Antelope Valley Groundwater Cases Proceeding No. 4408

Exhibits to Declaration of Joseph Scalmanini Re Rebuttal Testimony

EXHIBITS 152 - 170

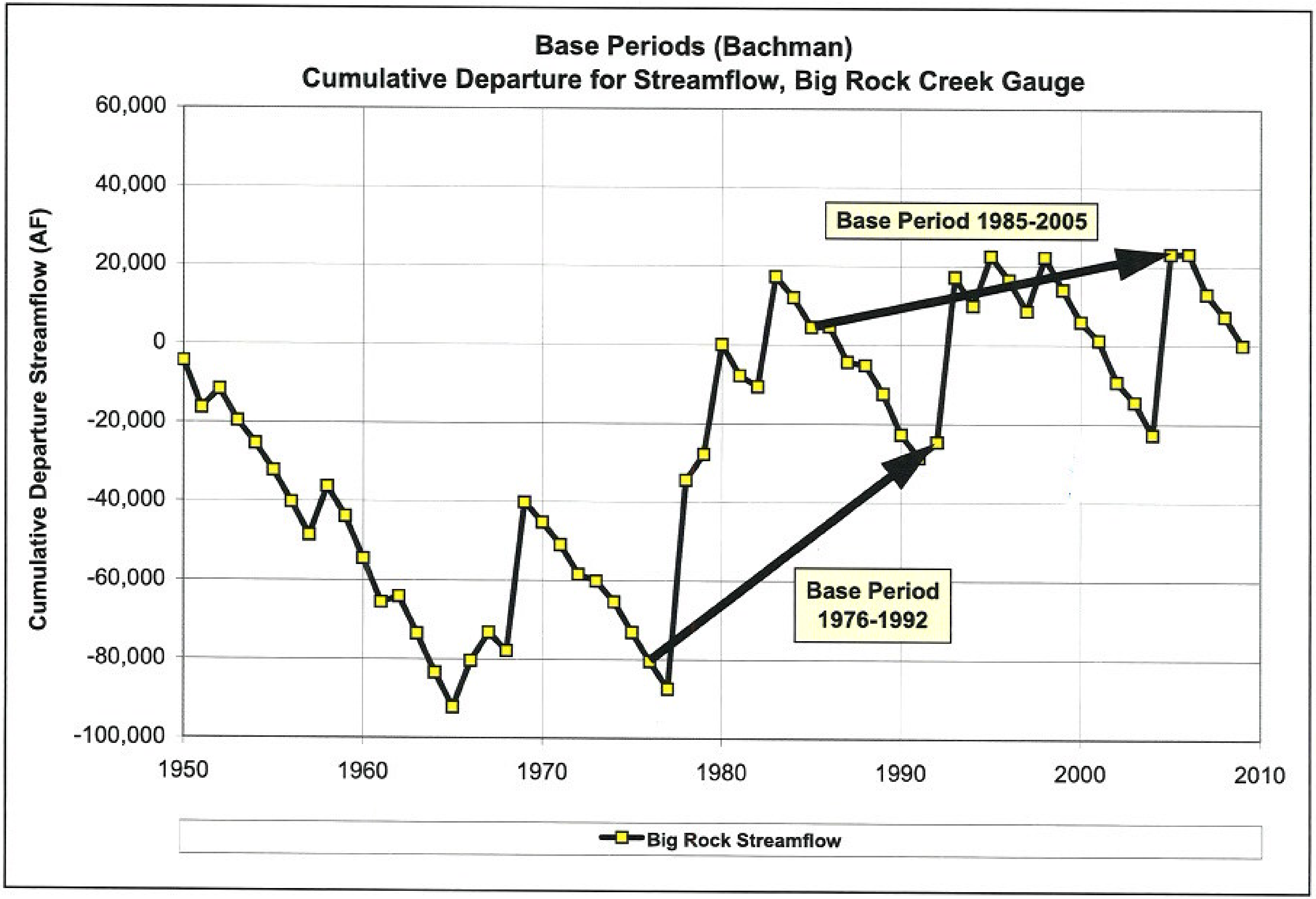

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Figure B1

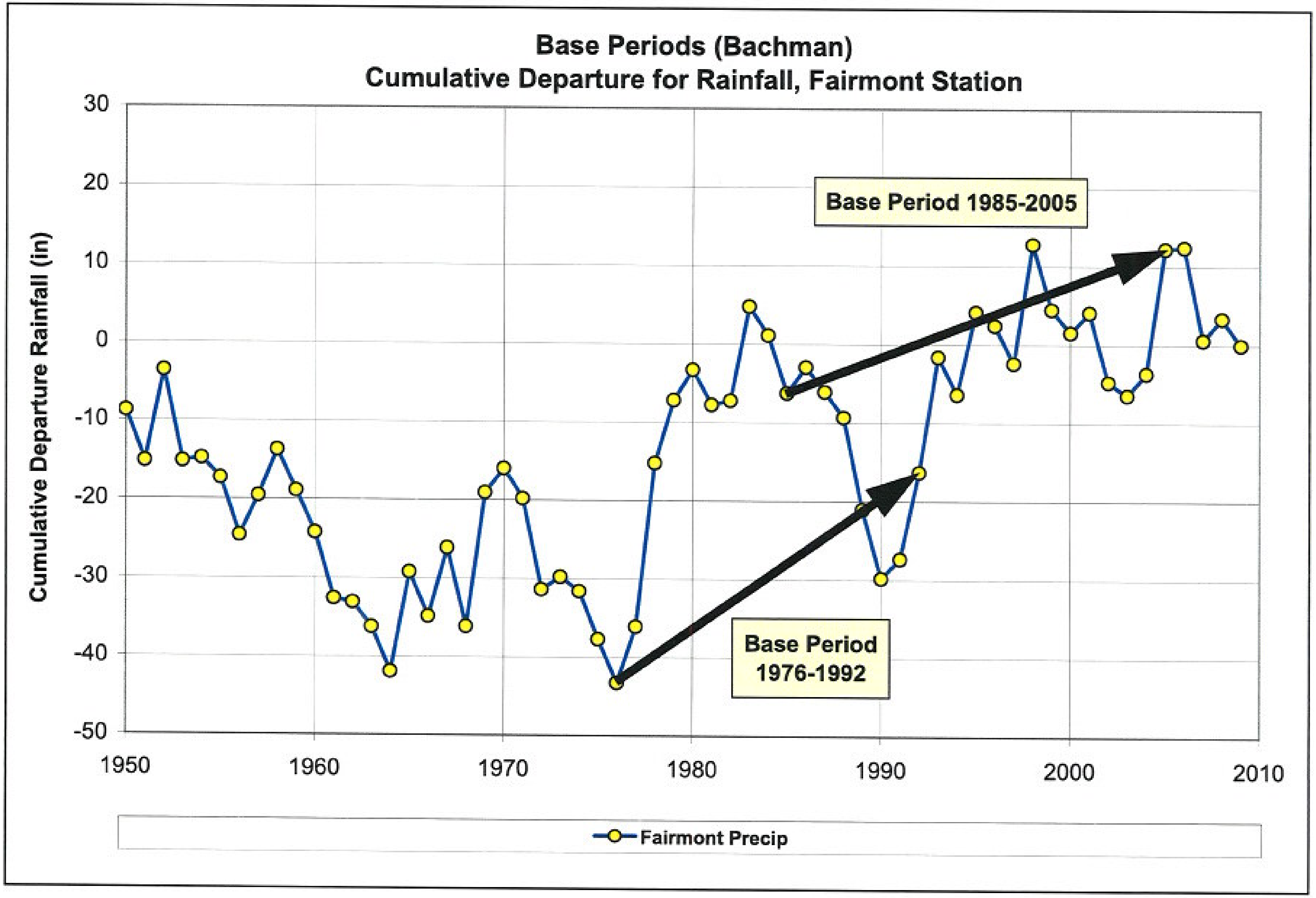

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Figure B2

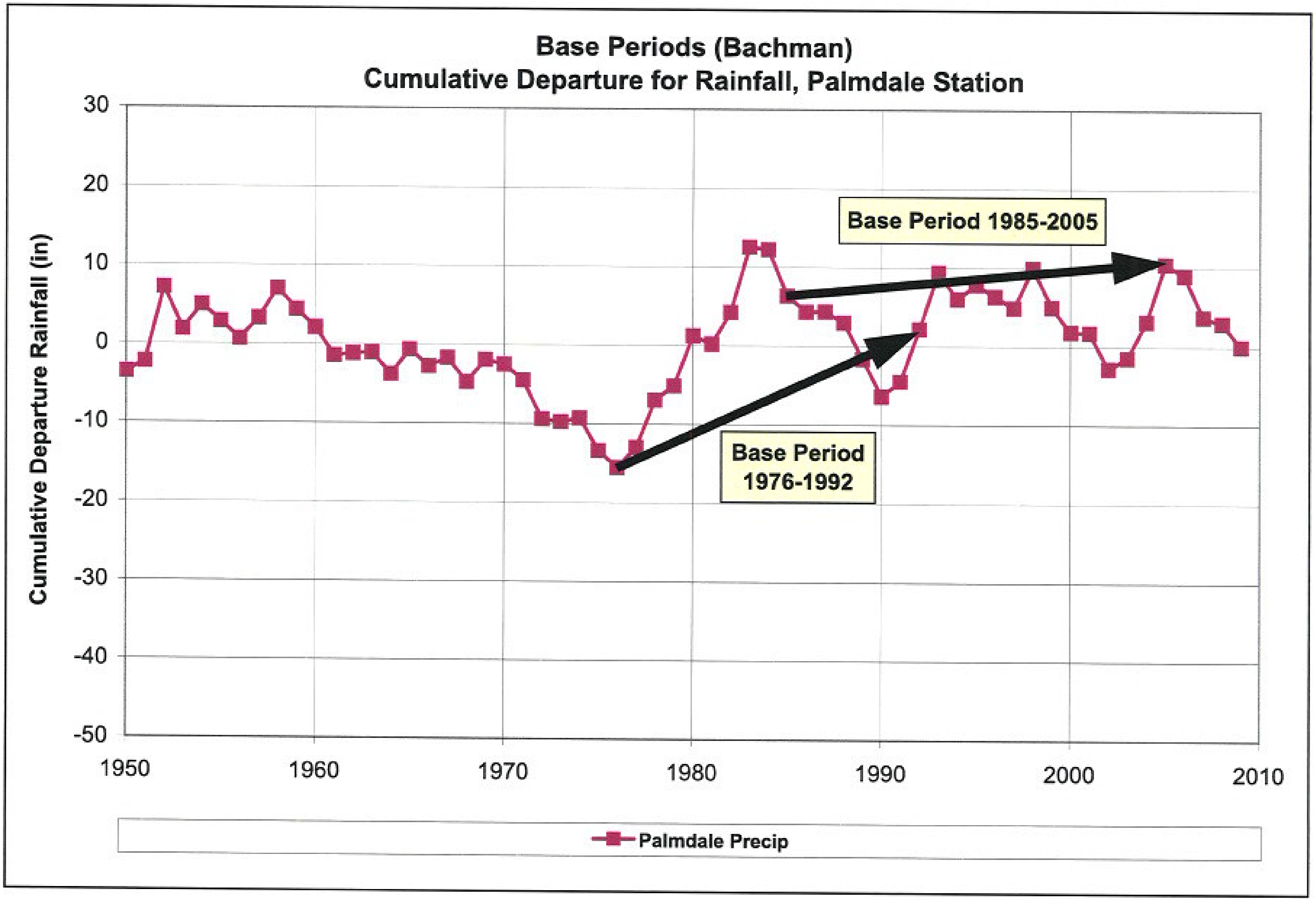

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Figure B3

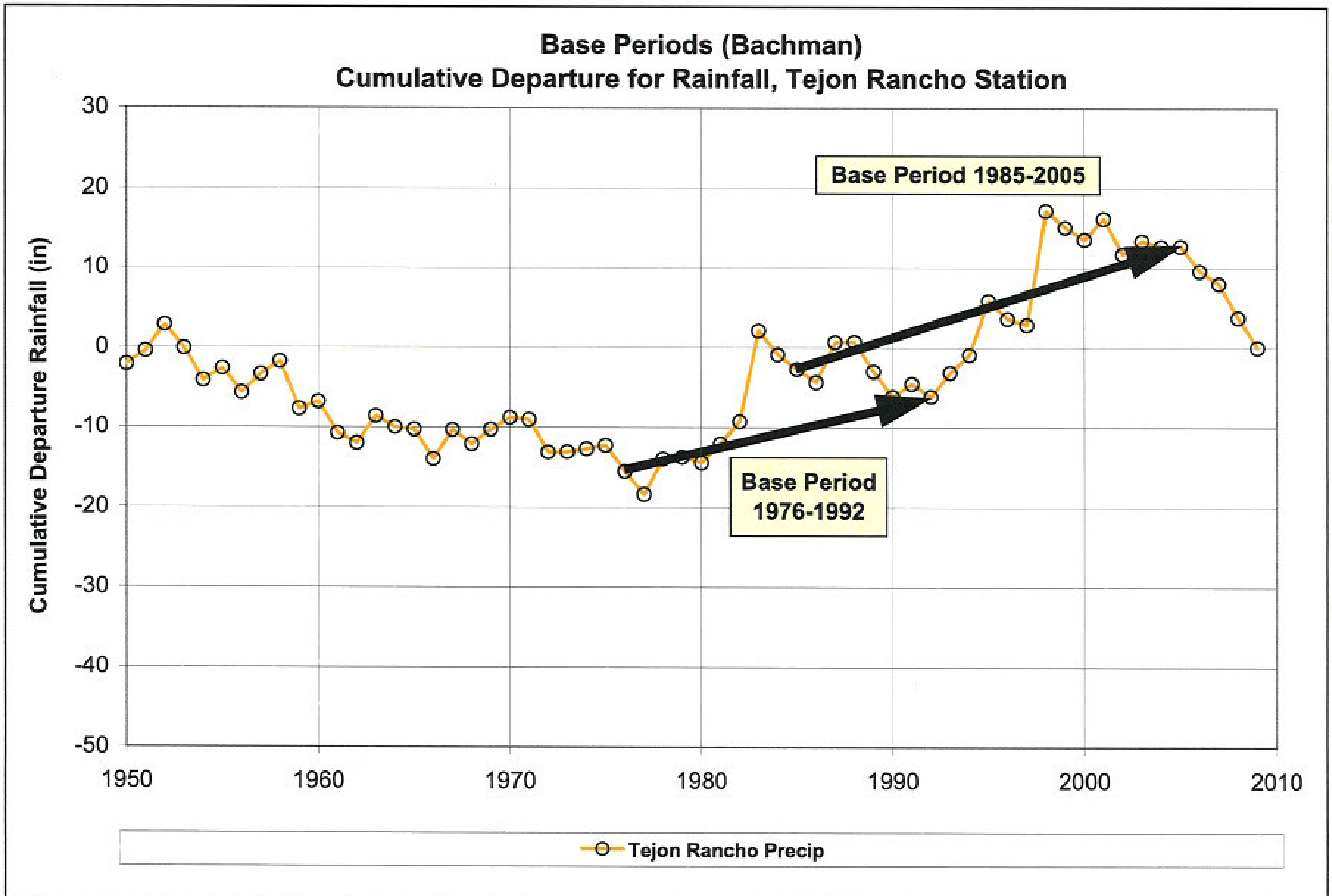

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Figure B4

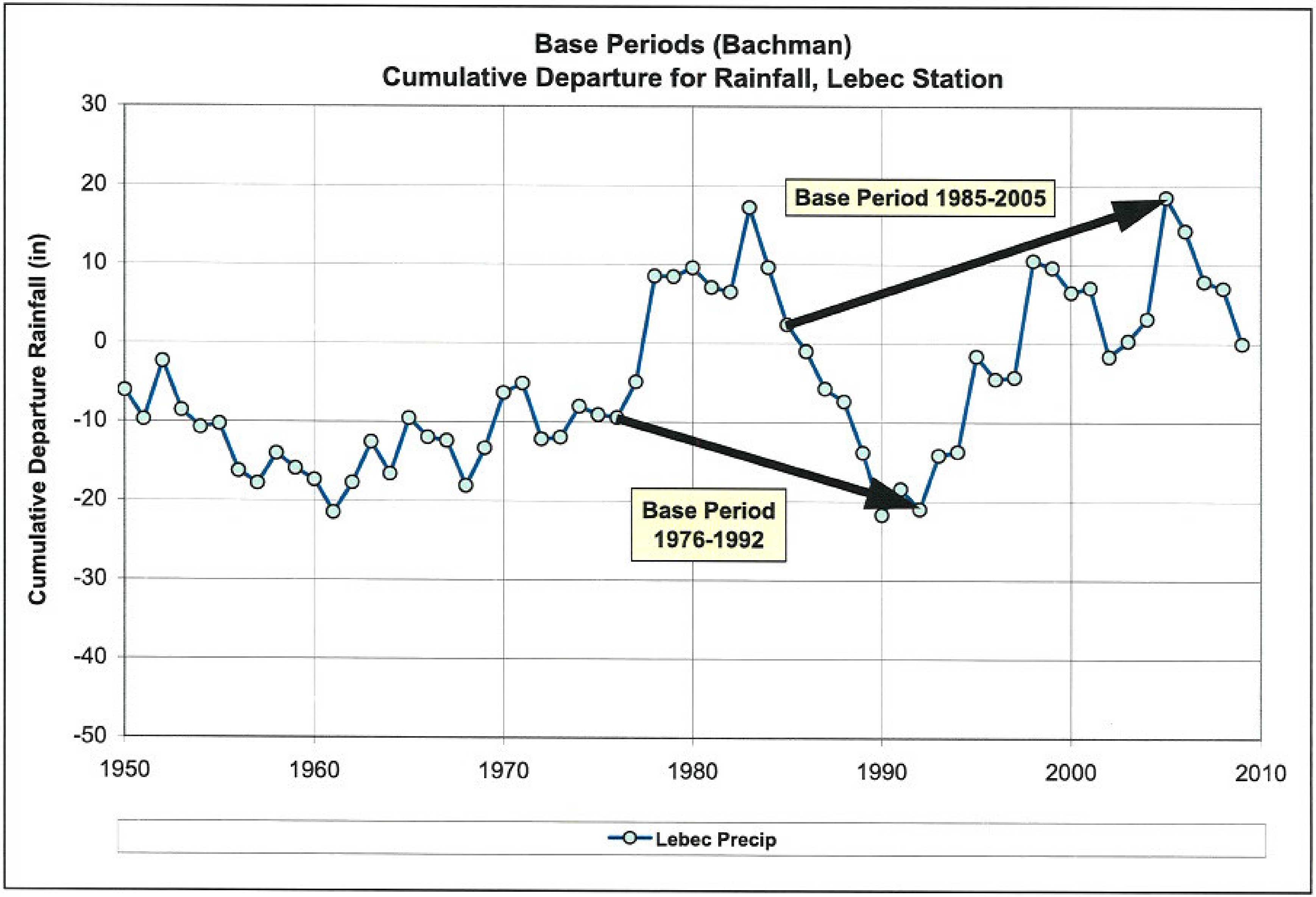

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Figure B5

Base Periods Based on Stream Discharge in Big Rock Creek

Antelope Valley Area of Adjudication

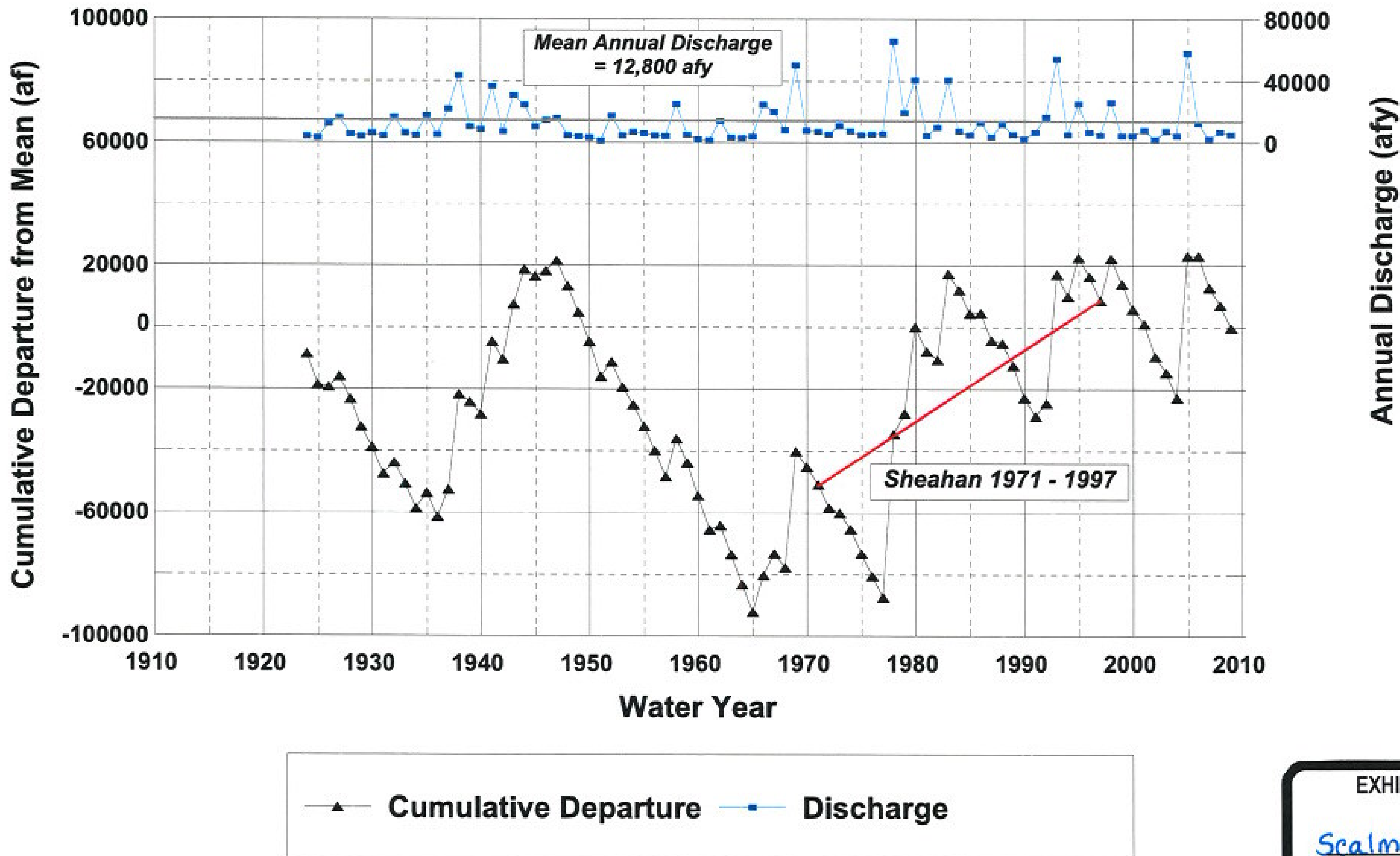

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Figure S3

Joe Scalmanini

From:	Gene Nebeker [enebeker@roadrunner.com]
Sent:	Wednesday, August 22, 2007 8:28 PM
To:	Mark Wildermuth; Bill Leever; Bruce Nelson; Steve Bachman; Tim Durbin; Robert Beeby; Joseph Scalmanini; Tom Sheahan; Ron Schnabel; Dick Rhone; Peter Leffler; June Oberdorfer; Dave Hardan; Michael Flood; Eugene Nebeker
Subject:	Fw: Native Vegetation Estimated Water Need
Follow Up Flag:	Follow up
Flag Status:	Red
Attachments:	Mountain ETo.xls

----- Original Message -----
From: Fastenau, Robert
To: Gene Nebeker
Cc: Inouye, David ; pierotti (pierotti) ; marks (marks)
Sent: Wednesday, August 22, 2007 3:20 PM
Subject: Native Vegetation Estimated Water Need

I was asked by Mr. Nebeker to find a method to estimate a native vegetation Kc value for the mountain areas surrounding Antelope Valley and a comparable ETo value for that region.

I used the published document "Guide to Estimating Irrigation Water Needs of Landscape Plantings in California" developed by University of California Cooperative Extension and DWR as the main reference. Chapter 2 of the guide helped me to develop a Knv (native vegetation) value for mountain vegetation. The water use number derived from the coefficient below should be considered a very broad estimate.

Kc value

Knv = ks X kd X kmc,

Knv (Native Vegetation Crop Coefficient)

ks (species factor): Well established native vegetation is categorized as a "very low" water user (0.1 and Less)

