EXHIBIT "K"

Date: December 17, 2012

To: File

From: David Dorrance, WDS II

RE: Summary of Groundwater Pumpage Documentation & Estimation Methods

This memorandum summarizes the methods that were used to estimate groundwater pumpage for WDS California II, LLC (WDS II) parcels in the Antelope Valley for the periods 2000-2004 and 2011-2012.

Results

Separately provided tables prepared as responses to Requests 1 and 2 of the Discovery Order for Phase 4 Trial (dated December 11, 2012) detail parcel-by-parcel results of the analysis summarized here. The following is a summation of those estimated annual groundwater pumpage volumes:

2000: 5,440 AF

2001: 4,758 AF

2002: 4,452 AF

2003: 5,465 AF

2004: 5,859 AF

2011: 2,244 AF

2012: 2,550 AF

Table 1 lists the WDS II parcels and Figure 1 depicts the locations of these parcels.

Methods

1) An inventory of all wells on WDS II parcels was performed. With the aid of former owners, tenants, the Department of Water Resources (DWR) and Southern California Edison (SCE), this inventory included a compilation of all available information, including:
    a. Driller logs;
    b. SCE pump tests;
    c. DWR, SCE and owner/tenant measured water levels;
    d. Flow meter readings;
    e. Operational/maintenance logs; and
    f. SCE power bills.
2) Where available, directly measured pumpage volumes were tabulated.

3) Where data were not available for Step 2 and the well under consideration was driven by an electric motor, monthly SCE power usage records were combined with well efficiency, dynamic depth to water and wellhead pressure data from well pump tests to estimate groundwater pumpage using the following methodology that was developed by the Arizona Department of Water Resources: http://www.azwater.gov/azdwr/statewideplanning/drought/documents/estimating_water_use.pdf
4) Where data were not available for Step 2 or Step 3 (e.g. certain diesel wells and where the former owner/tenant did not keep pumpage records), the applied water requirements of crops grown on WDS II parcels were estimated and Antelope Valley East Kern Water Agency (AVEK) surface water deliveries were deducted to provide an estimate of groundwater pumpage as follows.
5) Where available, the crops that were grown on each parcel in each year were obtained from the then landowner (or tenant).
6) Kern County annual crop survey databases (http://esps.kerndsa.com/gis/gis-download-data) were downloaded, migrated into GIS (ArcMap 10.1) and overlain with the assessor parcel maps to fill in data gaps on croppage and to confirm data reported by landowners (or tenants).
7) The following imagery was inspected on a parcel by parcel basis to fill in data gaps and to confirm information from Steps 5 and 6:
    a. Global Explorer (5/1/2000);
    b. National Land Cover Dataset for 2001 (a Landsat 7 derived data set by the United States Geological Survey (http://www.epa.gov/mrlc/nlcd-2001.html);
    c. Landsat 7 Imagery acquired on 7/26/2002 (band combinations 321 and 456);
    d. Landsat 7 Imagery acquired on 7/5/2003 (band combinations 321 and 456) and Global Explorer Imagery acquired on 6/1/2003
    e. Landsat 7 Imagery acquired on 7/7/2004 (band combinations 321 and 456).
    f. Landsat 7 Imagery acquired on 7/3/20011 (band combinations 321 and 456).
    g. Landsat 7 Imagery acquired on 7/5/20012 (band combinations 321 and 456).
8) AVEK surface water delivery records were obtained.
9) Total Applied Water requirements were estimated on a parcel-by-parcel basis using the following equation:

Total Applied Water Requirement = (AW_c) x Net Farmable Acreage

Net Farmable Acreage (acres): The imagery cited in Step 7 was inspected on a parcel-by-parcel basis to determine the amount of "unproductive fringe". Based on this inspection a correction factor of 90% to 98% was used to reduce gross acreage to net farmable acreage.

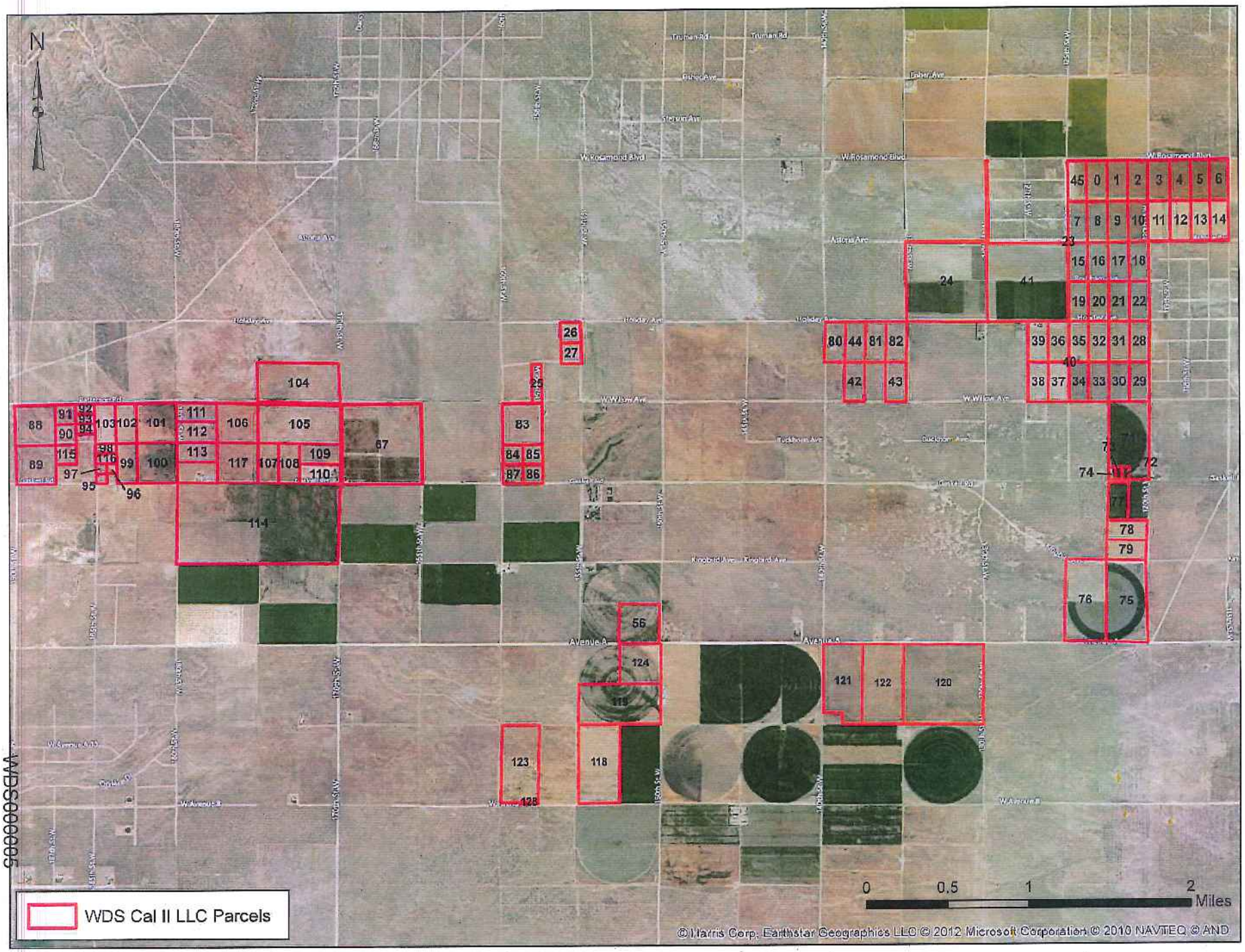
AW_c *(AF/acre)*: This is the unit applied water crop requirement for each crop type as developed by UC Davis & Nebecker (April 17, 2007) and US Davis (April 22, 2008). The only exceptions were: 1) a lower value of 2.0 AF/acre was assumed for grain crops (largely grown on the former Grimmway parcels). This lower assumed value was based on actual water application information reported by the farmer – which grew these crops on a truncated rotation that resulted in less water usage than on other farms in the area; and 2) a duty of 0.83 AF/parcel was assumed for parcels with residential or farm headquarter operations (all of which rely on WDS II domestic wells). This value was based on actual residential usage rates reported by Palmdale for the year 2005 in the City's 2010 Urban Water Management Plan.

10) In some cases, multiple parcels are served by single wells (And AVEK turnouts). These integrated irrigation systems were inspected and the former owners/tenants were consulted to determine which WDS II wells and turnouts served which parcels. The Total Applied Water requirement was summed for these parcel groups and the total AVEK deliveries to parcel groups where deducted from the Total Applied Water Requirement to obtain an estimated groundwater pumpage for the well being evaluated.

TABLE 1: WDS CAL II, LLC Parcels and Map Key

Map ID	APN/AIN
0	359-011-02
1	359-011-03
2	359-011-04
3	359-011-05
4	359-011-06
5	359-011-07
6	359-011-08
7	359-011-09
8	359-011-10
9	359-011-11
10	359-011-12
11	359-011-13
12	359-011-14
13	359-011-15
14	359-011-16
15	359-011-17
16	359-011-18
17	359-011-19
18	359-011-20
19	359-011-21
20	359-011-22
21	359-011-23
22	359-011-24
23	359-011-27
24	359-020-50
25	359-041-05
26	359-041-07
27	359-041-08
28	359-174-01
29	359-174-02
30	359-174-03
31	359-174-04
32	359-174-05
33	359-174-06
34	359-174-07
35	359-174-08
36	359-174-09
37	359-174-10
38	359-174-11
39	359-174-12
40	359-174-14
41	359-240-04
42	359-331-17
43	359-331-19
44	359-331-25
45	359-011-01
56	359-041-30
67	261-196-10
71	359-175-01
72	359-175-02
73	359-175-03
74	359-175-04
75	359-321-01
76	359-321-02
77	359-324-18
78	359-324-20
79	359-324-21
80	359-331-24
81	359-331-26
82	359-331-27
83	359-041-15
84	359-041-24
85	359-041-25
86	359-041-26
87	359-041-27
88	261-193-02
89	261-193-03
90	261-193-06
91	261-193-07
92	261-193-08
93	261-193-09
94	261-193-10
95	261-193-15
96	261-193-17
97	261-193-18
98	261-193-20
99	261-193-22
100	261-193-23
101	261-193-24
102	261-193-25
103	261-193-26
104	261-194-28
105	261-194-29
106	261-194-30
107	261-194-36
108	261-194-37
109	261-194-38
110	261-194-39
111	261-194-45
112	261-194-46
113	261-194-47
114	261-196-08
115	261-193-05
116	261-193-19
117	261-194-35
118	3258-001-038
119	3258-001-040
120	3261-001-004
121	3261-001-002
122	3261-001-003
123	3258-001-001
124	3258-001-024
128	3258-001-025

Note: in some cases the Map ID numbers are not consecutive


N
WDS Cal II LLC Parcels
0
0.5
1
2
Miles
© Harris Corp, Earthstar Geographics LLC © 2012 Microsoft Corporation © 2010 NAVTEQ © AND

WDS0000005

EXHIBIT "L"

APN's 359-011-02; 359-011-03; 359-011-004; 359-011-05; 359-011-06; 359-011-07; 359-011-08; 359-011-09; 359-011-10; 359-011-11; 359-011-12; 359-011-13; 359-011-14; 359-011-15; 359-011-16; 359-011-17; 359-011-18; 359-011-19; 359-011-20; 359-011-21; 359-011-22; 359-011-23; 359-011-24; 359-011-27; 359-020-50; 359-174-01; 359-174-02; 359-174-03; 359-174-04; 359-174-05; 359-174-06; 359-174-07; 359-174-08; 359-174-09; 359-174-10; 359-174-11; 359-174-12; 359-174-014; 359-240-04 359; 011-01

	Used in Adjudication		Actual Precip at Rosamond, CA				
Month	Assumed Total Precip (in)	Assumed Effective Precip (in)	2000 (in)	2001 (in)	2002 (in)	2003 (in)	2004 (in)
J	1.05	0.53	0.05	1.18	0.2	0.01	0.01
F	1.95	0.98	0.8	3.74	0.06	3.55	1.86
M	0.8	0	0.96	0.66	0.3	0.72	0.24
A	0.48	0	0.1	0.58	0	0.96	0.05
M	0.12	0	0	0	0.02	0.27	0
J	0.05	0	0	0	0	0	0
J	0.12	0	0.01	0.02	0	0.11	0
A	0.04	0	0	0	0	0	0
S	0.16	0	0	0	0.01	0	0
O	0.16	0	0.01	0.24	0.01	0.23	1.93
N	0.37	0	0	0.6	0.66	0.32	0.16
D	0.54	0.27	0	0.64	1.04	0.22	3.63
Total	**5.84**		**1.93**	**7.66**	**2.3**	**6.39**	**7.88**
% above normal			-67%	31%	-61%	9%	35%

