations in California. All are rather small in terms of the Statewide water supply, but they are of significance in the local water supply situation in which they operate. In Southern California, the desalting plants treat ground water

containing unacceptably high concentrations of salt or other constituents. In addition, water and power agencies in the area are studying coupling sea water desalination plants with power plants to make use of waste steam from the power production.

In July 1990, the Board of Directors of the Metropolitan Water District approved an appropriation of $500,000 to finance the estimated cost of a planning study for a desalination pilot plant. Under the $500,000 study, Metropolitan will determine potential sites for a demonstration desalting unit and the environmental concerns that would be associated with such a facility. The study will also identify potential participants in the project, as well as funding and design requirements, and will define the work needed to construct and operate a full-scale desalination plant.

Until recently, Southern California had the most desalting activity in the state. Now, desalting plants are planned or in operation also in the South Central Coastal region of California. The City of Santa Barbara has been investigating the feasibility of constructing a sea water desalting plant for an emergency water supply during the current drought and recently announced that it will negotiate a contract with a Massachusetts company to construct a desalter. PGandE's Diablo Canyon Nuclear Power Plant desalinates sea water to provide potable water for use around the power plant. The City of Morro Bay is desalting brackish ground water to supplement its water supply as a drought relief measure.

The economic feasibility of desalination depends primarily upon the salinity of the source water and the cost of other available water supplies. In Southern California, brackish (low salinity) ground water desalting costs $350 to $450 per acre-foot, Water from coupling desalting with power production is estimated to cost about $600 to $800 per acre-foot for very large scale facilities. The cost of sea water desalting without coupling to power plants varies, depending upon the circumstances. In some cases, costs can range up to $2,000 per acre-foot. Generally, sea water conversion is more costly than other sources of water.

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