kd (density factor): Is used to account for the difference in veg. density or the collective leaf area of all the plants (0.5 to 1.3) Average Density (1.0)

kmc (microclimate factor): Vegetation surrounded by heat-absorbing/reflective surfaces, or exposed to windy conditions have high values (0.5 to 1.4)

Knv = 0.1 X 1.0 X 1.4 (low species factor x average density factor x high microclimate factor)

Knv = 0.14

ETo for higher elevations (5,000 – 7,000 ft) (Detailed information on each station is contained in the attached file)

There are two CIMIS stations located in San Bernardino County at higher elevations:

Lake Arrowhead (Elev. 5,000 ft)

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Figure SA (1/2 pp.)

ETo (3 year average): **50 inches**

Big Bear Lake (Elev. 7,000 ft)

ETo (2 year average): **55 inches**

ETo (5 year average both stations): **52 inches**

Using the Native Vegetation Coefficient (Knv) and the ETo from the higher elevations the ETnv is as follows:

ETnv = Knv X ETo

ETnv = 0.14 X 52

ETnv = 7.3 inches

If you have any questions concerning the information above, please let me know.

Thank You

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Robert G. Fastenau

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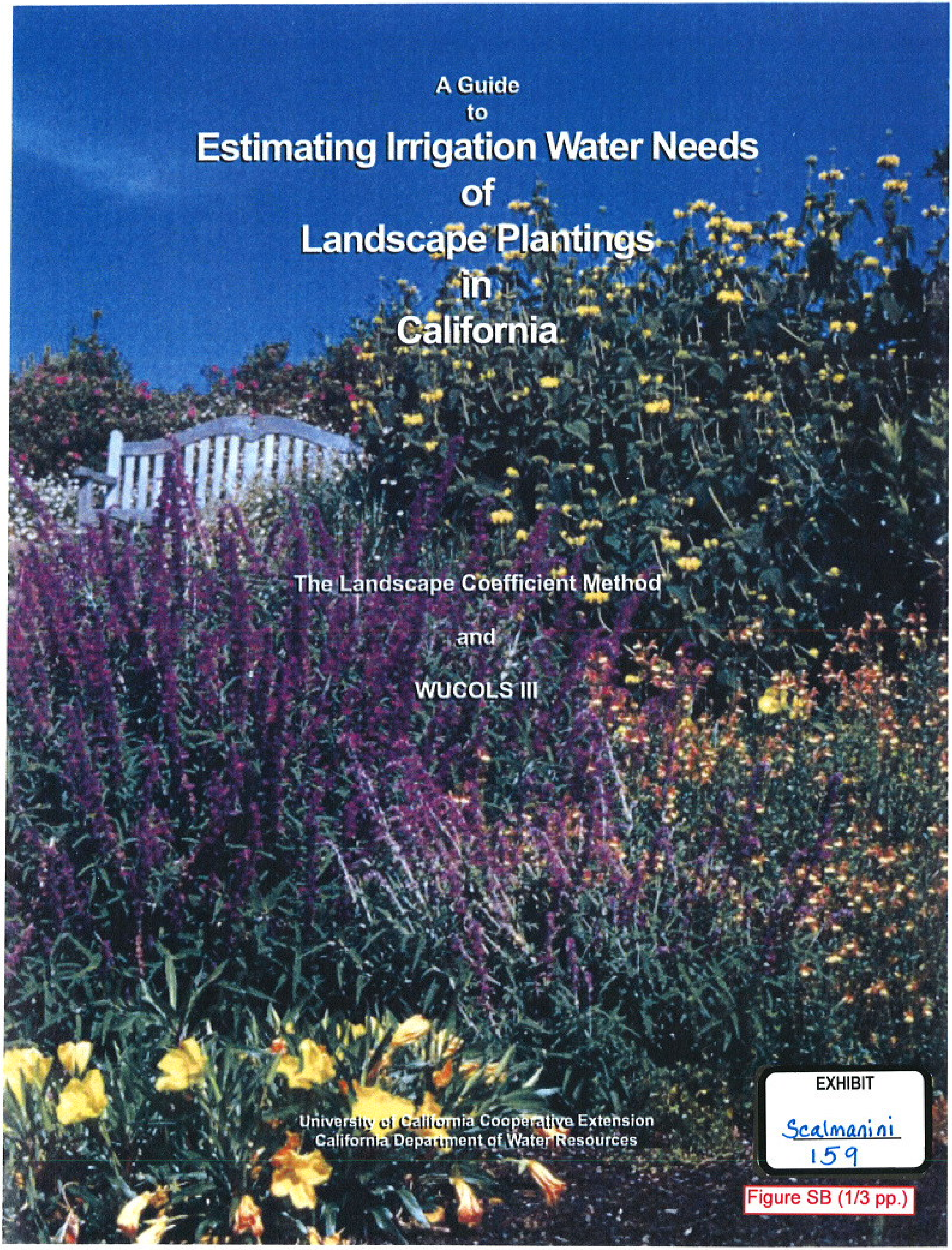

A Guide
to
Estimating Irrigation Water Needs of Landscape Plantings in California

The Landscape Coefficient Method

and

WUCOLS III

University of California Cooperative Extension
California Department of Water Resources

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Figure SB (1/3 pp.)

Chapter 2— Estimating Water Needs for Landscape Plantings

Two formulas are used to estimate water needs for landscape plantings:

- the landscape evapotranspiration formula and
- the landscape coefficient formula.

Both formulas are introduced here and then used in subsequent chapters to estimate water needs. The landscape coefficient was developed specifically for estimating **landscape** water needs and is the principal focus of Chapter 2.