Land Use Data

				PERCENT OF TOTAL WELL PUMPAGE FOR GROUP													AMOUNT OF GROUNDWATER APPLI							
Map ID	Parcel Group	County	Parcel #	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
0	4	Kern	359-011-02	2%	2%	1%	5%	0%	0%	3%	0%	0%	0%	0%	3%	0%	28	16	9	25	0	0	27	0
1	4	Kern	359-011-03	2%	2%	1%	5%	0%	0%	3%	0%	0%	0%	0%	3%	0%	28	16	9	25	0	0	27	0
2	4	Kern	359-011-04	2%	2%	1%	5%	0%	0%	3%	0%	0%	0%	0%	3%	0%	28	16	9	25	0	0	27	0
3	4	Kern	359-011-05	2%	3%	1%	0%	4%	0%	3%	5%	5%	0%	0%	3%	0%	39	22	9	0	41	0	27	19
4	4	Kern	359-011-06	2%	3%	1%	0%	4%	0%	0%	5%	5%	0%	0%	3%	0%	39	22	9	0	41	0	0	19
5	4	Kern	359-011-07	2%	3%	1%	0%	4%	0%	0%	5%	5%	0%	0%	3%	0%	39	22	9	0	41	0	0	19
6	4	Kern	359-011-08	2%	3%	1%	3%	4%	0%	0%	5%	0%	0%	0%	3%	0%	37	21	8	14	39	0	0	18
7	4	Kern	359-011-09	1%	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	16	9	19	0	0	0	0	0
8	4	Kern	359-011-10	1%	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17	10	20	0	0	0	0	0
9	4	Kern	359-011-11	1%	1%	3%	0%	0%	3%	3%	0%	0%	0%	0%	0%	0%	17	10	20	0	0	31	27	0
10	4	Kern	359-011-12	1%	1%	3%	0%	0%	5%	3%	0%	0%	0%	0%	0%	7%	17	10	20	0	0	49	27	0
11	4	Kern	359-011-13	2%	1%	2%	6%	0%	5%	3%	0%	0%	20%	5%	0%	7%	40	10	15	26	0	49	28	0
12	4	Kern	359-011-14	2%	1%	2%	6%	0%	0%	3%	5%	0%	0%	6%	3%	0%	40	10	15	26	0	0	28	19
13	4	Kern	359-011-15	3%	1%	2%	0%	4%	5%	0%	5%	0%	0%	5%	0%	0%	45	10	15	0	42	43	0	19
14	4	Kern	359-011-16	3%	1%	2%	0%	0%	4%	0%	0%	4%	0%	5%	0%	6%	43	9	14	0	0	41	0	0
15	4	Kern	359-011-17	2%	2%	1%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	28	16	8	24	0	0	0	0
16	4	Kern	359-011-18	2%	2%	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	29	16	9	26	0	0	0	0
17	4	Kern	359-011-19	2%	2%	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	29	16	9	26	0	0	0	0
18	4	Kern	359-011-20	2%	2%	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	29	16	9	26	0	0	0	0
19	4	Kern	359-011-21	2%	1%	1%	0%	4%	0%	3%	3%	0%	0%	0%	3%	0%	38	9	8	0	45	0	26	13
20	4	Kern	359-011-22	2%	1%	1%	0%	5%	0%	3%	4%	0%	0%	0%	3%	0%	40	10	9	0	47	0	27	14
21	4	Kern	359-011-23	2%	1%	1%	0%	4%	0%	0%	5%	0%	0%	0%	3%	0%	42	10	9	0	42	0	0	19
22	4	Kern	359-011-24	3%	1%	1%	0%	4%	0%	0%	5%	0%	0%	0%	3%	0%	45	10	9	0	42	0	0	19
23	4	Kern	359-011-27	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
24	4	Kern	359-020-50	20%	15%	19%	13%	28%	9%	0%	30%	39%	0%	36%	19%	54%	339	105	126	58	288	85	0	114
25	6	Kern	359-041-05	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
26	6	Kern	359-041-07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
27	6	Kern	359-041-08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
28	4	Kern	359-174-01	3%	1%	0%	0%	2%	5%	0%	0%	4%	0%	0%	3%	0%	45	10	0	0	18	43	0	0
29	4	Kern	359-174-02	2%	2%	0%	0%	2%	0%	3%	4%	0%	20%	5%	0%	7%	29	16	0	0	18	0	27	16
30	4	Kern	359-174-03	2%	2%	0%	0%	2%	0%	3%	4%	0%	20%	5%	0%	7%	29	16	0	0	18	0	27	16
31	4	Kern	359-174-04	3%	1%	0%	0%	2%	5%	4%	0%	4%	0%	0%	3%	0%	45	10	0	0	18	43	31	0
32	4	Kern	359-174-05	3%	1%	3%	0%	2%	5%	4%	0%	4%	0%	0%	3%	0%	45	10	20	0	18	43	31	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	PERCENT OF TOTAL WELL PUMPAGE FOR GROUP													AMOUNT OF GROUNDWATER APPLI							
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
33	4	Kern	359-174-06	2%	2%	1%	6%	2%	0%	3%	4%	0%	20%	5%	0%	7%	29	16	9	25	18	0	27	16
34	4	Kern	359-174-07	2%	2%	1%	5%	2%	0%	3%	3%	0%	19%	5%	0%	6%	28	16	8	24	17	0	26	13
35	4	Kern	359-174-08	2%	1%	3%	0%	2%	4%	4%	0%	4%	0%	0%	3%	0%	38	9	19	0	17	41	30	0
36	4	Kern	359-174-09	3%	1%	3%	0%	3%	5%	4%	0%	4%	0%	0%	3%	0%	45	10	20	0	30	43	31	0
37	4	Kern	359-174-10	2%	2%	1%	6%	3%	0%	3%	4%	0%	0%	0%	3%	0%	29	16	9	25	30	0	27	14
38	4	Kern	359-174-11	2%	2%	1%	6%	3%	0%	3%	4%	0%	0%	0%	3%	0%	29	16	9	25	30	0	27	14
39	4	Kern	359-174-12	2%	1%	3%	0%	3%	4%	4%	0%	4%	0%	0%	3%	0%	41	9	18	0	28	39	28	0
40	4	Kern	359-174-14	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
41	4	Kern	359-240-04	10%	18%	22%	10%	9%	40%	24%	0%	17%	0%	26%	23%	0%	162	132	141	44	96	372	193	0
42	8	Kern	359-331-17	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
43	8	Kern	359-331-19	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
44	8	Kern	359-331-25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
45	4	Kern	359-011-01	1%	1%	1%	3%	0%	0%	2%	0%	0%	0%	0%	1%	0%	14	8	4	13	0	0	14	0
56	7	Kern	359-041-30	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	272	272	272	272	272	272	272	272
67	2	Kern	261-196-10	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	#DIV/0!	#DIV/0!	681	681	571	571	571	571	571	571
68	15	Kern	359-041-29	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
69	15	Kern	359-041-31	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	25%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	272
70	15	Kern	359-041-32	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	1
71	5	Kern	359-175-01	47%	26%	17%	5%	14%	24%	24%	26%	26%	27%	27%	28%	15%	10	118	171	53	177	254	254	266
72	5	Kern	359-175-02	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0	4	6	9	13	8	8	9
73	5	Kern	359-175-03	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0	4	6	9	13	8	8	9
74	5	Kern	359-175-04	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	1	1	0	0	0
75	5	Kern	359-321-01	0%	19%	29%	32%	28%	27%	27%	29%	29%	30%	30%	31%	33%	0	85	289	361	348	281	281	293
76	5	Kern	359-321-02	0%	16%	29%	32%	28%	27%	27%	29%	29%	30%	30%	31%	33%	0	71	289	361	348	281	281	293
77	5	Kern	359-324-18	17%	12%	8%	10%	9%	7%	7%	4%	4%	4%	4%	8%	8%	3	54	78	106	108	70	70	44
78	5	Kern	359-324-20	18%	12%	8%	10%	9%	7%	7%	4%	4%	4%	4%	0%	4%	4	55	80	109	110	71	71	45
79	5	Kern	359-324-21	14%	12%	8%	10%	9%	7%	7%	4%	4%	4%	4%	0%	4%	3	55	80	109	110	71	71	45
80	9	Kern	359-331-24	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	1	1	1	1	1	1	1	1
81	9	Kern	359-331-26	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
82	9	Kern	359-331-27	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
83	1	Kern	359-041-15	51%	51%	51%	51%	51%	0%	0%	0%	0%	0%	0%	0%	0%	158	158	158	158	158	0	0	0
84	1	Kern	359-041-24	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	40	40	40	40	40	0	0	0
85	1	Kern	359-041-25	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	40	40	40	40	40	0	0	0
86	1	Kern	359-041-26	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	40	40	40	40	40	0	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	PERCENT OF TOTAL WELL PUMPAGE FOR GROUP													AMOUNT OF GROUNDWATER APPLI							
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
87	1	Kern	359-041-27	10%	10%	10%	10%	10%	100%	100%	100%	100%	100%	100%	100%	100%	31	31	31	31	31	1	1	1
88	3	Kern	261-193-02	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
89	3	Kern	261-193-03	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
90	3	Kern	261-193-06	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
91	3	Kern	261-193-07	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
92	3	Kern	261-193-08	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
93	3	Kern	261-193-09	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
94	3	Kern	261-193-10	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
95	3	Kern	261-193-15	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0	0	0	0	0	0	0	0
96	3	Kern	261-193-17	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0	0	0	0	0	0	0	0
97	3	Kern	261-193-18	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0	0	0	0	0	0	0	0
98	3	Kern	261-193-20	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0	0	0	0	0	0	0	0
99	3	Kern	261-193-22	0%	0%	0%	2%	0%	0%	0%	0%	0%	8%	5%	0%	0%	0	0	0	41	0	0	0	0
100	3	Kern	261-193-23	0%	0%	0%	7%	0%	17%	0%	14%	20%	0%	10%	0%	0%	0	0	0	166	0	206	0	183
101	3	Kern	261-193-24	0%	0%	0%	6%	0%	16%	0%	0%	0%	14%	9%	0%	0%	0	0	0	162	0	201	0	0
102	3	Kern	261-193-25	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%	5%	0%	0%	0	0	0	0	0	0	0	0
103	3	Kern	261-193-26	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0	0	0	0	0	0	0	0
104	3	Kern	261-194-28	22%	28%	23%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	363	363	320	320	320	0	0	0
105	3	Kern	261-194-29	22%	28%	23%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	363	363	320	320	320	0	0	0
106	3	Kern	261-194-30	0%	0%	0%	0%	7%	0%	0%	16%	0%	0%	0%	0%	0%	0	0	0	0	162	0	0	211
107	3	Kern	261-194-36	6%	7%	6%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	95	95	84	84	84	0	0	0
108	3	Kern	261-194-37	6%	7%	6%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	95	95	84	84	84	0	0	0
109	3	Kern	261-194-38	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
110	3	Kern	261-194-39	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	100%	1	1	1	1	1	1	2	1
111	3	Kern	261-194-45	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
112	3	Kern	261-194-46	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
113	3	Kern	261-194-47	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
114	3	Kern	261-196-08	45%	29%	42%	53%	54%	67%	100%	54%	80%	55%	70%	0%	0%	747	374	593	1,317	1,317	820	1,754	728
115	3	Kern	261-193-05	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
116	3	Kern	261-193-19	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0	0	0	0	0	0	0	0
117	3	Kern	261-194-35	0%	0%	0%	0%	7%	0%	0%	16%	0%	0%	0%	0%	0%	0	0	0	0	166	0	0	216
118	11	LA	3258-001-038	40%	34%	0%	0%	#DIV/0!	0%	0%	50%	100%	100%	100%	#DIV/0!	#DIV/0!	542	542	0	0	0	0	0	542

Land Use Data

Map ID	Parcel Group	County	Parcel #	PERCENT OF TOTAL WELL PUMPAGE FOR GROUP													AMOUNT OF GROUNDWATER APPLI							
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
119	13	LA	3258-001-040	100%	100%	100%	100%	#DIV/0!	100%	100%	100%	100%	100%	100%	100%	100%	559	559	559	559	0	559	559	559
120	14	LA	3261-001-004	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	1,081
121	10	LA	3261-001-002	100%	100%	100%	100%	#DIV/0!	100%	100%	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	247	494	247	247	0	494	494	494
122	11	LA	3261-001-003	41%	35%	69%	69%	#DIV/0!	100%	100%	50%	0%	0%	0%	#DIV/0!	#DIV/0!	547	547	547	547	0	547	547	547
123	11	LA	3258-001-001	18%	31%	31%	31%	#DIV/0!	0%	0%	0%	0%	0%	0%	#DIV/0!	#DIV/0!	245	490	245	245	0	0	0	0
124	12	LA	3258-001-024	100%	100%	100%	100%	#DIV/0!	100%	100%	100%	100%	100%	100%	100%	100%	275	275	275	275	0	275	275	275
126	15	LA	3258-001-031	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	297%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	3,211
127	15	LA	3258-001-030	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	1,084
128	11	LA	3258-001-025	0%	0%	1%	0%	#DIV/0!	0%	0%	0%	0%	0%	0%	#DIV/0!	#DIV/0!	5	5	5	0	0	0	0	0