The method used for estimating water needs for landscape plantings is basically the same as that used for crops and turfgrasses. The ET_c formula discussed in Chapter 1 is simply modified for application to landscapes. One key change, however, has been made: instead of using the crop coefficient (K_c), a landscape coefficient (K_L) has been substituted.

The Landscape Evapotranspiration Formula

Water needs of landscape plantings can be estimated using the landscape evapotranspiration formula:

$$ET_L = K_L \times ET_o$$

Landscape Evapotranspiration =
Landscape Coefficient x Reference Evapotranspiration

This formula (called the ET_L formula) states that water needs of a landscape planting (landscape evapotranspiration, ET_L) is calculated by multiplying the landscape coefficient (K_L) and the reference evapotranspiration (ET_o).

As mentioned above, the ET_L formula is basically the same as the ET_c formula from Chapter 1, except that a landscape coefficient (K_L) has been substituted for the crop coefficient (K_c). This change is necessary because of important differences which exist between crop or turfgrass systems and landscape plantings (see "Why a Landscape Coefficient").

The following is an example of a simple calculation using the landscape coefficient in the landscape evapotranspiration (ET_L) formula.

Example: A landscape architect wants to estimate water loss for the month of August from a large groundcover area being considered for a new commercial office park in Fresno. The architect looked up the reference evapotranspiration for August in Fresno (Appendix A) and found it to be 7.1 inches. The architect assigned a landscape coefficient value of 0.2. Using this information and the landscape evapotranspiration formula (ET_L formula), the architect makes the following calculations:

$K_L = 0.2$
$ET_o = 7.1$ inches for August in Fresno

$ET_L = K_L \times ET_o$
$ET_L = 0.2 \times 7.1 = 1.42$ inches

The architect estimates that the groundcover will need 1.4 inches in the month of August. (This is not the total amount of irrigation water needed, however, as irrigation efficiency needs to be considered. This topic is addressed in Chapter 5.)

Figure SB (2/3 pp.)

In this example, a landscape coefficient was assigned. In actual practice, K_L needs to be calculated. The formula needed to calculate K_L is the heart of the landscape coefficient method and is the subject of the next discussion.

The Landscape Coefficient Formula

As the name implies, the landscape coefficient was derived specifically to estimate water loss from landscape plantings. It has the same function as the crop coefficient, but is not determined in the same way. Landscape coefficients are calculated from three factors: species, density, and microclimate. These factors are used in the landscape coefficient formula as follows:

$$K_L = k_s \times k_d \times k_{mc}$$

Landscape Coefficient =
species factor x density factor x microclimate factor

This formula (called the K_L formula) states that the landscape coefficient is the product of a species factor multiplied by a density factor and a microclimate factor. By assigning numeric values to each factor, a value for K_L can be determined. The landscape coefficient is then used in the ET_L formula, just as the crop coefficient is used in the ET_c formula.

Why a Landscape Coefficient?

Crop coefficients are used for agricultural crops and turfgrasses, so why not for landscape plantings? There are three key reasons why landscape coefficients are needed instead.

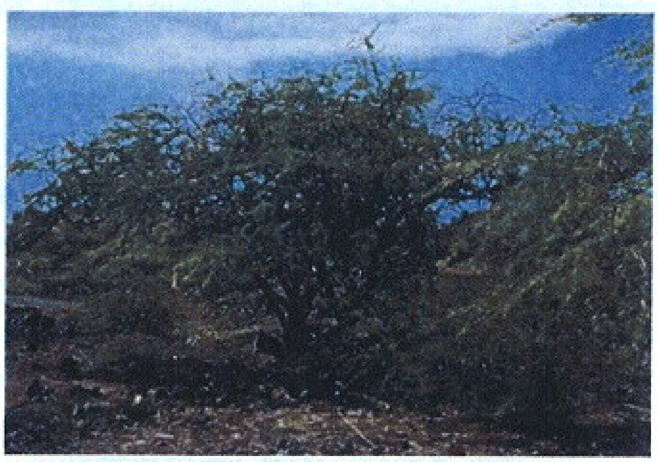
1. Unlike a crop or turfgrass, landscape plantings are typically composed of more than one **species**. Collections of species are commonly irrigated within a single irrigation zone, and the dif-

ET Rates and Plant Water Needs

Soil water availability plays a major role in controlling the rate of water loss from plants (ET rate). Many plants will lose water at a maximum rate as long as it is available. For example, some desert species have been found to maintain ET rates equivalent to temperate zone species when water is available. When soil moisture levels decrease, however, ET rates in desert species decline rapidly.

In landscape management, it is not the objective to supply all the water needed to maintain maximum ET rates. Rather, it is the intent to supply only a sufficient amount of water to maintain health, appearance and reasonable growth. Maximum ET rates are not required to do this.

The ET_L formula calculates the amount of water needed for health, appearance and growth, not the maximum amount that can be lost via evapotranspiration.



Some desert species, such as mesquite (*Prosopis glandulosa torreyana*), have been found to maintain ET rates equivalent to temperate zone species when water is available (Levitt et al 1995). When soil moisture levels decrease, however, ET rates in desert species decline rapidly.

Figure SB (3/3 pp.)

Table 2-4. Estimated Plant-Water-Use Coefficients K_{co} for Native Vegetation (From Wymore, 1974)

Vegetation	K_{co} Nov.-March	April	May	June	July
Sagebrush-grass	0.50	0.60	0.80	0.80	0.80
Pinyon-Juniper	0.65	0.70	0.80	0.80	0.80
Mixed Mountain shrub	0.60	0.67	0.81	0.85	0.82
Coniferous forest	0.70	0.71	0.80	0.80	0.80
Aspen forest	0.60	0.67	0.85	0.90	0.86
Rockland & Misc.	0.50	0.60	0.65	0.65	0.65
Phreatophytes	1.00	1.00	1.00	1.00	1.00
		Aug.	Sept.	Oct.	
Sagebrush-grass		0.71	0.53	0.50	
Pinyon-Juniper		0.80	0.69	0.65	
Mixed Mountain shrub		0.74	0.65	0.60	
Coniferous forest		0.79	0.75	0.71	
Aspen forest		0.75	0.65	0.60	
Rockland & Misc.		0.60	0.50	0.50	
Phreatophytes		1.00	1.00	1.00	

exists at apparent suctions greater than about 15 atmospheres. The volumetric-water content below which plants cannot use water is the *permanent wilting* water content, θ_{wp}. The maximum available water, AW_m, is therefore given by

$$AW_m = (S_r - \theta_{wp})\, D_r \qquad (2\text{-}44)$$

where D_r is the rooting depth of the plant. Note that AW_m is a volume per unit area. The available water AW can vary between AW_m and zero, the latter condition occurring when the volumetric water content is θ_{wp} everywhere in the root zone.

Water which enters the root zone is assumed to add to the existing available water until AW_m is reached. Any water in addition to that required to bring the available water to its maximum value and not used as ET is assumed to leave the root zone as deep percolation W in a matter of a few days. Plants are believed to transpire at a rate which decreases as AW decreases. Jensen et al. (1970) suggests that

$$K_c = K_{co} \frac{\ln\left(\frac{AW}{AW_m} \times 100 + 1\right)}{\ln 101} \qquad (2\text{-}45)$$

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Figure S1

3-Year Lag in Return Flows from Agricultural and M&I Irrigation

Table 4.8-1: Base Scenario for Natural Recharge Calculation: Alfalfa AWT of 6.5 af/ac and 100% excess applied water as return flow; M&I urban area 70% sewered
(afy)