				ED (AF)				
Map ID	Parcel Group	County	Parcel #	2008	2009	2010	2011	2012
0	4	Kern	359-011-02	0	0	0	20	0
1	4	Kern	359-011-03	0	0	0	20	0
2	4	Kern	359-011-04	0	0	0	20	0
3	4	Kern	359-011-05	28	0	0	20	0
4	4	Kern	359-011-06	28	0	0	20	0
5	4	Kern	359-011-07	28	0	0	20	0
6	4	Kern	359-011-08	0	0	0	19	0
7	4	Kern	359-011-09	0	0	0	0	0
8	4	Kern	359-011-10	0	0	0	0	0
9	4	Kern	359-011-11	0	0	0	0	0
10	4	Kern	359-011-12	0	0	0	0	33
11	4	Kern	359-011-13	0	151	47	0	33
12	4	Kern	359-011-14	0	0	55	20	0
13	4	Kern	359-011-15	0	0	47	0	0
14	4	Kern	359-011-16	24	0	45	0	32
15	4	Kern	359-011-17	0	0	0	0	0
16	4	Kern	359-011-18	0	0	0	0	0
17	4	Kern	359-011-19	0	0	0	0	0
18	4	Kern	359-011-20	0	0	0	0	0
19	4	Kern	359-011-21	0	0	0	19	0
20	4	Kern	359-011-22	0	0	0	20	0
21	4	Kern	359-011-23	0	0	0	20	0
22	4	Kern	359-011-24	0	0	0	20	0
23	4	Kern	359-011-27	0	0	0	0	0
24	4	Kern	359-020-50	228	0	352	137	266
25	6	Kern	359-041-05	0	0	0	0	0
26	6	Kern	359-041-07	0	0	0	0	0
27	6	Kern	359-041-08	0	0	0	0	0
28	4	Kern	359-174-01	25	0	0	20	0
29	4	Kern	359-174-02	0	150	47	0	33
30	4	Kern	359-174-03	0	150	47	0	33
31	4	Kern	359-174-04	25	0	0	20	0
32	4	Kern	359-174-05	25	0	0	20	0

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
33	4	Kern	359-174-06	0	150	47	0	33
34	4	Kern	359-174-07	0	143	44	0	32
35	4	Kern	359-174-08	24	0	0	19	0
36	4	Kern	359-174-09	25	0	0	20	0
37	4	Kern	359-174-10	0	0	0	20	0
38	4	Kern	359-174-11	0	0	0	20	0
39	4	Kern	359-174-12	23	1	1	18	0
40	4	Kern	359-174-14	0	0	0	0	0
41	4	Kern	359-240-04	102	0	254	165	0
42	8	Kern	359-331-17	0	0	0	0	0
43	8	Kern	359-331-19	0	0	0	0	0
44	8	Kern	359-331-25	0	0	0	0	0
45	4	Kern	359-011-01	0	1	1	10	0
56	7	Kern	359-041-30	272	164	272	272	272
67	2	Kern	261-196-10	571	571	571	0	0
68	15	Kern	359-041-29	0	0	0	0	0
69	15	Kern	359-041-31	0	0	0	0	0
70	15	Kern	359-041-32	0	0	0	0	0
71	5	Kern	359-175-01	300	423	351	355	274
72	5	Kern	359-175-02	10	14	12	12	9
73	5	Kern	359-175-03	10	14	12	12	9
74	5	Kern	359-175-04	0	1	1	1	1
75	5	Kern	359-321-01	331	468	388	392	593
76	5	Kern	359-321-02	331	468	388	392	593
77	5	Kern	359-324-18	49	59	49	97	147
78	5	Kern	359-324-20	51	61	50	0	77
79	5	Kern	359-324-21	51	61	50	0	77
80	9	Kern	359-331-24	1	1	1	1	1
81	9	Kern	359-331-26	0	0	0	0	0
82	9	Kern	359-331-27	0	0	0	0	0
83	1	Kern	359-041-15	0	0	0	0	0
84	1	Kern	359-041-24	0	0	0	0	0
85	1	Kern	359-041-25	0	0	0	0	0
86	1	Kern	359-041-26	0	0	0	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
87	1	Kern	359-041-27	1	1	1	1	1
88	3	Kern	261-193-02	0	0	0	0	0
89	3	Kern	261-193-03	0	0	0	0	0
90	3	Kern	261-193-06	0	0	0	0	0
91	3	Kern	261-193-07	0	0	0	0	0
92	3	Kern	261-193-08	0	0	0	0	0
93	3	Kern	261-193-09	0	0	0	0	0
94	3	Kern	261-193-10	0	0	0	0	0
95	3	Kern	261-193-15	0	28	0	0	0
96	3	Kern	261-193-17	0	28	0	0	0
97	3	Kern	261-193-18	0	28	0	0	0
98	3	Kern	261-193-20	0	56	0	0	0
99	3	Kern	261-193-22	0	225	83	0	0
100	3	Kern	261-193-23	504	0	166	0	0
101	3	Kern	261-193-24	0	372	137	0	0
102	3	Kern	261-193-25	0	220	81	0	0
103	3	Kern	261-193-26	0	220	0	0	0
104	3	Kern	261-194-28	0	0	0	0	0
105	3	Kern	261-194-29	0	0	0	0	0
106	3	Kern	261-194-30	0	0	0	0	0
107	3	Kern	261-194-36	0	0	0	0	0
108	3	Kern	261-194-37	0	0	0	0	0
109	3	Kern	261-194-38	0	0	0	0	0
110	3	Kern	261-194-39	3	2	1	1	1
111	3	Kern	261-194-45	0	0	0	0	0
112	3	Kern	261-194-46	0	0	0	0	0
113	3	Kern	261-194-47	0	0	0	0	0
114	3	Kern	261-196-08	2,006	1,516	1,117	0	0
115	3	Kern	261-193-05	0	0	0	0	0
116	3	Kern	261-193-19	0	56	0	0	0
117	3	Kern	261-194-35	0	0	0	0	0
118	11	LA	3258-001-038	542	542	542	0	0

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
119	13	LA	3258-001-040	559	559	559	559	559
120	14	LA	3261-001-004	0	0	0	0	0
121	10	LA	3261-001-002	0	0	0	0	0
122	11	LA	3261-001-003	0	0	0	0	0
123	11	LA	3258-001-001	0	0	0	0	0
124	12	LA	3258-001-024	275	275	275	275	275
126	15	LA	3258-001-031	0	0	0	0	0
127	15	LA	3258-001-030	0	0	0	0	0
128	11	LA	3258-001-025	0	0	0	0	0

INTRODUCTION

At the Antelope Valley Groundwater Adjudication Settlement Meeting facilitated by Randy Williams on October 7, 2009, the group selected Steve Dassler, Andrew Werner and Gene Nebeker to recalculate the total groundwater pumping in the Antelope Valley based on 1) crop water requirements prepared by experts in Antelope Valley crop water use primarily from the University of California and 2) recommendations from mutual water companies regarding the mutuals' groundwater pumping.

The historical water use by agriculture was calculated by multiplying these crop water requirements by the acres of the various crops reported in the "Problem Statement" prepared by a Technical Committee. To be consistent with the procedure in the "Problem Statement," an extra 5% was added to take into account water use that may have been unreported. In these crop water use calculations, nothing was changed from the "Problem Statement" except the crop water requirements. Any other data taken from the "Problem Statement" has not been confirmed or vetted. A relatively arbitrary twelve year time period was examined because the "Problem Statement" separates data into five-year periods and the data ended with 2006. The overall result indicating under-valuing of the groundwater pumping in the "Problem Statement" is insensitive to the period that was chosen.

When the groundwater adjudication began, no reliable crop water requirements for the Antelope Valley, prepared by rigorous peer-reviewed analysis, existed. As a result, in April 19, 2007, the "Estimate of Crop Water Requirements in the Antelope Valley" was prepared by Grant Poole, former Los Angeles County Farm Advisor in Antelope Valley, Steve Orloff, Los Angeles County Farm Advisor in Antelope Valley just prior to Mr. Poole and current Farm Advisor in Siskiyou County, Blake Sanden, Kern County Farm Advisor in Antelope Valley, Tim Hays, Agricultural Consultant and California Licensed Pest Control Advisor in Antelope Valley, Blaine Hansen, Ph.D., Irrigation and Drainage Specialist at University of California at Davis, and Eugene B. Nebeker, Ph.D., grower in Antelope Valley and licensed Professional Engineer in Chemical and Agricultural Engineering. The resulting crop water requirements compare closely to the experiences of growers in Antelope Valley.

Crop water requirements for grapes do not appear in these University of California crop water requirements because grapes represent a very small consumption of water because the acreages of grapes are small. In these calculations, the crop water requirements for grapes used in the "Problem Statement" were retained because any inaccuracies do not significantly affect the results.

The information for mutual water company groundwater use was furnished by Mr. John Ukkestad of the Antelope Valley United Water Purveyors.

The results of these analyses show the "Problem Statement" under-valued groundwater pumping in the Antelope Valley by 13,471 to 22,440 acre-feet per year or an average of 18,957 acre-feet per year. Total groundwater pumping varied between 132,091 to 196,738 acre-feet per year for an average of 165,213 per year.

Crop Water Requirements and Applied Water

Crop	Problem Statement (AF) (1)	U of C (AF) (2)
Alfalfa	6.5	7.65
Carrots	3.9	4.60
Grain	2.6	3.05
Melons and Squash	2.8	3.11
Onions	4.5	5.22
Orchard	4.9	5.36
Pasture	6.7	7.45
Potatoes	2.8	3.35
Sugar Beets	4.6	4.96
Vinyard	3.7	

(1) Problem Statement Appendix D-3, Table 4
(2) University of CA, Table 4 (2007)

Appendix D-3

Applied Crop Water Duties, Irrigation Efficiencies, and Agricultural Return Flows

In order to estimate water requirements for agricultural irrigation in some detail over recent time (since 1970), and as a basis for assessing historical as well as current agricultural water requirements, applied water duties for individual crops were developed and utilized as follows. As part of the development and utilization of crop water duties, it was recognized that irrigation practices and other farming practices require the application of more water than is simply required for plant growth. Of the additional applied water, some of it deep percolates and thus contributes to groundwater recharge as so-called return flow, while some of it is lost to evaporation and does not contribute to recharge. The fate of water applied in excess of plant water requirements was tracked as part of the overall development of crop water duties, primarily to estimate the amounts of applied water that contribute to groundwater recharge.

Applied Crop Water Duties

Included within the Los Angeles County annual crop reports and the Kern County annual pesticide use reports are crop acreage subdivisions applicable to the Antelope Valley for vegetable crops (notably onions and root vegetables), field crops (notably alfalfa), and fruit and nut crops. Those annual land use and crop acreage data were converted to water requirements using a CIMIS-based (California Irrigation Management Information System) approach where reference evapotranspiration data were coupled with various crop coefficients to first estimate the total annual evapotranspirative water requirements of the various crops grown in the Valley. Those requirements were then factored to consider any effective precipitation that would have reduced the need for applied water to meet the respective evapotranspirative water requirements. The resultant crop evapotranspirative water requirements were then converted to applied crop water requirements by considering irrigation system distribution uniformity values. Finally, applied water for cultural practices that involve the application of water for field preparation, pre-irrigation, and erosion control was added to the applied water for consumption of the crops to develop applied crop water duties (AW_T).

In sequential equation form, the preceding approach to estimating applied crop water requirements can be expressed as follows. The results are summarized in Appendix D-3: Tables 1 through 5.

Crop Water Requirement

$$ET_C = K_C * ET_O$$

where

ET_C = crop evapotranspirative requirement

K_C = crop coefficient

ET_O = reference evapotranspiration

Crop Evapotranspiration of Applied Water

$$ET_{AW} = ET_C - P_e$$

where

ET_{AW} = evapotranspiration of applied water

P_e = effective precipitation

Total Applied Water

$$AW_T = \frac{ET_{AW}}{DU} + AW_{er} + AW_{pr}$$

where

AW_T = total applied crop water duty

DU = distribution uniformity of irrigation system[1]

AW_{er} = applied water for erosion control

AW_{pr} = applied water for field preparation and pre-irrigation

The crops grown in the Antelope Valley, as reported by the Los Angeles and Kern County Agricultural Commissioners, were grouped into the following crop categories for purposes of estimating annual applied water requirements: alfalfa and irrigated pasture, carrots, deciduous orchard, grain (barley, wheat, hay, sorghum, sudan), melons and squash, onions, potatoes, sugar beets, and grapes. The daily reference evapotranspiration (ET_o) data reported for the nearest CIMIS station, at Victorville, shows only small fluctuation from year to year, so they were utilized to develop average ET_o values for each bimonthly and monthly period of the growth stages for each crop grown in the Antelope Valley. These values were calculated as the average of the daily data within each of the growth stage periods from each year of available data at the Victorville CIMIS station. The resultant bimonthly (and monthly) average ET_o values are tabulated in Appendix D-3: Table 1.

Crop coefficients (K_c) specific to the high desert of California for each of the growth stage periods of each crop category were derived from the University of California Cooperative Extension as listed in Appendix D-3: Table 5. Those crop coefficients were then combined with

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[1] *DU is a term relating to the evenness of water application to plants throughout a field and is defined as:*

$$\frac{\text{Minimum depth of water applied to plants in a field}}{\text{Average amount of water applied to plants}} \times 100$$

where the minimum equals the average of the lowest quarter of the values. (ITRC, California Polytechnic State University, 1994).

the corresponding average ET_o values to estimate crop water requirements in the Antelope Valley. Specifically, the products of the K_c value and average ET_o for each bimonthly growth stage period were summed to estimate the total annual evapotranspirative water requirements (ET_c) of the various crops grown in the Valley (Appendix D-3: Table 2). Crop coefficients and growth stage periods for vineyard (grape crops) grown in California's high desert were not available; available monthly coefficients and growth stage periods specific to Yolo and Solano Counties were utilized with the Victorville ET_o values to estimate the annual crop water requirement ET_c for grapes grown in the Valley.

Interpretation of the seasonal variation in the relative amounts of precipitation and evaporation in the Valley indicated that, typically, evaporative losses exceed the amount of precipitation in all months from March through November so rainfall during those months was considered to be lost to evaporation and thus not available for uptake by the crops. Consequently, only the precipitation occurring in December through February would be available for the crops and approximately one-half of that was considered to be "effective precipitation" (P_e) that contributed to meeting ET_c of the various crops, and thus reduce applied water requirements. After allowing for effective precipitation (P_e) (up to the ET_c value), the remainder is the average amount of applied water required to directly meet crop evapotranspirative requirements (ET_{AW}), as summarized in Appendix D-3: Table 3.

The amount of total applied water needed to meet crop water requirements (ET_{AW}), specifically to accommodate irrigation distribution uniformities (DU) and cultural practices in the Valley, was then calculated. For all crops, there are no known data on DU values; anecdotal information suggests that there have been widespread efforts to utilize irrigation equipment and practices to increase DU values into the range of 80 percent. For purposes of converting the applied water needed to meet crop water requirements (ET_{AW}) to applied crop water requirements (AW_c), irrigation system DU was assumed to be 80 percent for all crops. Ultimately, that value was checked by computing overall irrigation efficiencies as described below, and then assessing the resultant values in the context of generally reported values in the Valley. For those crops where water is used for field preparation and pre-irrigation (all except pasture, orchard, and grapes) and/or are subject to damage from soil erosion in the Valley (carrots and onions), respective amounts of water were added to that applied at the estimated distribution uniformity for irrigation systems in the Valley. Anecdotal information suggests that, for alfalfa, carrot, grain, melon/squash, onion, potato, and sugar beet crops grown in the Antelope Valley, an additional 2 to 6.5 inches of water are applied for field preparation and pre-irrigation purposes (AW_{pr}); and for carrot and onion crops, an additional 3 to 6 inches of water are applied for erosion control (AW_{er}). Accordingly, the applied water requirements for those crops were increased by these amounts to arrive at estimates of total applied water (applied crop water duties, AW_T) as summarized in Appendix D-3: Table 4. Overall, the resultant values of total applied water in Appendix D-3: Table 4 are within ranges typically reported for crops and irrigation practices in the Antelope Valley.

Irrigation Efficiency

Historically, the term "irrigation efficiency" has been used to describe the fraction of total applied water that was consumptively used by a crop. With time, the definition of the term has been broadened to recognize that other uses of water associated with the growing and harvesting of crops are also beneficial. Thus, a modern definition of "irrigation efficiency" can be considered to be the ratio of that portion of applied water that is beneficially used for farming operations divided by total applied water, expressed as a percentage. In the Antelope Valley setting, the application of water for cultural practices that include field preparation, pre-irrigation, and erosion control can be considered a beneficial use of water. Thus, in this analysis, irrigation efficiency is defined as the fraction of total applied water that is consumptively used by a crop plus water used for field preparation, pre-irrigation, and erosion control.

In equation form, the preceding can be expressed as follows, where ET_{AW}, ET_{er} and ET_{pr} are as defined above.

Overall Irrigation Efficiency

$$E_{irr} = \frac{ET_{AW} + AW_{er} + AW_{pr}}{AW_T}$$

where

E_{irr} = overall efficiency of irrigation

Utilizing the preceding definition, the total beneficial use of water results in irrigation efficiency values in the range of 80 to 85 percent for the crops grown and the associated farming practices in the Antelope Valley, as delineated in Appendix D-3: Table 4.

Return Flows

As introduced above, most of the applied water in crop irrigation is consumptively used in plant growth. Additional water is applied for beneficial purposes such as field preparation, pre-irrigation, and erosion control. Some of the applied water not consumptively used by crops deep percolates and ultimately becomes groundwater recharge, while other of the additional applied water evaporates. Since the main focus of tracking the fate of applied water in excess of plant consumptive use was to estimate return flow contributions to groundwater recharge, the return flow component was estimated by first recognizing that applied irrigation in excess of plant water requirements contributes to return flow, and then separately considering the individual components of additional water applied to irrigated areas. Respectively, in the Antelope Valley, those components are for the purposes of erosion control, field preparation, and pre-irrigation.

Erosion Control – As delineated in Appendix D-3: Table 4, about 3 to 6 inches of water are applied during certain stages of plant growth for carrots and onions to resist the sand-blasting

effects of wind and the granular soils in the area. Over the course of overall plant growth cycles, those amounts of water are quite small since they are for the purpose of wetting only the uppermost soil profile to keep seedlings from being damaged by wind. Thus, that applied water is not expected to infiltrate to a sufficient depth to contribute to soil moisture that ultimately deep percolates. Consequently, water applied for erosion control is considered to be lost to evaporation from the uppermost soil profile, and not part of return flow.

Field Preparation and Pre-Irrigation – As delineated in Appendix D-3: Table 4, for certain crops, between 2 and 6.5 inches of additional water are applied for some combination of field preparation and pre-irrigation. In the one case of alfalfa, where soil moisture is maintained near field capacity throughout the year, the application of any water above crop water requirements is considered to contribute to an increase in soil moisture that, in turn, precipitates deep percolation past the crop root zone. Thus, all additional applied water is considered to be part of return flows that ultimately become groundwater recharge. For all other crops where additional water is applied for field preparation or pre-irrigation outside the period of active plant growth, all water is considered to contribute to soil moisture which can be later captured by the plants, or can be deep percolated as a result of subsequent application of water during the plant growing season. However, recognizing that the application of water outside the plant growing season results in shallow soil moisture being susceptible to evaporation, water in the uppermost 6 inches of soil is considered to be lost to evaporation and thus not part of the return flows that ultimately become groundwater recharge. For average Antelope Valley soil conditions, field capacity is about one inch per foot of depth. Thus, the application of 4 to 6 inches of water for field preparation and pre-irrigation of certain crops will tend to wet several feet of soil; of that, evaporation will consume water stored in the uppermost half-foot of soil profile (about one-half inch of water) and the balance is in the soil profile from which it can ultimately deep percolate as return flow to groundwater recharge.

Derivations of individual quantities of return flows on a per-crop basis, following the methodology described above, are delineated in Appendix D-3: Table 6. Total amounts of agricultural return flows, for selected years prior to 1970 (when the preceding level of detail was not available, and for which return flows were estimated to be 30 percent of total applied water) and for each year since 1970, are summarized in Appendix D-3: Table 7 and illustrated in Appendix D-3: Figure 1.

References

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Univ. of California, Cooperative Extension Program, date not available. *Table 2: "Normal Year" grass potential evapotranspiration (ETo), forage crop coefficients and ET for the High Desert.*

Appendix D-3: Table 1
Reference Evapotranspiration and Crop Coefficients by Growth Stage
Antelope Valley Area of Adjudication

Growth Stage Periods		Reference Evapotranspiration*		Crop Coefficients**												
		Monthly	Bimonthly	Alfalfa	Pasture	Deciduous	Grain	Fall Silage	Sugar Beets	Melons	Onions	Spring Carrots	Summer Carrots	Potatoes	Grapes***
		ET_o (in)	ET_o (in)	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c
January	1	2.02	0.91	0.40	1.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.11	0.40	1.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	1	2.61	1.18	0.40	1.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.43	1.00	1.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
March	1	4.55	2.05	1.15	1.00	0.25	0.66	0.00	0.00	0.00	0.30	0.31	0.00	0.55	0.35
	2		2.50	1.15	1.00	0.54	0.92	0.00	0.15	0.18	0.30	0.55	0.00	0.61	
April	1	6.19	2.89	0.95	1.00	0.60	1.00	0.00	0.15	0.18	0.30	0.82	0.00	0.88	0.55
	2		3.30	0.95	1.00	0.66	1.00	0.00	0.37	0.34	0.53	1.03	0.00	1.16	
May	1	7.30	3.45	0.95	1.00	0.72	1.15	0.00	0.61	0.72	0.83	1.11	0.00	1.21	0.73
	2		3.85	0.95	1.00	0.79	1.10	0.00	0.88	1.11	1.14	1.13	0.31	1.19	
June	1	8.85	4.29	0.95	1.00	0.84	0.78	0.14	1.11	1.11	1.14	1.05	0.53	0.87	0.82
	2		4.56	0.95	1.00	0.86	0.00	0.25	1.11	1.11	1.14	1.00	0.82	0.55	
July	1	9.77	4.90	0.95	1.00	0.92	0.00	0.56	1.11	0.78	1.04	0.00	1.03	0.00	0.82
	2		4.87	0.95	1.00	0.94	0.00	1.00	1.07	0.29	0.92	0.00	1.11	0.00	
August	1	8.99	4.61	0.95	1.00	0.94	0.00	1.15	1.04	0.00	0.80	0.00	1.13	0.00	0.72
	2		4.38	0.95	1.00	0.94	0.00	1.20	1.00	0.00	0.68	0.00	1.05	0.00	
September	1	6.52	3.48	0.95	1.00	0.94	0.00	1.20	0.97	0.00	0.00	0.00	0.00	0.00	0.50
	2		3.04	0.95	1.00	0.91	0.00	1.06	0.00	0.00	0.00	0.00	0.00	0.00	
October	1	4.66	2.51	0.95	1.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		2.15	0.95	1.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
November	1	2.68	1.64	0.95	1.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.04	0.95	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	1	2.05	1.06	0.95	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.99	0.95	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (inches)		66.19	66.19												
Total (feet)		5.52	5.52												

* Avg ET_o for specified periods, based on available historical and daily data at the Victorville CIMIS Station, 1994 - 2003

** Crop growth stages and coefficients from Univ. California Cooperative Extension; values for the California High Desert.

*** Crop coefficients for grapes from Univ. California Cooperative Extension; monthly values for Yolo and Solano Counties (High Desert value not available)

Appendix D-3: Table 2
Evapotranspiration of Crops
Antelope Valley Area of Adjudication

		Evapotranspiration of Crops											
Growth Stage Periods		Alfalfa	Pasture	Deciduous	Grain	Fall Silage	Sugar Beets	Melons	Onions	Spring Carrots	Summer Carrots	Potatoes	Grapes
		ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)
January	1	0.36	0.91	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.44	1.11	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	1	0.47	1.18	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	1.43	1.43	0.00	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
March	1	2.36	2.05	0.51	1.35	0.00	0.00	0.00	0.62	0.64	0.00	1.13	1.59
	2	2.88	2.50	1.35	2.30	0.00	0.38	0.45	0.75	1.38	0.00	1.53	
April	1	2.75	2.89	1.73	2.89	0.00	0.43	0.52	0.87	2.37	0.00	2.54	3.40
	2	3.14	3.30	2.18	3.30	0.00	1.22	1.12	1.75	3.40	0.00	3.83	
May	1	3.28	3.45	2.48	3.97	0.00	2.10	2.48	2.86	3.83	0.00	4.17	5.33
	2	3.66	3.85	3.04	4.24	0.00	3.39	4.27	4.39	4.35	1.19	4.58	
June	1	4.08	4.29	3.60	3.35	0.60	4.76	4.76	4.89	4.50	2.27	3.73	7.26
	2	4.33	4.56	3.92	0.00	1.14	5.06	5.06	5.20	4.56	3.74	2.51	
July	1	4.66	4.90	4.51	0.00	2.74	5.44	3.82	5.10	0.00	5.05	0.00	8.01
	2	4.63	4.87	4.58	0.00	4.87	5.21	1.41	4.48	0.00	5.41	0.00	
August	1	4.38	4.61	4.33	0.00	5.30	4.79	0.00	3.69	0.00	5.21	0.00	6.47
	2	4.16	4.38	4.12	0.00	5.26	4.38	0.00	2.98	0.00	4.60	0.00	
September	1	3.31	3.48	3.27	0.00	4.18	3.38	0.00	0.00	0.00	0.00	0.00	3.26
	2	2.89	3.04	2.77	0.00	3.22	0.00	0.00	0.00	0.00	0.00	0.00	
October	1	2.38	2.51	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	2.04	2.15	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
November	1	1.56	1.64	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.99	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	1	1.01	1.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.94	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (inches)		62.10	66.19	47.38	22.94	27.31	40.55	23.91	37.57	25.02	27.47	24.02	35.33
Total (feet)		5.18	5.52	3.95	1.91	2.28	3.38	1.99	3.13	2.09	2.29	2.00	2.94

Appendix D-3: Table 3
Evapotranspiration of Applied Water
Antelope Valley Area of Adjudication