Study Period	Year	Return Flows – M&I – Urban Area – Septic tank Gross = Net	Urban Area – Outdoor Irrigation Gross	Urban Area – Outdoor Irrigation Net	MWC and RR Areas – Septic tank Gross = Net	MWC and RR Areas – Outdoor Irrigation Gross	MWC and RR Areas – Outdoor Irrigation Net	Recycled Gross = Net	Agricultural Gross	Agricultural Net	Artificial Recharge – Spreading Gross = Net	Artificial Recharge – Injection Gross = Net	Outflows – Urban Pumping	Outflows – Agricultural Pumping	Outflows – Pumpage to Aqueduct	Outflows – Other	Total Pumping	Total Outflow	Change in Storage	Total Artificial Recharge	Total Return Flows (Net)	Natural Recharge
1929-1944	1929	392	317		168	43		0	61,417		0	0	3,241	204,724	0	300						
	1930	421	340		180	46		0	54,034		0	0	3,423	180,112	0	300						
	1931	449	363		193	49		0	51,037		0	0	3,606	170,125	0	300						
	1932	478	386		205	53		0	48,041		0	0	3,788	160,138	0	300						
	1933	507	409		217	56		0	45,045		0	0	3,971	150,150	0	300						
	1934	536	433		230	59		0	42,049		0	0	4,153	140,163	0	300						
	1935	564	456		242	62		0	39,053		0	0	4,335	130,176	0	300						
	1936	593	479		254	65		0	43,383		0	0	4,518	144,611	0	300						
	1937	622	502		266	68		0	47,713		0	0	4,700	159,045	0	300						
	1938	650	525		279	72		0	52,044		0	0	4,882	173,479	0	300						
	1939	679	548		291	75		0	56,374		0	0	5,065	187,914	0	300						
	1940	708	572		303	78		0	60,704		0	0	5,247	202,348	0	300						
	1941	736	595		316	81		0	63,882		0	0	5,430	212,941	0	300						
	1942	765	618		328	84		0	67,060		0	0	5,612	223,533	0	300						
	1943	794	641		340	87		0	70,238		0	0	5,794	234,126	0	300						
	1944	823	664		353	91		0	73,416		0	0	5,977	244,719	0	300						
1945-1950	1945	851	687		365	94		0	76,593		0	0	6,159	255,311	0	300						
	1946	880	711		377	97		0	82,188		3,625	0	6,341	273,980	0	300						
	1947	845	682		362	93		0	88,027		3,625	0	6,049	296,757	0	300						
	1948	929	750		398	102		0	96,749		0	0	6,747	322,497	0	300						
	1949	1,114	900		478	123		0	98,305		0	0	8,296	327,685	0	300						
	1950	891	719		382	98		0	104,303		0	0	6,432	347,676	0	300						
1951-1962	1951	844	681	750	362	93	102	0	108,765	96,749	0	0	6,039	362,549	0	300	368,589	368,889	(278,874)	0	96,807	(8,792)
	1952	785	634	900	337	86	123	0	107,357	98,305	0	0	5,550	357,856	0	300	363,406	363,706	(278,874)	0	100,450	(15,618)
	1953	1,297	1,048	719	556	143	98	116	105,949	104,303	0	0	9,621	353,162	0	300	362,983	363,283	(278,874)	0	107,089	(22,680)
	1954	1,320	1,066	681	566	145	93	109	104,540	108,765	0	0	10,013	348,468	0	300	358,481	358,781	(278,874)	0	111,534	(31,627)
	1955	1,382	1,116	634	592	152	86	142	103,132	107,357	0	0	10,529	343,774	0	300	354,303	354,603	(278,874)	0	110,193	(34,464)
	1956	1,859	1,501	1,048	797	205	143	185	101,724	105,949	0	0	13,088	339,081	0	300	352,169	352,469	(278,874)	0	109,980	(36,385)
	1957	1,715	1,385	1,066	735	189	145	171	100,316	104,540	0	0	12,553	334,387	0	300	346,940	347,240	(278,874)	0	108,372	(40,006)
	1958	1,779	1,437	1,116	763	196	152	70	102,039	103,132	0	0	12,409	340,131	0	300	352,540	352,840	(278,874)	0	107,012	(33,048)
	1959	2,164	1,748	1,501	928	238	205	42	103,762	101,724	0	0	16,745	345,792	0	300	362,536	362,836	(278,874)	0	106,564	(22,602)
	1960	1,812	1,464	1,385	777	200	189	26	105,485	100,316	0	0	14,736	351,535	0	300	366,271	366,571	(278,874)	0	104,565	(15,808)
	1961	2,712	2,190	1,437	1,162	299	196	23	107,209	102,039	0	0	22,625	357,279	0	300	379,904	380,204	(278,874)	0	107,589	(5,236)
	1962	3,739	3,019	1,748	1,602	412	238	41	102,946	103,762	0	0	25,658	351,143	0	300	376,801	377,101	(278,874)	0	111,131	(12,903)
1963-1970	1963	2,507	2,024	1,464	1,074	276	200	37	98,684	105,485	0	0	20,776	345,022	0	300	365,798	366,098	(170,219)	0	110,767	85,113
	1964	2,730	2,205	2,190	1,170	301	299	56	94,421	107,209	0	0	22,514	338,862	0	300	361,377	361,677	(170,219)	0	113,654	77,805
	1965	2,732	2,206	3,019	1,171	301	412	92	90,159	102,946	0	0	21,475	332,652	0	300	354,127	354,427	(170,219)	0	110,372	73,836
	1966	2,894	2,337	2,024	1,240	319	276	103	85,896	98,684	0	0	24,141	326,530	0	300	350,672	350,972	(170,219)	0	105,221	75,532
	1967	2,742	2,214	2,205	1,175	302	301	124	81,634	94,421	0	0	22,873	320,209	0	300	343,082	343,382	(170,219)	0	100,967	72,196
	1968	3,541	2,859	2,206	1,517	390	301	145	77,371	90,159	0	0	26,367	314,087	0	300	340,475	340,775	(170,219)	0	97,869	72,687
	1969	3,719	3,003	2,337	1,594	410	319	154	73,109	85,896	0	0	28,920	307,878	0	300	336,798	337,098	(170,219)	0	94,018	72,861
	1970	3,295	2,661	2,214	1,412	363	302	152	68,846	81,634	0	0	25,863	300,142	0	300	326,005	326,305	(170,219)	0	88,009	67,077
1971-1978	1971	3,528	2,849	2,859	1,512	389	390	150	72,429	77,371	0	0	27,896	308,917	0	300	336,813	337,113	(55,179)	0	85,610	196,124
	1972	3,920	3,166	3,003	1,680	432	410	148	59,466	73,109	0	0	31,196	255,911	0	300	287,108	287,408	(55,179)	0	82,268	149,959
	1973	3,751	3,029	2,661	1,608	413	363	145	58,653	68,846	0	0	29,582	250,227	0	300	279,809	280,109	(55,179)	0	77,373	147,556
	1974	3,629	2,930	2,849	1,555	400	389	143	61,327	72,429	0	0	29,130	257,480	0	300	286,611	286,911	(55,179)	0	80,993	150,738
	1975	3,560	2,875	3,166	1,526	392	432	287	64,039	59,466	0	0	27,891	266,373	0	300	294,263	294,563	(55,179)	0	68,435	170,949
	1976	3,532	2,852	3,029	1,514	389	413	285	52,115	58,653	0	0	28,100	197,077	0	300	225,177	225,477	(55,179)	0	67,427	102,871
	1977	3,153	2,547	2,930	1,351	347	400	283	70,023	61,327	0	0	25,743	266,118	0	300	291,860	292,160	(55,179)	0	68,445	167,537
	1978	3,471	2,803	2,875	1,488	382	392	281	63,991	64,039	0	0	21,452	236,472	0	300	257,924	258,224	(55,179)	0	72,545	130,499
1979-1984	1979	3,705	2,992	2,852	1,588	408	389	279	55,533	52,115	0	0	22,525	190,180	0	300	212,705	213,005	(4,798)	0	60,926	147,369
	1980	3,616	2,920	2,547	1,550	399	347	890	58,345	70,023	0	0	22,147	193,315	0	300	215,462	215,762	(4,798)	0	78,973	132,081
	1981	3,865	3,121	2,803	1,656	426	382	1,303	52,196	63,991	0	0	20,889	160,637	0	300	181,525	181,825	(4,798)	0	74,001	103,117
	1982	3,988	3,221	2,992	1,709	439	408	2,416	44,705	55,533	0	0	24,408	152,229	0	300	176,636	176,936	(4,798)	0	67,049	105,181
	1983	3,265	2,637	2,920	1,399	360	399	1,929	42,747	58,345	0	0	19,711	157,425	0	300	177,136	177,436	(4,798)	0	68,257	104,472
	1984	4,559	3,682	3,121	1,954	502	426	2,046	37,326	52,196	0	0	26,308	139,104	0	300	165,412	165,712	(4,798)	0	64,302	96,702
1985-1991	1985	4,988	4,028	3,221	2,138	549	439	2,239	33,374	44,705	0	0	25,343	118,844	0	300	144,187	144,487	2,139	0	57,729	86,896
	1986	5,771	4,660	2,637	2,473	635	360	2,474	27,371	42,747	0	0	29,936	100,691	0	300	130,627	130,927	2,139	0	56,462	76,604
	1987	6,372	5,146	3,682	2,731	702	502	3,241	21,197	37,326	0	0	31,652	78,727	0	300	110,379	110,679	2,139	0	53,654	58,964
	1988	6,811	5,500	4,028	2,919	750	549	3,349	24,950	33,374	0	0	34,607	89,925	0	300	124,532	124,832	2,139	0	51,030	75,941
	1989	8,288	6,693	4,660	3,552	913	635	6,437	15,488	27,371	0	0	36,944	49,673	0	300	86,618	86,918	2,139	0	50,944	38,112
	1990	8,342	6,736	5,146	3,575	919	702	6,678	15,843	21,197	0	0	34,205	51,052	0	300	85,257	85,557	2,139	0	45,839	41,856
	1991	6,964	5,623	5,500	2,984	767	750	6,657	15,125	24,950	0	0	36,695	62,146	15,658	300	114,499	114,799	2,139	0	47,605	69,132
1992-1997	1992	7,714	6,230	6,693	3,306	850	913	6,306	19,606	15,488	0	0	33,108	77,510	0	300	110,618	110,918	33,467	0	40,422	103,963
	1993	9,565	7,724	6,736	4,099	1,053	919	6,433	16,610	15,843	0	0	38,366	61,654	0	300	100,019	100,319	33,467	0	43,596	90,191
	1994	10,443	8,434	5,623	4,476	1,150	767	6,429	17,198	15,125	0	0	44,233	59,395	0	300	103,628	103,928	33,467	0	42,863	94,532
	1995	10,526	8,501	6,230	4,511	1,159	850	6,877	19,800	19,606	0	0	47,976	68,879	0	300	116,855	117,155	33,467	0	48,600	102,022
	1996	11,707	9,454	7,724	5,017	1,289	1,053	6,879	22,717	16,610	0	238	49,134	74,152	0	300	123,285	123,585	33,467	238	48,991	107,823
	1997	11,790	9,521	8,434	5,053	1,298	1,150	7,163	25,419	17,198	0	656	49,240	79,096	0	300	128,336	128,636	33,467	656	50,788	110,658
1998-2005	1998	10,574	8,539	8,501	4,532	1,164	1,159	7,729	27,019	19,800	0	0	42,626	91,622	0	300	134,247	134,547	(62,145)	0	52,294	20,108
	1999	12,341	9,966	9,454	5,289	1,359	1,289	7,357	28,216	22,717	0	0	47,318	89,929	0	300	137,247	137,547	(62,145)	0	58,449	16,954
	2000	12,908	10,424	9,521	5,532	1,422	1,298	7,417	33,363	25,419	5,001	0	47,703	106,667	0	300	154,370	154,670	(62,145)	5,001	62,097	25,427
	2001	13,299	10,740	8,539	5,700	1,465	1,164	7,824	30,032	27,019	0	0	56,278	101,109	0	300	157,387	157,687	(62,145)	0	63,546	31,996
	2002	13,351	10,782	9,966	5,722	1,470	1,359	5,729	33,634	28,216	0	0	52,005	120,375	0	300	172,380	172,680	(62,145)	0	64,337	46,198
	2003	13,012	10,508	10,424	5,577	1,433	1,422	5,033	31,698	33,363	0	0	46,682	116,302	0	300	162,984	163,284	(62,145)	0	66,831	32,308
	2004	13,724	11,083	10,740	5,882	1,511	1,465	5,011	30,855	30,032	0	0	52,602	111,690	0	300	164,291	164,591	(62,145)	0	66,854	35,592
	2005	13,577	10,964	10,782	5,819	1,495	1,470	3,070	29,474	33,634	11	558	49,341	102,054	0	300	151,395	151,695	(62,145)	569	68,352	20,629
		A		B	C		D	E		F	G	H	I	J	K	L	I+J+K	1 = I+J+K+L	2	3 = G+H	4 = ΣA..F	1+2-3-4

M&I return flows based on 45/55% indoor/outdoor water usage.
Return Flows from M&I septic tanks and Recycled water (A, C, and E) and Artificial recharge (G and H) are not lagged.
Return Flows from M&I outdoor irrigation and Agricultural irrigation are lagged by 3 years (Highlighted in yellow, Columns B, D, and F).
Change in storage is the sum of Gravity Drainage and Compaction.

Period	Period Length (yr)	Total Outflow (af)	Total Storage Change (af)	Total Artificial Recharge (af)	Total Return Flows (af)	Natural Recharge (afy)
1951-1962	12	4,348,524	(3,346,489)	0	1,283,297	(23,431)
1963-1970	8	2,780,733	(1,361,748)	0	821,877	74,639
1971-1978	8	2,281,964	(441,432)	0	604,298	152,029
1979-1984	6	1,130,879	(28,249)	0	413,509	114,820
1985-1991	7	798,198	14,971	0	363,664	64,215
1992-1997	6	684,542	200,801	894	275,261	101,531
1998-2005	8	1,236,792	(497,163)	5,570	504,738	28,651
1951-2005	55	13,241,343	(5,459,309)	6,464	4,266,573	63,800