Growth Stage Periods		Monthly Precipitation (in)	Bimonthly Precipitation (in)	Effective Precipitation P_e (in)	Evapotranspiration of Applied Water											
					Alfalfa	Pasture	Deciduous	Grain	Fall Silage	Sugar Beets	Melons	Onions	Spring Carrots	Summer Carrots	Potatoes	Grapes
					ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)
January	1	1.05	0.47	0.24	0.13	0.68	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.58	0.29	0.15	0.82	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	1	1.95	0.88	0.44	0.03	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.07	0.54	0.90	0.90	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
March	1	0.8	0.44	0.00	2.36	2.05	0.51	1.35	0.00	0.00	0.00	0.62	0.64	0.00	1.13	1.59
	2		0.36	0.00	2.88	2.50	1.35	2.30	0.00	0.38	0.45	0.75	1.38	0.00	1.53	
April	1	0.48	0.26	0.00	2.75	2.89	1.73	2.89	0.00	0.43	0.52	0.87	2.37	0.00	2.54	3.40
	2		0.22	0.00	3.14	3.30	2.18	3.30	0.00	1.22	1.12	1.75	3.40	0.00	3.83	
May	1	0.12	0.06	0.00	3.28	3.45	2.48	3.97	0.00	2.10	2.48	2.86	3.83	0.00	4.17	5.33
	2		0.06	0.00	3.66	3.85	3.04	4.24	0.00	3.39	4.27	4.39	4.35	1.19	4.58	
June	1	0.05	0.03	0.00	4.08	4.29	3.60	3.35	0.60	4.76	4.76	4.89	4.50	2.27	3.73	7.26
	2		0.02	0.00	4.33	4.56	3.92	0.00	1.14	5.06	5.06	5.20	4.56	3.74	2.51	
July	1	0.12	0.06	0.00	4.66	4.90	4.51	0.00	2.74	5.44	3.82	5.10	0.00	5.05	0.00	8.01
	2		0.06	0.00	4.63	4.87	4.58	0.00	4.87	5.21	1.41	4.48	0.00	5.41	0.00	
August	1	0.04	0.02	0.00	4.38	4.61	4.33	0.00	5.30	4.79	0.00	3.69	0.00	5.21	0.00	6.47
	2		0.02	0.00	4.16	4.38	4.12	0.00	5.26	4.38	0.00	2.98	0.00	4.60	0.00	
September	1	0.16	0.08	0.00	3.31	3.48	3.27	0.00	4.18	3.38	0.00	0.00	0.00	0.00	0.00	3.26
	2		0.08	0.00	2.89	3.04	2.77	0.00	3.22	0.00	0.00	0.00	0.00	0.00	0.00	
October	1	0.16	0.08	0.00	2.38	2.51	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.08	0.00	2.04	2.15	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
November	1	0.37	0.14	0.00	1.56	1.64	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.23	0.00	0.99	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	1	0.54	0.26	0.13	0.88	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.28	0.14	0.80	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (inches)		5.84	5.84	1.77	60.33	64.42	47.38	21.52	27.31	40.55	23.91	37.57	25.02	27.47	24.02	35.33
Total (feet)		0.49	0.49	0.15	5.03	5.37	3.95	1.79	2.28	3.38	1.99	3.13	2.09	2.29	2.00	2.94

Appendix D-3: Table 4
Applied Crop Water Duties and Irrigation Efficiency Values
(DU = 80%)
Antelope Valley Area of Adjudication

Crop	ET_c[1] (in)	P_e[2] (in)	ET_{AW}[3] (in)	DU[4] (%)	AW_c[5] (in)	AW_{er}[6] (in)	AW_{pr}[7] (in)	AW_T[8] (in)	(ft)	E_{irr}[9] (%)
Alfalfa	62.10	1.77	60.33	80	75.42	0	2.0	77.42	6.5	81
Carrots	27.47	0.00	27.47	80	34.33	6	6.5	46.83	3.9	85
Grain	22.94	1.42	21.52	80	26.90	0	4.0	30.90	2.6	83
Melons/Squash	23.91	0.00	23.91	80	29.88	0	4.0	33.88	2.8	82
Onions	37.57	0.00	37.57	80	46.96	3	4.0	53.96	4.5	83
Orchard (Deciduous)	47.38	0.00	47.38	80	59.22	0	0.0	59.22	4.9	80
Pasture	66.19	1.77	64.42	80	80.53	0	0.0	80.53	6.7	80
Potatoes	24.02	0.00	24.02	80	30.03	0	4.0	34.03	2.8	82
Silage	27.31	0.00	27.31	80	34.14	0	4.0	38.14	3.2	82
Sugar Beets	40.55	0.00	40.55	80	50.68	0	4.0	54.68	4.6	81
Vineyard (Grapes)	35.33	0.00	35.33	80	44.16	0	0.0	44.16	3.7	80

[1] $ET_c = K_c * ET_o$ where ET_o = average ET_o for specified periods, based on data from Victorville CIMIS Station, 1994-2003); K_c values from Univ. California Cooperative Extension

[2] P_e = effective precipitation offsetting ET_c, up to 1/2 of the average precipitation, in Dec. - Feb., inclusive

[3] ET_{AW} = evapotranspiration of applied water = $ET_c - P_e$

[4] DU = irrigation distribution uniformity

[5] AW_c = applied water for crop requirement = $ET_{AW} \div DU$

[6] AW_{er} = applied water for erosion control (after Nebeker, 4-19-07)

[7] AW_{pr} = applied water for field preparation and pre-irrigation (after Nebeker, 4-19-07)

[8] AW_T = applied crop water duty = $AW_c + AW_{er} + Aw_{pr}$

[9] E_{irr} = overall irrigation efficiency for beneficial uses = $(ET_{AW} + AW_{er} + AW_{pr}) \div AW_T$

Appendix D-3: Table 5
Crop Coefficients and Growth Stages
California High Desert

UC CE University of California

Table 1. "Normal Year" grass potential evapotranspiration (ETo), forage crop coefficients and ET for the High Desert.

		Crop Coefficients (Kc) Values in the High Desert[1]														Crop Water Use estimates (ETc in inches) in the High Desert near Lancaster, CA										
DATE	Pasture ETo	[2]Alfalfa	Silage 4/1-8/25	Silage 8/15 10/15	[3]Sudan	Cereal Forage	Sugar Beets	Peas/Beans	Onions	Carrots	Carrots	Potatoes	Deciduous Fruit Trees[4]	Melons	Sod	Pasture/ Sod	[2]Alfalfa	Silage 4/1- 8/25	8/15- 10/15	[3]Sudan	Cereal Forage	Sugar Beets	Peas/Beans	Onions	Carrots	Carrots	Potatoes	Deciduous Fruit Trees	Melons
1/1	0.97	0.49				0.30									1.00	0.97	0.49				0.29								
1/15	1.97	0.49				0.30									1.00	1.97	0.49				0.59								
2/1	1.19	0.49				0.30				2					1.00	1.19	0.49				0.59				2.38				
2/15	1.45	1.00				0.41				2					1.00	1.45	1.45				1.37				2.90				
3/1	2.09	1.15				0.55			2.00	0.31		0.85	0.55		1.00	2.09	2.39				2.34	0.39	0.36	0.76	1.40		1.85	1.37	0.46
3/15	2.84	1.15				0.92	0.18	0.14	0.30	0.55		0.81	0.54	0.18	1.00	2.84	2.92				2.80	0.42	0.39	0.84	2.30		2.46	1.69	0.50
4/1	2.80	0.95	0.14			1.00	0.15	0.14	0.30	0.62		0.88	0.60	0.16	1.00	2.80	2.66	0.39			3.20	1.16	1.47	1.70	3.50		3.71	2.11	1.09
4/15	3.20	0.95	0.19			1.00	0.37	0.48	0.53	1.03		1.16	0.66	0.34	1.00	3.20	3.04	0.58			4.14	2.20	4.00	2.99	4.00	7.20	4.38	2.69	2.89
5/1	3.60	0.95	0.31			1.15	0.61	1.11	0.83	1.11	2	1.21	0.72	0.72	1.00	3.60	3.42	1.13			4.41	3.53	4.51	4.57	4.53	1.24	4.77	3.17	4.45
5/15	4.01	0.95	0.94			1.19	0.89	1.15	1.14	1.13	0.31	1.19	0.73	1.11	1.00	4.01	3.81	3.78			5.32	4.72	4.89	4.85	4.46	2.34	3.70	3.67	4.72
6/1	4.25	0.95	1.14	0.14		0.78	1.11	1.10	1.14	1.06	0.85	0.67	0.94	1.11	1.00	4.25	4.04	4.83	0.68			4.72	4.89	4.85	4.46	2.34	3.70	3.67	4.72
6/15	4.52	0.95	1.19	0.28	0.30		1.11	0.83	1.14	1.00	0.82	0.58	0.85	1.11	1.00	4.52	4.29	5.53	1.13	1.36		5.29	2.39	5.04		5.00		4.46	3.78	
7/1	4.65	0.95	1.19	0.56	0.60		1.11	0.49	1.04		1.03		0.92	0.76	1.00	4.65	4.61	5.72	2.73	4.12				4.44		5.36		4.94	1.40
7/15	4.63	0.95	1.15	1.00	1.10		1.07		0.92		1.11		0.94	0.29	1.00	4.63	4.59	5.65	4.83	5.31				3.60		5.09		4.23	
8/1	4.50	0.95	1.06	1.15	0.95		1.04		0.80		1.13		0.94		1.00	4.50	4.29	4.78	5.18	3.83				2.81		4.49		4.02	
8/15	4.28	0.95	0.99	1.20	1.10		1.00		0.68		1.05		0.94		1.00	4.28	4.07	4.17	5.14	4.71						4.39		3.53	
9/1	3.79	0.95		1.20	0.95		0.97						0.94		1.00	3.79	3.86		4.60	3.19						0.00		2.99	
9/15	3.27	0.95		1.05	1.00								0.91		1.00	3.27	3.11		3.47	3.27								2.47	
10/1	2.90	0.95			1.10								0.85		1.00	2.90	2.75			3.10								1.96	
10/15	2.48	0.95			1.12								0.78		1.00	2.48	2.36			2.73								1.19	
11/1	1.70	0.95											0.70		1.00	1.70	1.62												
11/15	1.07	0.95													1.00	1.07	1.02												
12/1	0.97	0.95													1.00	0.97	0.92												
12/15	0.95	0.95													1.00	0.90	0.59												
TOTALS	67.60																												
Total Inches of Water Use																67.02	63.00	38.23	37.06	31.70	33.11	40.53	32.23	41.01	30.42	34.43	34.10	48.27	24.01
Irrigation Efficiency Estimate																80%	80%	80%	80%	80%	80%	75%	75%	75%	75%	75%	75%	75% before 1981 80% after 1981	75%

[1]Crop Coefficients (Kc) were adapted from two sources.
1.) Hanson, B.R., L. Shwankl, and A. Fulton. 1999. Scheduling Irrigations: When and how much water to apply. Water Management Series Publication number 3396. Dept. of Land, Air Water Resources, University of California, Davis, California. Pp. 177-181.

2.) Pruitt, W.O., E. Fereres, K. Kaita, and R.L. Snyder. 1987. "Reference Evapotranspiration (ETo) for California." UC Bull. 1922. Pp. 12-13.

[2]Kc of 0.95 takes into account reduced ET during cuttings over season.

[3]Sudan cut 7/1, 8/15, and 10/15. ET reduced for 1 to 2 weeks after cutting.

[4]Deciduous Fruit Tree crop coefficients were adapted from Orloff, S.B. Deciduous Orchard Water Use, clean cultivated trees for a normal year in Litteneck. Local Extension publication.

Pasture ETo and Forage crop Kc values were drafted by S.L. Sanden,Kern County Farm Advisor, 2002.
Modified by G.J. Poole, LA County Farm Advisor, 2004.

4/19/07

AN ESTIMATE OF CROP WATER REQUIREMENTS IN THE ANTELOPE VALLEY

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DISCUSSION

The irrigation challenges in Antelope Valley are perhaps unique to all of California because solid set irrigation is one of the most popular types, sandy soils are common, and heavy winds prevail.

The calculations below are the best estimates of average crop water usage assuming all irrigations perform as anticipated with no unexpected problems such as equipment failure, the irrigation sets finishing when expected, etc. and no severe weather events such as excessive heat, high winds, etc. Otherwise, more water is required than these estimates represent. These calculations account for planting dates, harvesting dates, and end-of-season dates.

Historical data from Palmdale and Littlerock were used to estimate the amount of reference or "normal year" potential evapotranspiration (ETo) for Antelope Valley as shown in Table 2. ETo data from the CIMIS weather station in Victorville, CA is very similar to the Palmdale and Littlerock data and the Victorville is shown in Table 1 for comparison.. Climatic conditions largely

determine evapotranspiration and observations over many years by local Farm Advisors have indicated that Victorville data closely represent the climatic conditions in Antelope Valley.

Once the reference evapotranspiration ETo is known, the evapotranspiration for each crop (ETc) can be determined by

$$ETc = Kc\ (ETo)$$

where Kc is the crop coefficient. The crop coefficient varies with the crop, its stage of development, and the frequency of irrigation at less than full crop cover. Since these coefficients are practically independent of location, they can be used over a wide area.

ETc is the amount of water that must be supplied to the plant for proper growth, sometimes called net water requirements. Unfortunately, irrigation systems are not perfect and some additional water losses occur in the form of deep percolation, ponding, runoff, etc. The total amount of water that must be applied to the crop, often called gross water requirements, is calculated by

$$\text{Gross Water Requirement} = \text{Net Water Requirement} / (\text{Irrigation System Efficiency})$$

These irrigation system efficiencies have been developed over the years from field studies by University of California researchers and the Natural Resources Conservation Service (NRCS). With rare exceptions, irrigation system efficiencies for each particular type of irrigation method have not varied significantly from 1970 to the present. However, because the cost of irrigation water was less during these earlier periods, the amount of water wasted during these periods was greater than today. Some growers in the Antelope Valley area estimate their total water usage per acre was 25% greater during these earlier periods.