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Figure S2

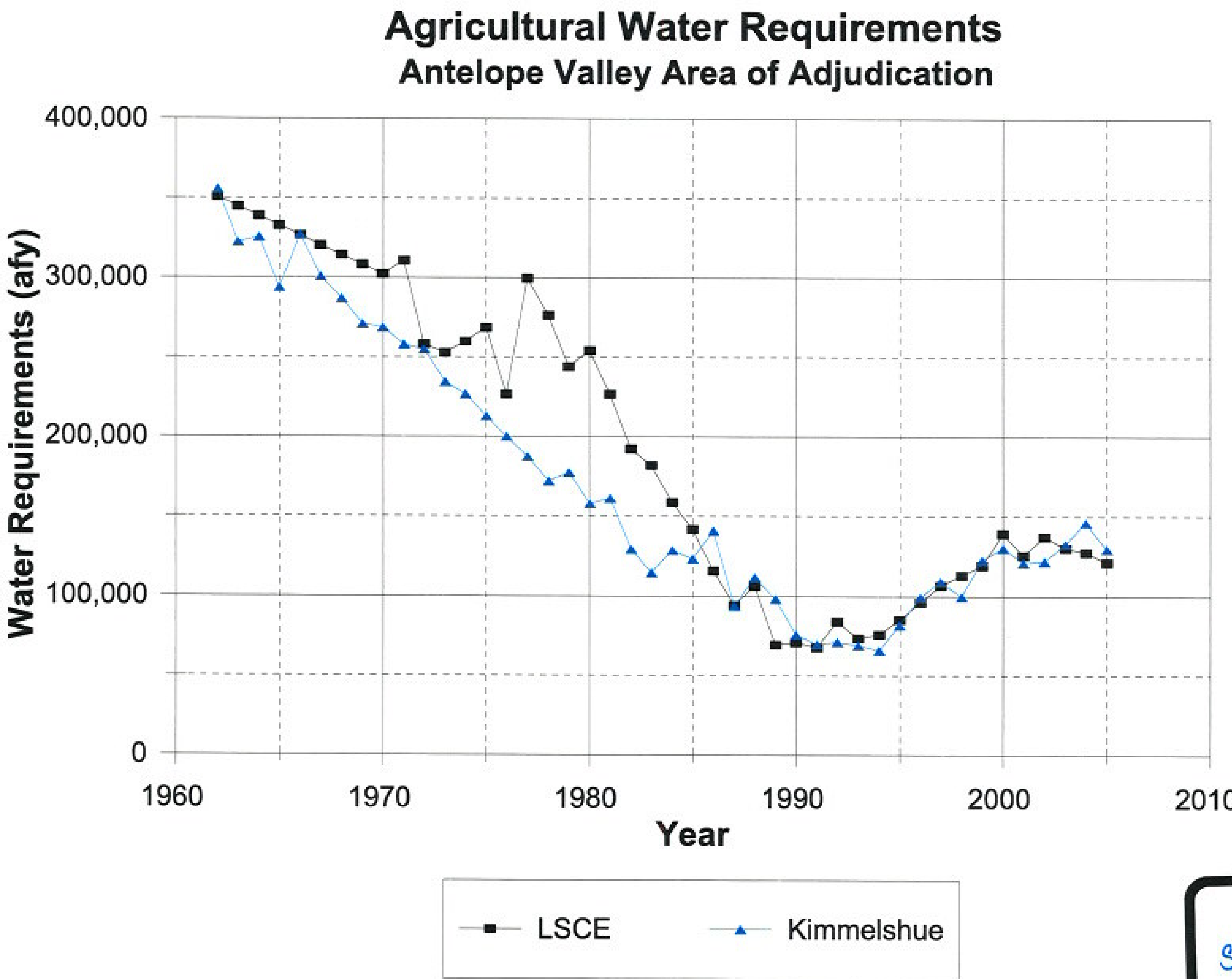

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Figure K1

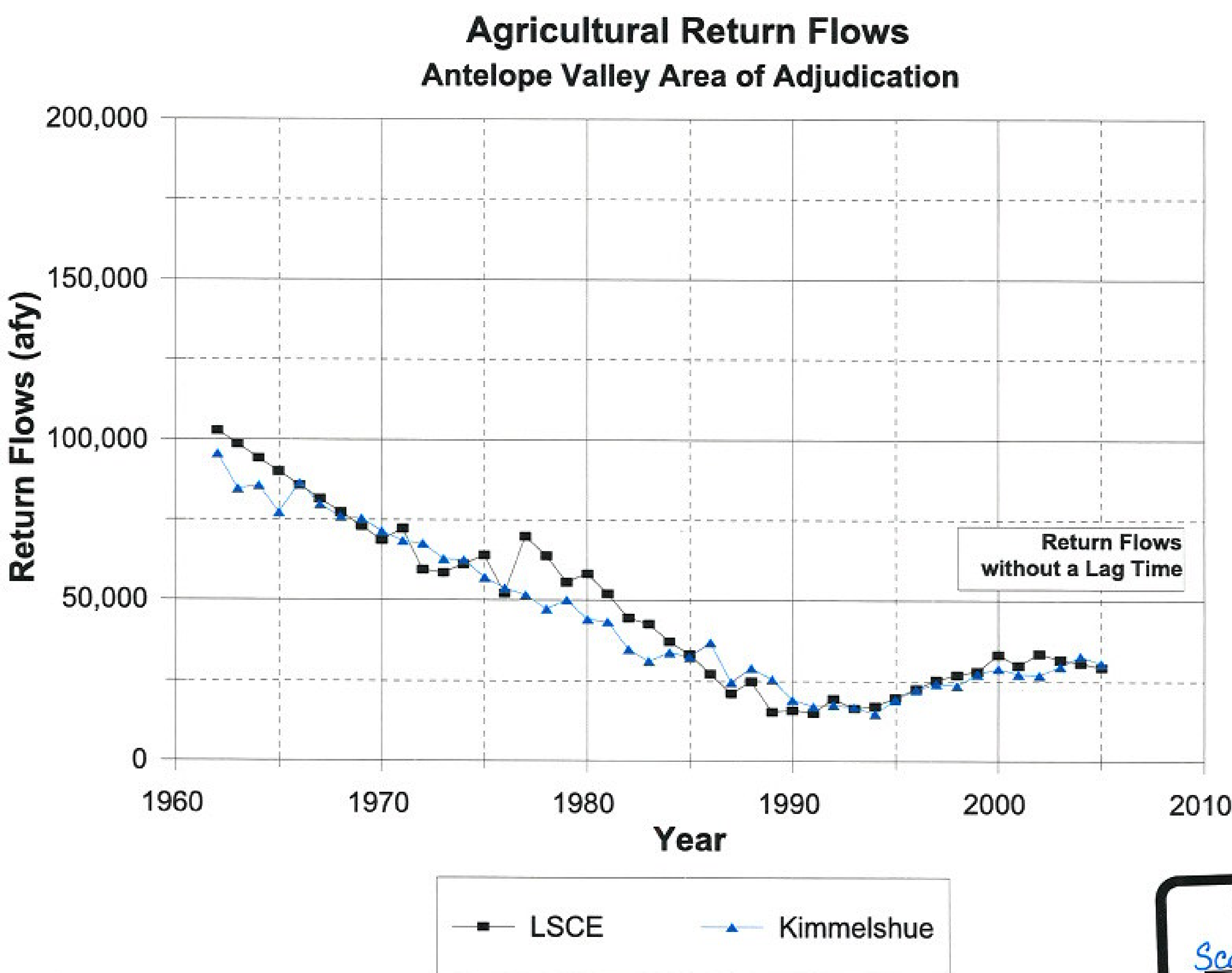

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Figure K2

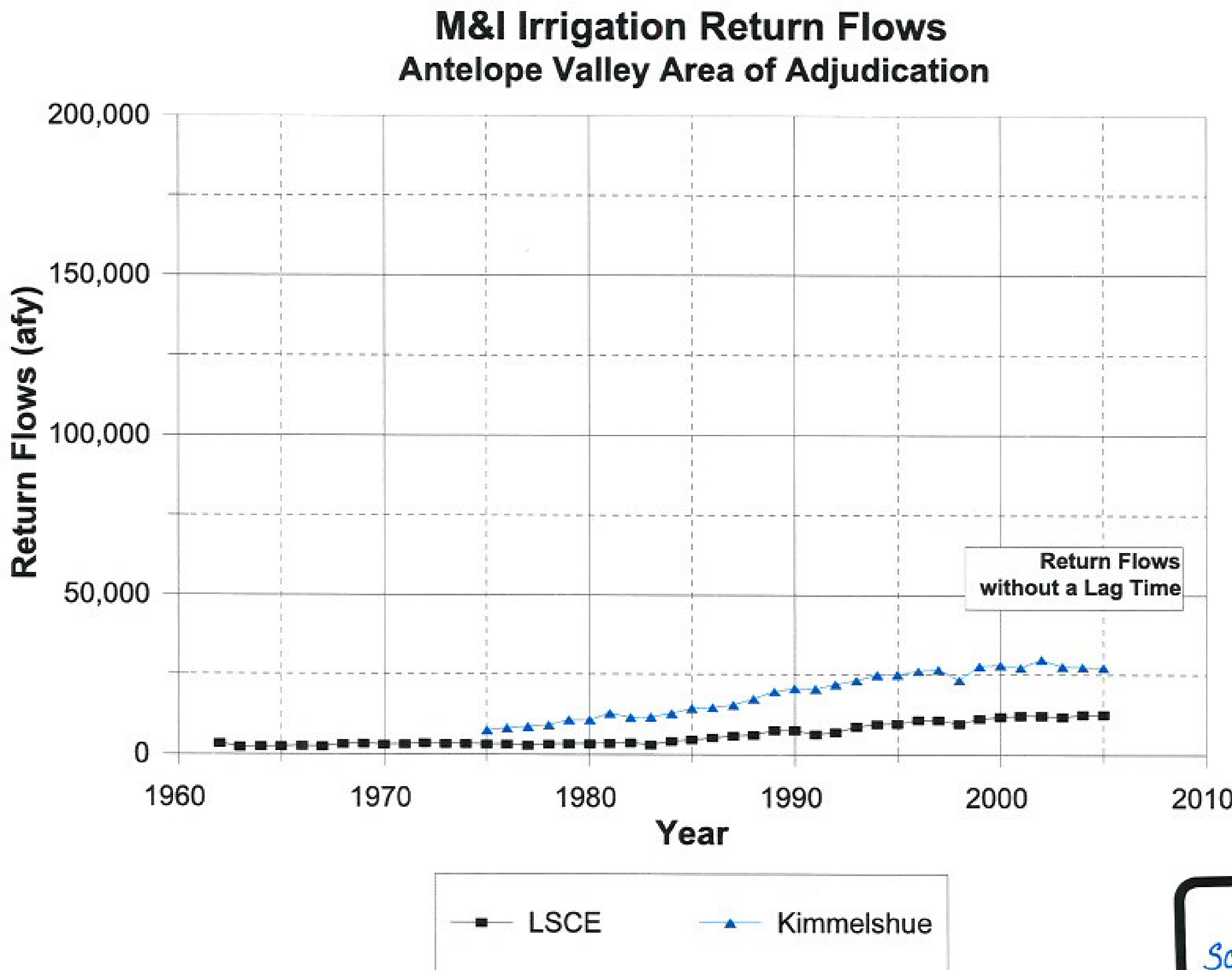

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Figure K3

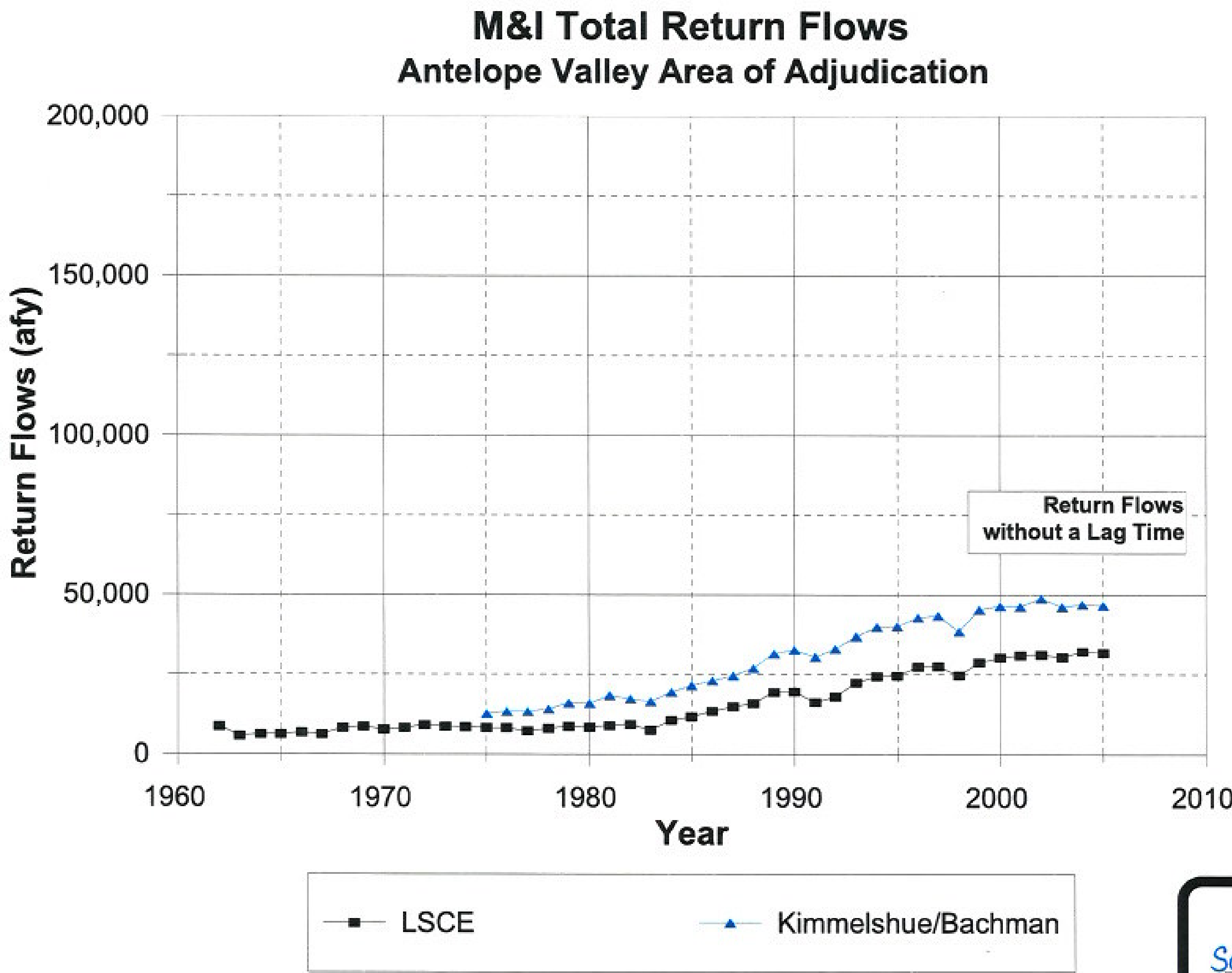

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Figure K4

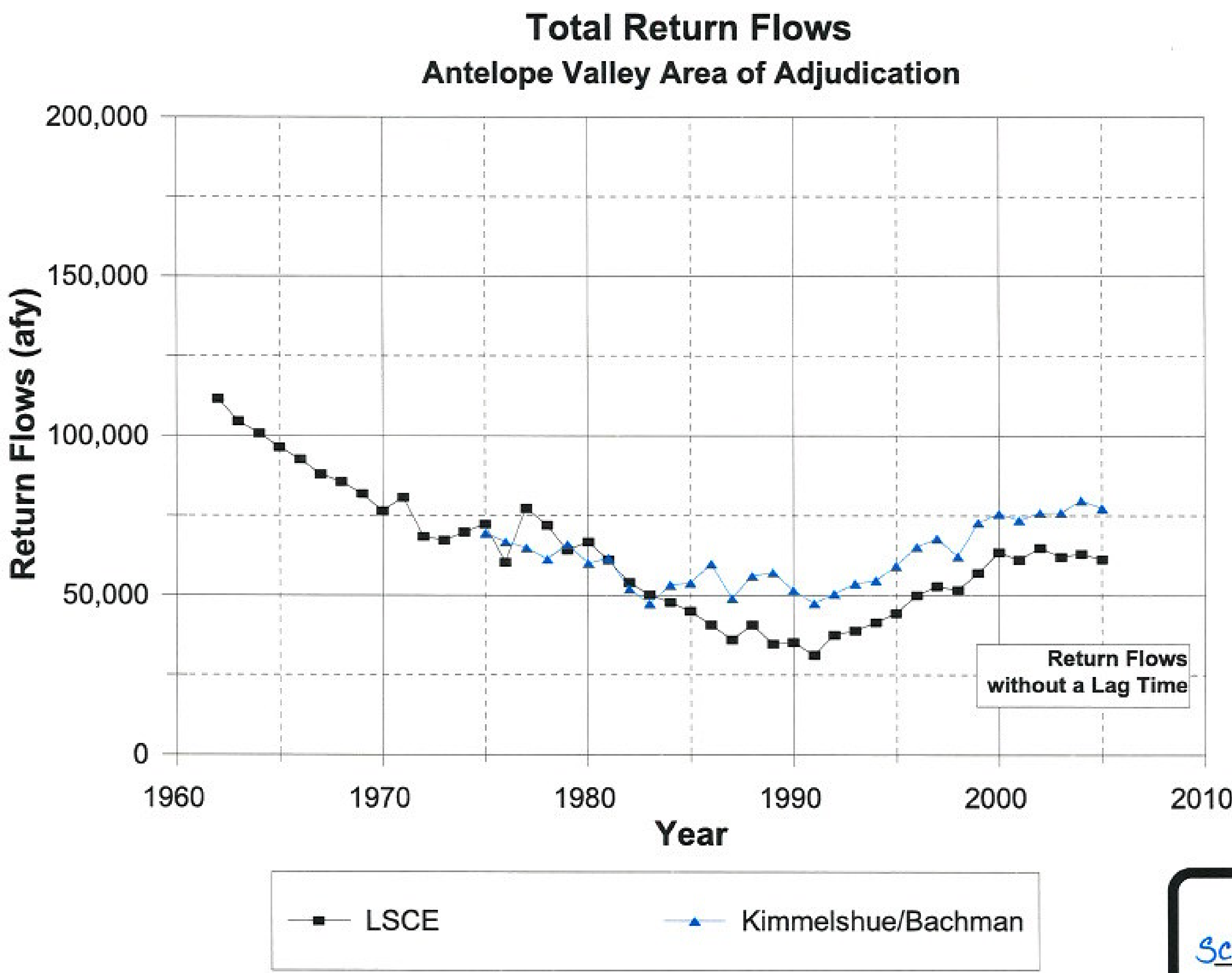

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Figure K5

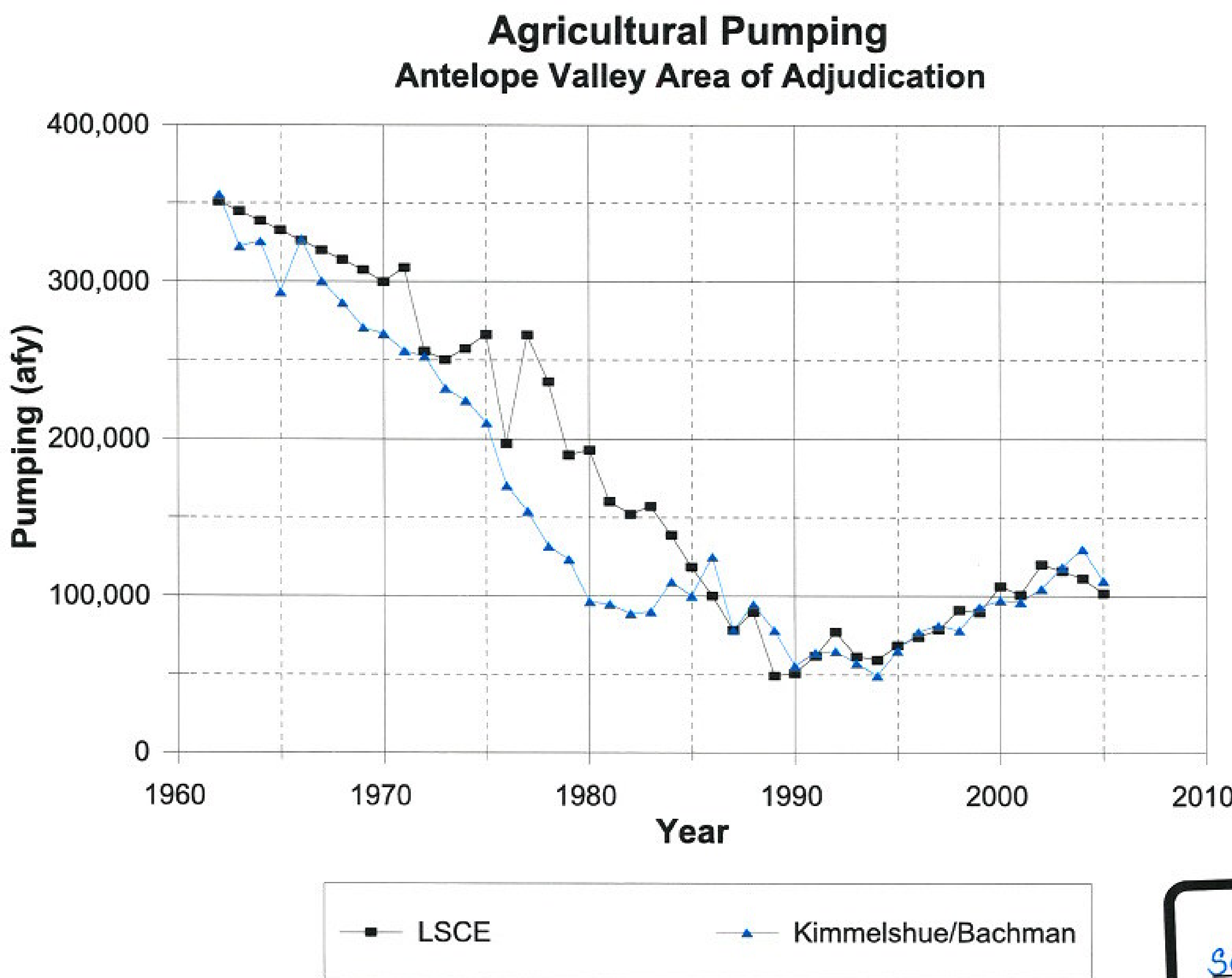
Agricultural Pumping
Antelope Valley Area of Adjudication
Pumping (afy)
400,000
300,000
200,000
100,000
0
1960
1970
1980
1990
2000
2010
Year
LSCE
Kimmelshue/Bachman