The following tables represent the "normal year" potential evapotranspiration, ETo , Crop Coefficients, and Evapotranspiration Requirements for various crops currently and historically grown in the Lancaster, CA area. Note that a heavy rainfall winter, which produces "effective rainfall," that is, rainfall that soaks into the soil and is not dissipated by evaporation, runoff, etc. may slightly reduce these requirements.

Table 4 lists the water requirements to reduce wind erosion damage in onion and carrot crops and the water applied when no crop is growing to facilitate field preparation and other cultural practices. These water requirements are not included in the crop evaporation estimates. Table 4 also shows the total crop water requirements in Antelope Valley.

Table 1. Plant evapotranspiration data for Jan. to December 2003, collected from Victorville, CA CIMIS weather station number 117, to be used as an estimate for ET near Palmdale, CA.

January	ETo(in)	February	ETo(in)	March	ETo(in)	April	ETo(in)	May	ETo(in)	June	ETo(in)	July	ETo(in)	August	ETo(in)	September	ETo(in)	October	ETo(in)	November	ETo(in)	December	ETo	January	ETo
1/1	0.07	2/1	0.13	3/1	0.12	4/1	0.24	5/1	0.21	6/1	0.29	7/1	0.34	8/1	0.22	9/1	0.26	10/1	0.21	11/1	0.07	12/1	0.1	1/1	0.09
1/2	0.07	2/2	0.11	3/2	0.13	4/2	0.18	5/2	0.21	6/2	0.31	7/2	0.32	8/2	0.27	9/2	0.16	10/2	0.2	11/2	0.08	12/2	0.07	1/2	0.08
1/3	0.06	2/3	0.09	3/3	0.09	4/3	0.17	5/3	0.16	6/3	0.32	7/3	0.38	8/3	0.28	9/3	0.17	10/3	0.16	11/3	0.08	12/3	0.08	1/3	0.08
1/4	0.07	2/4	0.11	3/4	0.10	4/4	0.18	5/4	0.20	6/4	0.31	7/4	0.31	8/4	0.32	9/4	0.23	10/4	0.16	11/4	0.08	12/4	0.07	1/4	0.06
1/5	0.08	2/5	0.10	3/5	0.12	4/5	0.19	5/5	0.22	6/5	0.29	7/5	0.32	8/5	0.32	9/5	0.22	10/5	0.17	11/5	0.09	12/5	0.07	1/5	0.06
1/6	0.13	2/6	0.11	3/6	0.15	4/6	0.19	5/6	0.22	6/6	0.30	7/6	0.32	8/6	0.32	9/6	0.25	10/6	0.17	11/6	0.08	12/6	0.11	1/6	0.05
1/7	0.14	2/7	0.11	3/7	0.14	4/7	0.20	5/7	0.21	6/7	0.30	7/7	0.31	8/7	0.31	9/7	0.27	10/7	0.17	11/7	0.1	12/7	0.06	1/7	0.08
1/8	0.06	2/8	0.08	3/8	0.15	4/8	0.23	5/8	0.14	6/8	0.31	7/8	0.3	8/8	0.33	9/8	0.26	10/8	0.17	11/8	0.07	12/8	0.07	1/8	0.07
1/9	0.07	2/9	0.09	3/9	0.16	4/9	0.22	5/9	0.25	6/9	0.31	7/9	0.32	8/9	0.32	9/9	0.25	10/9	0.19	11/9	0.1	12/9	0.08	1/9	0.06
1/10	0.03	2/10	0.12	3/10	0.16	4/10	0.24	5/10	0.21	6/10	0.30	7/10	0.31	8/10	0.32	9/10	0.21	10/10	0.16	11/10	0.09	12/10	0.08	1/10	0.07
1/11	0.06	2/11	0.02	3/11	0.16	4/11	0.21	5/11	0.25	6/11	0.28	7/11	0.32	8/11	0.24	9/11	0.22	10/11	0.15	11/11	0.09	12/11	0.06	1/11	0.07
1/12	0.07	2/12	0.00	3/12	0.16	4/12	0.23	5/12	0.28	6/12	0.27	7/12	0.31	8/12	0.31	9/12	0.23	10/12	0.17	11/12	0	12/12	0.05	1/12	0.07
1/13	0.07	2/13	0.01	3/13	0.19	4/13	0.19	5/13	0.22	6/13	0.28	7/13	0.32	8/13	0.27	9/13	0.23	10/13	0.16	11/13	0.08	12/13	0.04	1/13	0.07
1/14	0.06	2/14	0.08	3/14	0.17	4/14	0.06	5/14	0.18	6/14	0.30	7/14	0.33	8/14	0.28	9/14	0.27	10/14	0.19	11/14	0.08	12/14	0.06	1/14	0.08
1/15	0.08	2/15	0.11	3/15	0.04	4/15	0.18	5/15	0.25	6/15	0.32	7/15	0.33	8/15	0.3	9/15	0.27	10/15	0.2	11/15	0.06	12/15	0.06	1/15	0.07
1/16	0.08	2/16	0.11	3/16	0.10	4/16	0.20	5/16	0.28	6/16	0.29	7/16	0.25	8/16	0.29	9/16	0.27	10/16	0.15	11/16	0.06	12/16	0.08	1/16	0.07
1/17	0.09	2/17	0.08	3/17	0.18	4/17	0.18	5/17	0.27	6/17	0.30	7/17	0.21	8/17	0.28	9/17	0.25	10/17	0.15	11/17	0.07	12/17	0.05	1/17	0.08

1/18	0.08	2/18	0.10	3/18	0.18	4/18	0.16	5/18	0.26	6/18	0.32	7/18	0.28	8/18	0.3	9/18	0.21	10/18	0.16	11/18	0.08	12/18	0.06	1/18	0.08
January	**ETo(in)**	**February**	**ETo(in)**	**March**	**ETo(in)**	**April**	**ETo(in)**	**May**	**ETo(in)**	**June**	**ETo(in)**	**July**	**ETo(in)**	**August**	**ETo(in)**	**September**	**ETo(in)**	**October**	**ETo(in)**	**November**	**ETo(in)**	**December**	**ETo**	**January**	**ETo**
1/19	0.08	2/19	0.12	3/19	0.15	4/19	0.19	5/19	0.25	6/19	0.29	7/19	0.29	8/19	0.32	9/19	0.21	10/19	0.15	11/19	0.07	12/19	0.06	1/19	0.07
1/20	0.10	2/20	0.11	3/20	0.18	4/20	0.20	5/20	0.27	6/20	0.25	7/20	0.3	8/20	0.24	9/20	0.22	10/20	0.15	11/20	0.12	12/20	0.07	1/20	0.07
1/21	0.10	2/21	0.13	3/21	0.16	4/21	0.18	5/21	0.28	6/21	0.26	7/21	0.31	8/21	0.22	9/21	0.22	10/21	0.15	11/21	0.11	12/21	0.07	1/21	0.09
1/22	0.07	2/22	0.15	3/22	0.19	4/22	0.15	5/22	0.31	6/22	0.27	7/22	0.26	8/22	0.29	9/22	0.21	10/22	0.17	11/22	0.09	12/22	0.07	1/22	0.1
1/23	0.06	2/23	0.09	3/23	0.19	4/23	0.20	5/23	0.31	6/23	0.27	7/23	0.29	8/23	0.28	9/23	0.23	10/23	0.14	11/23	0.07	12/23	0.03	1/23	0.08
1/24	0.09	2/24	0.11	3/24	0.16	4/24	0.22	5/24	0.30	6/24	0.26	7/24	0.32	8/24	0.23	9/24	0.17	10/24	0.14	11/24	0.04	12/24	0.06	1/24	0.07
1/25	0.10	2/25	0.02	3/25	0.18	4/25	0.21	5/25	0.29	6/25	0.31	7/25	0.31	8/25	0.25	9/25	0.2	10/25	0.16	11/25	0.11	12/25	0.06	1/25	0.08
1/26	0.10	2/26	0.07	3/26	0.23	4/26	0.23	5/26	0.27	6/26	0.28	7/26	0.22	8/26	0.2	9/26	0.2	10/26	0.16	11/26	0.07	12/26	0.09	1/26	0.08
1/27	0.10	2/27	0.11	3/27	0.19	4/27	0.26	5/27	0.30	6/27	0.30	7/27	0.28	8/27	0.22	9/27	0.2	10/27	0.14	11/27	0.09	12/27	0.05	1/27	0.1
1/28	0.08	2/28	0.12	3/28	0.23	4/28	0.23	5/28	0.31	6/28	0.32	7/28	0.28	8/28	0.24	9/28	0.23	10/28	0.13	11/28	0.05	12/28	0.05	1/28	0.08
1/29	0.09			3/29	0.23	4/29	0.22	5/29	0.32	6/29	0.34	7/29	0.19	8/29	0.27	9/29	0.22	10/29	0.17	11/29	0.06	12/29	0.06	1/29	0.08
1/30	0.10			3/30	0.22	4/30	0.21	5/30	0.31	6/30	0.35	7/30	0.24	8/30	0.24	9/30	0.22	10/30	0.14	11/30	0.07	12/30	0.07	1/30	0.13
1/31	0.11			3/31	0.23			5/31	0.30			7/31	0.24	8/31	0.29			10/31	0.11			12/31	0.06	1/31	0.09
January	2.55	February	2.59	March	5.04	April	5.95	May	7.84	June	8.90	July	9.11	August	8.57	September	6.76	October	5.00	November	2.31	December	2.05	January	2.41
Daily Ave.	0.08	Daily Ave.	0.09	Daily Ave.	0.16	Daily Ave.	0.20	Daily Ave.	0.25	Daily Ave.	0.30	Daily Ave.	0.29	Daily Ave.	0.28	Daily Ave.	0.23	Daily Ave.	0.16	Daily Ave.	0.08	Daily Ave.	0.07	Daily Ave.	0.08

TABLE 2. CROP COEFFICIENTS (Kc) IN THE HIGH DESERT[1,5]

Date	Pasture ETo	Alfalfa[2]	Silage 4/1-8/25	Silage 6/15-10/15	Sudan[3]	Cereal Forage	Sugar Beets	Peas/ Beans	Onions	Carrots	Carrots	Potatoes	Deciduous[4] Fruit Trees	Melons	Sod
1/1	0.87	0.40				0.30									1.00
1/15	1.07	0.40				0.30									1.00
2/1	1.19	0.40				0.30				0.31					1.00
2/15	1.45	1.00				0.41				0.31					1.00
3/1	2.08	1.15				0.66			0.30	0.31		0.55	0.25		1.00
3/15	2.54	1.15				0.92	0.15	0.14	0.30	0.55		0.61	0.54	0.18	1.00
4/1	2.80	1.05	0.14			1.00	0.15	0.14	0.30	0.82		0.88	0.60	0.18	1.00
4/15	3.20	1.05	0.18			1.00	0.37	0.46	0.53	1.03		1.16	0.66	0.34	1.00
5/1	3.60	1.05	0.31			1.15	0.61	1.11	0.83	1.11	0.31	1.21	0.72	0.72	1.00
5/15	4.01	1.05	0.94			1.10	0.88	1.15	1.14	1.13	0.31	1.19	0.79	1.11	1.00
6/1	4.25	1.05	1.14	0.14		0.78	1.11	1.15	1.14	1.05	0.55	0.87	0.84	1.11	1.00
6/15	4.52	1.05	1.18	0.25	0.30		1.11	0.93	1.14	1.00	0.82	0.55	0.86	1.11	1.00
7/1	4.85	1.05	1.18	0.56	0.85		1.11	0.49	1.04		1.03		0.92	0.78	1.00
7/15	4.83	1.05	1.15	1.00	1.10		1.07		0.92		1.11		0.94	0.29	1.00
8/1	4.50	1.05	1.06	1.15	0.85		1.04		0.80		1.13		0.94		1.00
8/15	4.28	1.05	0.98	1.20	1.10		1.00		0.68		1.05		0.94		1.00
9/1	3.75	1.05		1.20	0.85		0.97						0.94		1.00
9/15	3.27	1.05		1.06	1.00								0.91		1.00
10/1	2.90	1.05			1.10								0.85		1.00
10/15	2.48	1.05			1.10								0.79		1.00
11/1	1.70	1.05											0.70		1.00
11/15	1.07	0.40													1.00
12/1	0.97	0.40													1.00
12/15	0.90	0.40													1.00
Total	67.08														