Figure K6

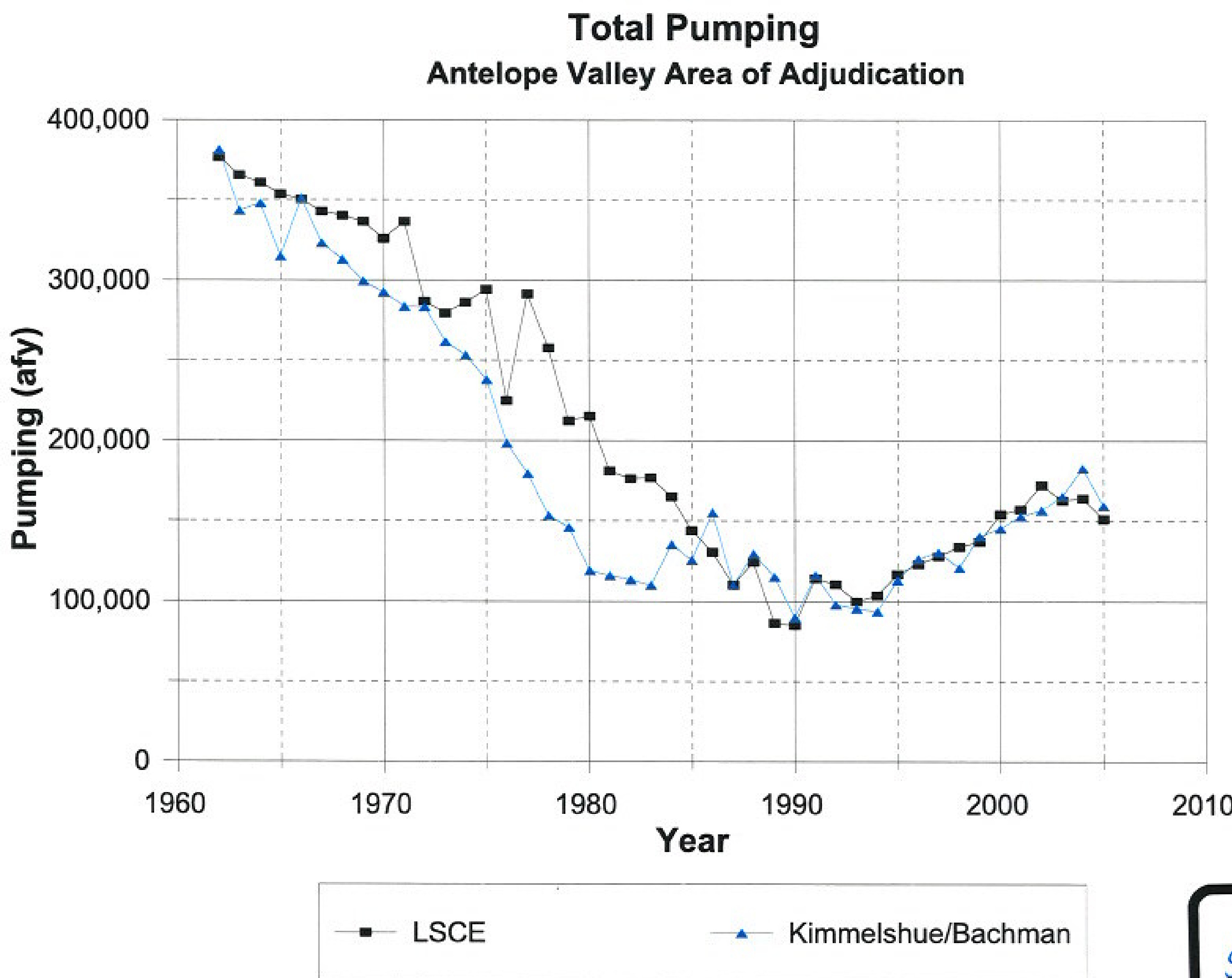

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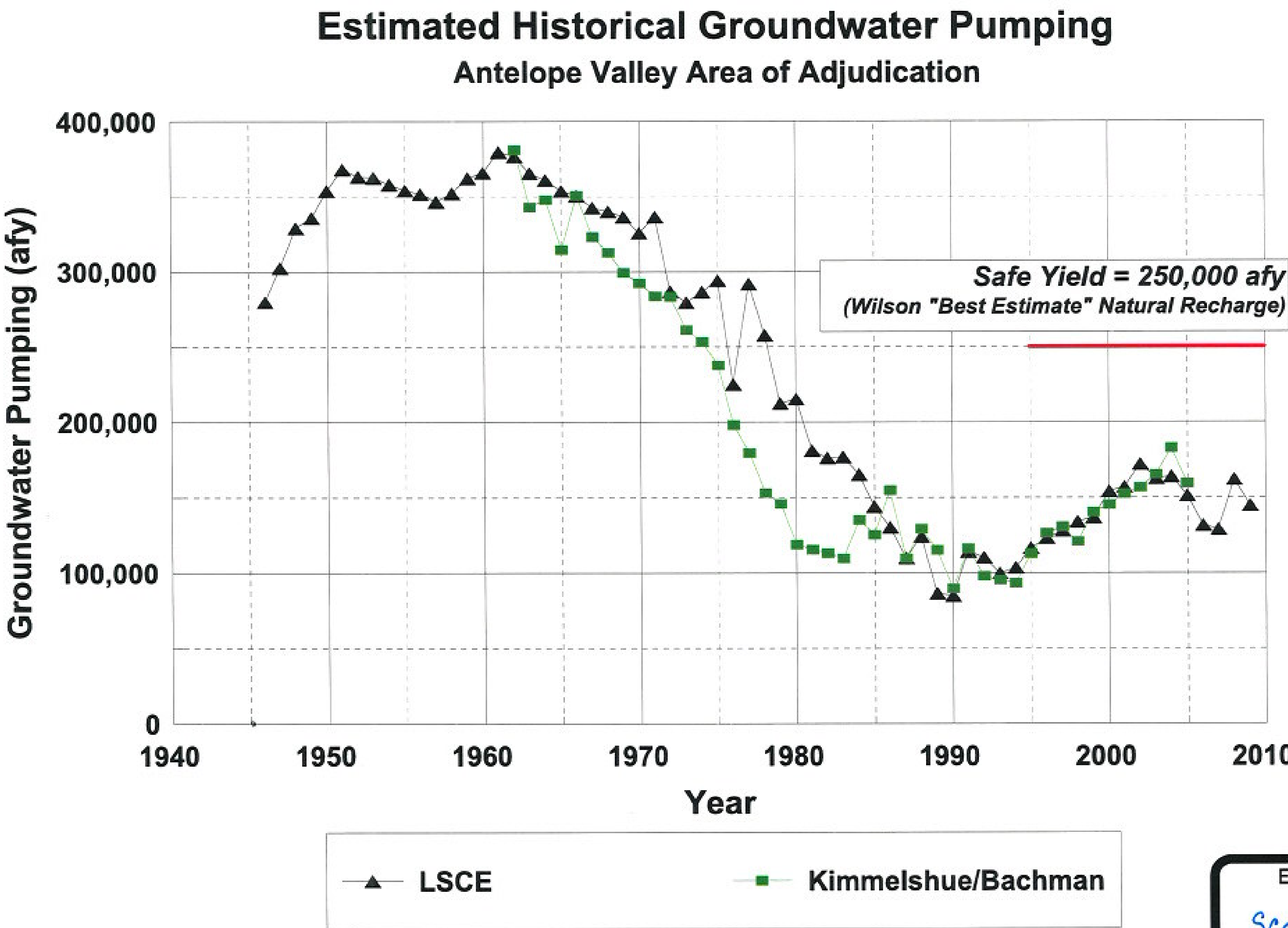
Figure K7



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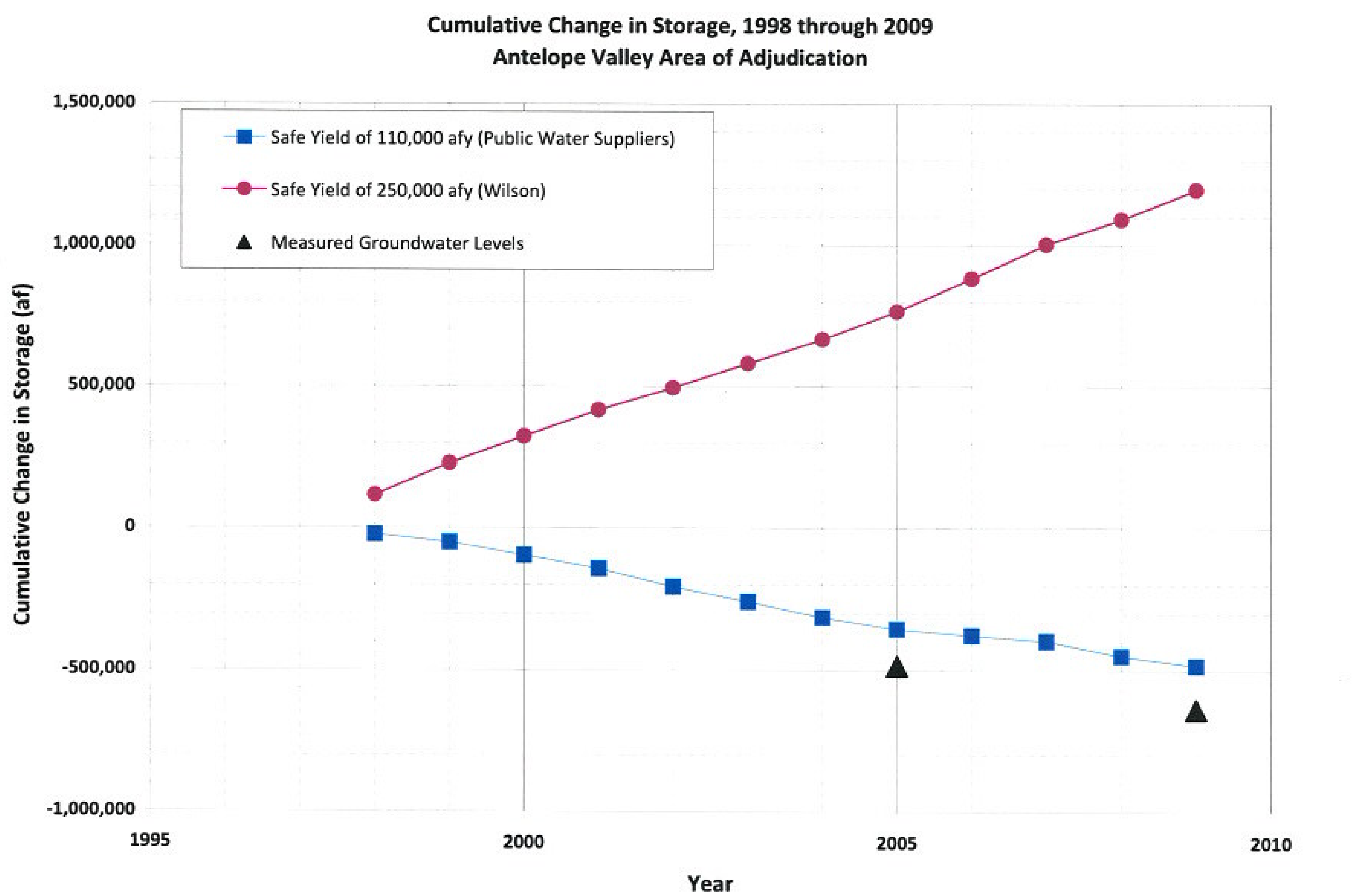

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Figure W2