TABLE 3. CROP EVAPOTRANSPIRATION (ET_C IN INCHES) IN ANTELOPE VALLEY

Date	Pasture/ Sod	Alfalfa	Silage 4/1-8/25	Silage 6/15-10/15	Sudan	Cereal Forage	Sugar Beets	Peas/ Beans	Onions	Carrots	Carrots	Potatoes	Deciduous Fruit Trees	Melons
1/1	0.87	0.35				0.26								
1/15	1.07	0.43				0.32								
2/1	1.19	0.48				0.36				0.37				
2/15	1.45	1.45				0.60				0.45				
3/1	2.08	2.39				1.37			0.62	0.64		1.14	0.52	
3/15	2.54	2.92				2.34	0.38	0.36	0.76	1.40		1.55	1.37	0.46
4/1	2.80	2.94	0.39			2.80	0.42	0.39	0.84	2.30		2.46	1.68	0.50
4/15	3.20	3.36	0.56			3.20	1.18	1.47	1.70	3.30		3.71	2.11	1.09
5/1	3.60	3.78	1.13			4.14	2.20	4.00	2.99	4.00	1.12	4.36	2.59	2.59
5/15	4.01	4.21	3.76			4.41	3.53	4.61	4.57	4.53	1.24	4.77	3.17	4.45
6/1	4.25	4.46	4.83	0.58		3.32	4.72	4.89	4.85	4.46	2.34	3.70	3.57	4.72
6/15	4.52	4.75	5.33	1.13	1.36		5.02	4.20	5.15	4.52	3.71	2.49	3.89	5.02
7/1	4.85	5.09	5.72	2.73	4.12		5.38	2.38	5.04		5.00		4.46	3.78
7/15	4.83	5.07	5.55	4.83	5.31		5.17		4.44		5.36		4.54	1.40
8/1	4.50	4.73	4.78	5.18	3.83		4.68		3.60		5.09		4.23	
8/15	4.28	4.49	4.17	5.14	4.71		4.28		2.91		4.49		4.02	
9/1	3.75	3.94		4.50	3.19		3.64				0.00		3.53	
9/15	3.27	3.43		3.47	3.27.						0.00		2.98	
10/1	2.90	3.05			3.19								2.47	
10/15	2.48	2.60			2.73.								1.96	
11/1	1.70	1.79											1.19	
11/15	1.07	0.43												
12/1	0.97	0.39												
12/15	0.90	0.36												
Total Inches Of Net Water Use	67.08	66.89	36.22	27.56	31.71	23.12	40.60	22.30	37.47	25.97	28.35	24.18	48.28	24.01

TABLE 4. GROSS AND NET CROP WATER REQUIREMENTS (IN INCHES) IN ANTELOPE VALLEY

	Pasture/ Sod	Alfalfa	Silage 4/1-8/25	Silage 6/15-10/15	Sudan	Cereal Forage	Sugar Beets	Peas/ Beans	Onions	Carrots	Carrots	Potatoes	Deciduous Fruit Trees	Melons
Net Evapo-transpiration Water Requirement	67.08	66.89	36.22	27.56	31.71	23.12	40.60	22.30	37.47	25.97	28.35	24.18	48.28	24.01
Net Soil Erosion Water Requirement									3.54	4.46	6.08			
Net Non-Growing Water Requirement[10]	0.00	2.00	4.00	4.00	4.00	4.00	4.00	4.00	6.00[7]	6.50[8]	6.50[8]	4.00	0.00	4.00
Total Net Water Requirement	67.08	68.89	40.22	31.56	35.71	27.12	44.60	26.30	47.01	36.93	40.93	30.18	48.28	28.01
Irrigation Efficiency	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%[9]	75%
Gross Water Requirement														
Inches	89.44	91.85	53.63	42.08	46.80	36.16	59.47	35.07	62.68	49.24	54.57	40.24	64.37	37.35
Acre Feet	7.45	7.65	4.47	3.51	3.90	3.01	4.96	2.92	5.22	4.10	4.55	3.35	5.36	3.11

References

1) Crop Coefficients were adapted from two references: Hansen, B.R., Shwannkl, L., and Fulton, A. "Scheduling Irrigations: When and How Much Water to Apply," Water Management Series Publication Number 3396, Dept. of Land, Air & Water Resources, University of California, Davis, California and Pruitt, W. O., Fereres, E., Kelta, K., and Snyder, R. L., "Reference Evapotransppiration (ETo) for California," UC Bull. 1922
2) Kc of 1.05 takes into account reduced ET during the cuttings throughout the season. Since some alfalfa varieties go dormant during major portions of December and January and some rainfall may occur during this period, perhaps about 3 inches of applied water need not be applied during this period.
3) Sudan was cut on 7/1, 8/16, and 10/16. ET was reduced for 1 to 2 weeks after cutting.
4) Deciduous Fruit Tree Crop Coefficients were adapted from Orloff, S. B. "Deciduous Orchard Water Use, clean cultivated trees for a normal year in Littlerock, Local Extension Publication
5) Pasture ETo and Forage Crop Coefficients were drafted by B. L. Sanden, Kern County Farm Advisor, 2002, and modified by G. J. Poole, Los Angeles County Farm Advisor, 2004
6) Assumes a 5-year life of an alfalfa stand and includes the water requirement for pre-irrigation before field preparation and planting.
7) Water is required for pre-irrigation before field preparation, fumigation and "water capping" after fumigation.
8) Water is required for pre-irrigation before field preparation, fumigation and "water capping" after fumigation.
9) From 1991 on, drip irrigation in orchards became popular and the irrigation efficiency increased to 90%.
10) These water requirements are not included elsewhere.

NEBEKER RANCH, INC.
LANCASTER, CALIFORNIA

MAIL ADDRESS:
400 N. Rockingham Avenue
Los Angeles, CA 90049
310-440-8862

March 25, 2008

Dr, Blaine Hanson
Extension Irrigation and Drainage Specialist
Department of Land, Air and Water Resources
113 Veihmeyer Hall
University of California, Davis

Dear Dr. Hanson:

I would appreciate it if you and your colleagues would comment on:

Crop Water Requirements for Antelope Valley

You and your colleagues helped me assemble the document "An Estimate of Crop Water Requirements in the Antelope Valley" dated April 19, 2007. Are these values accurate and reasonable estimates of crop water requirements for this area?

Relation Between Applied Water and Net Water Required for Irrigation

The relation between Applied Water and Net Water is:

Applied Water = Net Water/(Distribution Uniformity – Miscellaneous Unavoidable Losses)

where Distribution Uniformity is the "catch-can" distribution uniformity and Miscellaneous Unavoidable Losses include scheduling difficulties, maintenance, breaks, unexpected pressure losses, and other problems often encountered in the field. The denominator in the above equation is often referred to as the "Irrigation Efficiency." This denominator is only Distribution Uniformity for an ideal system in which Irrigation Management Practices are zero and not for a real system in the field.

Net Water

Net Water in the above equation is the sum of all beneficial uses of water not simply water for evapotranspiration. Other beneficial uses include water to control soil erosion when the plants are small and all water used during the non-growing time periods that include water preceding field preparation, fumigation and "water capping."

Fate of the Difference Between Applied Water and Net Water

All of the difference between Applied Water and Net Water is not return flow. This difference needs to be divided between at least four factors including losses between the sprinkler nozzles and the soil, pooling in the fields, runoff, and return flows. Quantifying these values is a challenge. After discussing this issue with University of California specialists, I estimated the following ranges of these values as a percent of Applied Water that may occur in the Antelope Valley:

Return Flow	4% to 25%[1]
Losses Between the Sprinkler Nozzles and the Soil	3% to 15%[2]
Pooling in the Fields	0% to 3%
Runoff	0% to 3%

1 Minimum Leaching Requirements are Estimated at 4%
2 These losses may be 2 to 5% greater during the hot, dry winds in Antelope Valley

Thank you for your assistance in this matter.

Eugene B. Nebeker, Ph.D., P.E.
President

cc: Mr. Steve Orloff, University of California Cooperative Extension Farm Advisor

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ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616-8628

April 22, 2008

Dr. Gene Nebeker
400 N. Rockingham
Los Angeles, CA 90049

Dear Gene:

In response to your letter of March 25, 2008, the following are offered:

1. Crop Water Requirements for Antelope Valley

Crop evapotranspiration (ET) is by far the largest beneficial use. The potential ET is calculated as the product of crop coefficients and a reference crop ET, obtained from the CIMIS network. Crop coefficients are developed from field studies, either on an agricultural experiment station or in commercial fields, by making direct measurements of the crop ET using lysimeters or meteorological methods and then calculating the ratio of the crop ET to the reference crop ET.

You assembled the document "An Estimate of Crop Water Requirements in the Antelope Valley" dated April 19, 2007 with assistance from University of California farm advisors or former advisors and UC specialists working in crop ET. The document lists estimates of crop coefficients of crops grown in the area in question and historical reference crop ET. After reviewing these data, in our opinion, they are the best available information on this matter and are as accurate as possible for your area. For example, your estimate of the seasonal alfalfa ET is reasonable when compared to estimates for the Imperial Valley or Arizona, both of which have extremely hot summer climates.

2. Relation between Applied Water and Net Water Required for Irrigation

You have described a relation between Applied Water and Net Water as:

Applied Water = Net Water/(Distribution Uniformity – Miscellaneous Unavoidable Losses)

You have defined Miscellaneous Unavoidable Losses to include scheduling difficulties, maintenance, breaks, unexpected pressure losses, and other problems often encountered in the field. In theory, we feel that including the Miscellaneous Unavoidable Losses in the efficiency equation is appropriate, but caution should be used in promoting these losses as necessary adjustments to the water supply. For example, one could argue that losses due to irrigation scheduling difficulties could be avoided if growers paid more attention to water management. Note that in your equation, these losses are expressed as a fraction of the total amount of applied water. Confusion can exist in the appropriate value to be used for distribution uniformity (DU) because of the different definitions of DU. One definition is the catch can uniformity which accounts for the nonuniform water applications due to the sprinkler spacings. However, the field-wide DU not only includes the catch can

uniformity (which is usually the dominate factor in the field-wide DU in the valley), but also nonuniformity due to pressure losses throughout the field, leaks, non-vertical risers, and mixed nozzle sizes (which should be avoided).

The field wide DU should be used in your equation. The article, "Practical Potential Irrigation Efficiencies", (B. Hanson, Proceedings of the First International Conference, American Society of Civil Engineers, August 14-18, 1995) lists estimates of practical maximum irrigation efficiencies based on the practical maximum attainable field-wide uniformities (sometimes called the global uniformity) for different irrigation methods. These estimates are based on irrigation system evaluations conducted by mobile irrigation evaluation laboratories throughout the state.

A reasonable estimate of the field-wide DU of portable solid set sprinkler systems is about 75% under low wind conditions. This means that about 25% of the water reaching the ground surface would be deep percolation assuming no other losses, which in your case, you feel that there are other losses that do not become deep percolation. However, as the wind speed increases above about 5 miles per hour, the catch can DU decreases rapidly, as does the field wide DU.

3. Net Water

We agree that the Net Water in the above equation is the sum of all beneficial uses of water not simply water for evapotranspiration. Other beneficial uses include water to control soil erosion when the plants are small and all water used during the non-growing time periods that include water preceding field preparation, fumigation and "water capping." These additional beneficial uses can reflect the site specific conditions of your area and grower experience. In our opinion, these additional beneficial uses are reasonable.

4. Fate of the Difference between Applied Water and Net Water

It is frequently assumed that the difference between Applied Water and Net Water is deep percolation. However, you feel that this difference needs to be divided between at least four sinks including losses between the sprinkler nozzles and the soil, pooling in the fields, runoff, and return flows or deep percolation. As you stated, quantifying these values is a challenge, and some cases can only be based on grower experience. Your estimates of these values for the Antelope Valley are:

Return Flow	4% to 25% [1]
Losses between the Sprinkler Nozzles and the Soil	3% to 15% [2]
Pooling in the Fields	0% to 3%
Runoff	0% to 3%

1 Minimum Leaching Requirements are estimated at 4%

2 These losses may be 2 to 5% greater during the hot, dry winds in Antelope Valley

We feel that these sinks are reasonable descriptions of the partitioning. However, the return flow minimum value (based on a leaching requirement of 4%) needs to be adjusted upward. No irrigation method can apply water such that 4% of the applied water is return flow unless the field is severely under irrigated. Basing irrigation water management on minimum leaching requirements is not very practical, in our opinion. A rough guess for the minimum return flow is 15 to 20%. The values for evaporation losses can be justified from research results. A commonly used value is 10% (based on research results); however, it could be more under the Antelope Valley conditions. No research data exists on the other sinks, and thus, grower experience is the only source of these estimates.

Sincerely,

Blaine Hanson
Extension Irrigation and Drainage Specialist
Dept. of Land, Air and Water Resources
University of California, Davis

Steve Orloff
Farm Advisor, Siskiyou County and former Farm Advisor, Los Angeles County
University of California Cooperative Extension

APPLIED AG WATER (Problem Statement)

ACREAGE TOTAL (1)

Year	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	TOTAL
1995	7,093	4,754	869	2,411	1,342	120	550	0	0	17,139
1996	7,088	4,441	3,370	2,755	1,386	180	374	0	0	19,593
1997	7,492	3,922	5,506	2,818	1,411	75	529	0	15	21,768
1998	7,300	1,905	8,139	2,982	1,607	75	324	320	24	22,677
1999	8,417	1,378	8,162	2,706	1,749	75	285	480	26	23,277
2000	8,720	1,452	10,787	3,304	2,124	408	244	797	33	27,868
2001	7,808	1,624	9,485	2,992	2,143	265	237	598	49	25,200
2002	7,958	1,702	14,128	2,223	1,447	40	323	459	54	28,335
2003	7,261	1,546	11,782	3,778	1,410	80	216	665	63	26,801
2004	7,703	1,783	10,954	3,288	1,426	40	216	394	140	25,944
2005	7,074	2,626	9,909	3,358	1,363	40	231	470	107	25,178
2006	6,741	2,865	8,126	3,242	1,802	0	77	562	113	23,528
2007										
2008										

WATER APPLICATION TOTAL (AF)

	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	SUB TOTAL	PLUS Unreported Farms (3)	MINUS Surface Water (4)	MINUS Reclaim Water (4)	TOTAL APPLIED GROUND-WATER
Applied Water Rqrmnt /acre (2)	6.5	2.6	3.9	4.5	4.9	4.6	2.8	2.8	3.7					
1995	46,105	12,360	3,389	10,850	6,576	552	1,540	0	0	81,371	4,068	(12,846)	(3,294)	**69,299**
1996	46,072	11,547	13,143	12,398	6,791	828	1,047	0	0	91,826	4,591	(18,245)	(3,602)	**74,570**
1997	48,698	10,197	21,473	12,681	6,914	345	1,481	0	56	101,845	5,092	(23,691)	(3,838)	**79,408**
1998	47,450	4,953	31,742	13,419	7,874	345	907	896	89	107,675	5,384	(17,110)	(3,414)	**92,535**
1999	54,711	3,583	31,832	12,177	8,570	345	798	1,344	96	113,455	5,673	(25,235)	(3,678)	**90,215**
2000	56,680	3,775	42,069	14,868	10,408	1,877	683	2,232	122	132,714	6,636	(28,221)	(4,381)	**106,748**
2001	50,752	4,222	36,992	13,464	10,501	1,219	664	1,674	181	119,669	5,983	(19,643)	(4,597)	**101,412**
2002	51,727	4,425	55,099	10,004	7,090	184	904	1,285	200	130,919	6,546	(10,138)	(6,628)	**120,699**
2003	47,197	4,020	45,950	17,001	6,909	368	605	1,862	233	124,144	6,207	(6,390)	(7,501)	**116,460**
2004	50,070	4,636	42,721	14,796	6,987	184	605	1,103	518	121,619	6,081	(7,682)	(8,142)	**111,876**
2005	45,981	6,828	38,645	15,111	6,679	184	647	1,316	396	115,786	5,789	(9,282)	(9,998)	**102,295**
2006	43,817	7,449	31,691	14,589	8,830	0	216	1,574	418	108,583	5,429	(12,731)	(11,797)	**89,484**
2007														
2008														

(1) Problem Statement Appendix D, Table D.2-1b
(2) Problem Statement Appendix D-3, Table 4
(3) 5% of Subtotal, Problem Statement Appendix D, Table D.3-1
(4) Problem Statement Appendix D, Table D.4-4

APPLIED AG WATER (U of C)

ACREAGE TOTAL (1)

Year	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	TOTAL
1995	7,093	4,754	869	2,411	1,342	120	550	0	0	17,139
1996	7,088	4,441	3,370	2,755	1,386	180	374	0	0	19,593
1997	7,492	3,922	5,506	2,818	1,411	75	529	0	15	21,768
1998	7,300	1,905	8,139	2,982	1,607	75	324	320	24	22,677
1999	8,417	1,378	8,162	2,706	1,749	75	285	480	26	23,277
2000	8,720	1,452	10,787	3,304	2,124	408	244	797	33	27,868
2001	7,808	1,624	9,485	2,992	2,143	265	237	598	49	25,200
2002	7,958	1,702	14,128	2,223	1,447	40	323	459	54	28,335
2003	7,261	1,546	11,782	3,778	1,410	80	216	665	63	26,801
2004	7,703	1,783	10,954	3,288	1,426	40	216	394	140	25,944
2005	7,074	2,626	9,909	3,358	1,363	40	231	470	107	25,178
2006	6,741	2,865	8,126	3,242	1,802	0	77	562	113	23,528
2007										
2008										

WATER APPLICATION TOTAL (AF)

	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	SUB TOTAL	PLUS Unreported Farms (3)	MINUS Surface Water (4)	MINUS Reclaim Water (4)	TOTAL APPLIED GROUND-WATER	Difference (U of C - Prob Stmt)
Applied Water Rqrmnt /acre (2)	7.65	3.05	4.6	5.22	5.36	4.96	3.11	3.35	3.7						
1995	54,261	14,500	3,997	12,585	7,193	595	1,711	0	0	94,843	4,068	(12,846)	(3,294)	**82,771**	**13,471**
1996	54,223	13,545	15,502	14,381	7,429	893	1,163	0	0	107,136	4,591	(18,245)	(3,602)	**89,880**	**15,311**
1997	57,314	11,962	25,328	14,710	7,563	372	1,645	0	56	118,949	5,092	(23,691)	(3,838)	**96,512**	**17,104**
1998	55,845	5,810	37,439	15,566	8,614	372	1,008	1,072	89	125,815	5,384	(17,110)	(3,414)	**110,675**	**18,139**
1999	64,390	4,203	37,545	14,125	9,375	372	886	1,608	96	132,601	5,673	(25,235)	(3,678)	**109,361**	**19,145**
2000	66,708	4,429	49,620	17,247	11,385	2,024	759	2,670	122	154,963	6,636	(28,221)	(4,381)	**128,997**	**22,249**
2001	59,731	4,953	43,631	15,618	11,486	1,314	737	2,003	181	139,656	5,983	(19,643)	(4,597)	**121,399**	**19,987**
2002	60,879	5,191	64,989	11,604	7,756	198	1,005	1,538	200	153,359	6,546	(10,138)	(6,628)	**143,139**	**22,440**
2003	55,547	4,715	54,197	19,721	7,558	397	672	2,228	233	145,267	6,207	(6,390)	(7,501)	**137,583**	**21,124**
2004	58,928	5,438	50,388	17,163	7,643	198	672	1,320	518	142,269	6,081	(7,682)	(8,142)	**132,526**	**20,650**
2005	54,116	8,009	45,581	17,529	7,306	198	718	1,575	396	135,428	5,789	(9,282)	(9,998)	**121,937**	**19,642**
2006	51,569	8,738	37,380	16,923	9,659	0	239	1,883	418	126,809	5,429	(12,731)	(11,797)	**107,710**	**18,226**
2007															
2008															

(1) Problem Statement Appendix D, Table D.2-1b
(2) University of CA, Table 4 (2007)
(3) 5% of Subtotal, Problem Statement Appendix D, Table D.3-1
(4) Problem Statement Appendix D, Table D.4-4

Table D.2-1b
Summary of Historical Crop Acreages Grouped by Applied Crop Water Requirements
Crop Acreages Shown by County and in Total for the Antelope Valley

		Los Angeles County Portion of Antelope Valley										Kern County Portion of Antelope Valley										Total Acreage for Antelope Valley									
Year	Source	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Total	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Total	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Total
1910	(1)																														4,629
1918	(2)																					7,155									11,960
1920	(2)																					7,400									
1922	(2)																					7,000									
1924	(2)																					12,000									16,780
1925	(2)																					14,000									
1927	(2)																					20,250									
1929	(2)																					25,000									31,420
1930	(2)																					22,000									
1931	(2)																					21,700									
1934	(2)																					15,317									23,800
1935	(2)																					16,000									
1938	(2)																					23,000									
1939	(2)																					20,000									
1945	(2)																					29,600									37,796
1945	(3)	30,000	9,000			2,260		740			42,000		4,000								4,000	30,000	13,000			2,260		740			46,000
1946	(2)																					31,500									40,027
1947	(2)																					34,700									
1948	(2)																					37,700									
1949	(2)																					38,900									52,497
1950	(2)																					38,525									54,666
1950	(4)																					62,200	4,200			4,500	200	100		0	71,200
1951	(2)																					39,845									54,455
1957	(5)																					37,530	14,570			1,540	2,210	1,290		0	57,140
1961	(6)																					43,950	4,690			1,410	2,290	2,110		60	54,710
1970	(7)	29,200	15,300		50	1,855	1,500	100			48,015	3,833	1,689	80	907	520	960	854	0	0	8,643	32,833	16,989	80	957	2,375	2,460	954	0	0	56,658
1971	(7)	26,400	23,700			1,867	1,500	150			53,617	4,057	1,886	89	1,013	581	1,072	953	0	0	9,651	30,457	25,586	89	1,013	2,448	2,572	1,103	0	0	63,268
1972	(7)	23,400	16,000		80	1,591	1,500	85			42,656	3,228	1,500	71	806	462	853	758	0	0	7,678	26,628	17,500	71	886	2,053	2,353	843	0	0	50,334
1972	(8)																					38,080	1,390			1,400				60	42,290
1973	(7)	21,600	18,100		240	1,390	1,220	70			43,020	3,255	1,513	72	813	466	880	765	0	0	7,744	25,055	19,613	72	1,053	2,056	2,080	835	0	0	50,764
1974	(7)	20,200	23,700		250	1,540	1,070	155			46,915	3,550	1,650	78	886	508	938	834	0	0	8,445	23,750	25,350	78	1,136	2,048	2,008	989	0	0	55,360
1975	(7)	19,400	27,150		700	1,393	1,200	200			50,043	3,787	1,760	83	945	542	1,001	890	0	0	9,008	23,187	28,910	83	1,645	1,935	2,201	1,090	0	0	59,051
1976	(7)	20,375	11,800		1,200	1,162	1,868	480			36,885	2,791	1,297	61	697	400	738	656	0	0	6,638	23,166	13,097	61	1,897	1,562	2,606	1,136	0	0	43,524
1977	(7)	23,375	16,500	1,160	2,500	1,162	3,700	340	500		51,237	3,877	1,602	85	968	555	1,025	911	0	0	9,223	27,252	20,302	1,245	3,468	1,717	4,725	1,251	500	0	60,460
1978	(7)	23,400	16,250		1,700	1,180	3,200	311			46,041	3,484	1,619	77	870	499	921	819	0	0	8,287	26,884	17,869	77	2,570	1,679	4,121	1,130	0	0	54,328
1979	(7)	22,600	10,034	80	1,715	1,219	2,200	150	80		38,288	2,897	1,346	64	723	415	766	681	0	0	6,892	25,497	11,380	154	2,438	1,634	2,966	831	80	0	45,180
1980	(7)	22,600	12,395	50	425	1,349	3,860	315			40,994	3,102	1,442	66	774	444	820	729	0	0	7,378	25,702	13,837	116	1,199	1,793	4,680	1,044	0	0	48,373
1981	(7)	20,100	11,600	80	977	1,015	2,775	420			36,857	2,790	1,298	61	698	399	737	655	0	0	6,636	22,890	12,798	141	1,675	1,414	3,512	1,075	0	0	43,493
1982	(7)	16,300	12,850	180	1,433	1,046	340	625			32,774	2,480	1,153	55	619	355	655	583	0	0	5,899	18,780	14,003	235	2,052	1,401	995	1,208	0	0	38,673
1983	(7)	13,957	14,717		1,810	1,004	317	585			32,390	2,451	1,139	54	612	351	648	576	0	0	5,830	16,408	15,856	54	2,422	1,355	965	1,161	0	0	38,220
1984	(7)	12,068	12,868	61	1,447	1,047	260	597			28,346	2,146	997	47	535	307	567	504	0	0	5,103	14,213	13,865	108	1,983	1,354	827	1,101	0	0	33,451
1985	(7)	10,593	11,726	71	1,548	993	0	543			25,474	1,928	896	42	481	276	509	453	0	0	4,585	12,520	12,622	113	2,030	1,269	509	996	0	0	30,059
1986	(7)	8,461	9,719	85	1,451	862		389			20,968	1,587	737	35	396	227	419	373	0	0	3,774	10,047	10,457	120	1,847	1,090	419	762	0	0	24,742
1986	(9)																					9,860	1,330			1,970				30	15,630
1987	(7)	8,867	2,641	92	1,467	936		246			14,248	1,136	529	25	284	163	301	267	0	0	2,707	10,005	3,169	117	1,751	1,099	301	514	0	0	16,956
1988	(7)	7,598	7,874	74	1,868	965		389			18,369	1,522	754	36	405	232	429	381	0	0	3,857	9,220	8,628	110	2,073	1,197	429	770	0	0	22,226
1989	(7)	8,230	831	66	1,642	1,005		46			9,840	951	442	21	237	136	251	224	0	0	2,263	7,182	1,273	106	1,879	1,141	251	270	0	0	12,103
1990	(7)	6,223	1,023	110	1,519	1,057		47			9,979	1,048	487	23	282	159	277	246	0	0	2,495	7,271	1,511	133	1,781	1,206	277	294	0	0	12,474
1991	(7)	5,799	788	27	1,656	1,015		103			9,387	1,083	494	23	285	152	281	250	0	0	2,529	6,882	1,282	50	1,922	1,167	281	353	0	0	11,896
1992	(7)	5,281	5,412	4	1,632	1,031		149			13,509	1,647	785	36	411	238	435	387	0	0	3,916	6,928	6,177	40	2,043	1,267	435	536	0	0	17,426
1993	(7)	5,582	1,815	16	1,533	1,315		125			10,385	1,353	629	30	338	194	358	318	0	0	3,219	6,935	2,444	46	1,871	1,509	358	442	0	0	13,604
1994	(7)	5,528	2,621	21	1,319	1,505		191			11,184	1,362	633	30	340	195	360	320	0	0	3,240	6,890	3,254	51	1,659	1,700	360	511	0	0	14,424
1995	(7)	5,462	4,263	549	1,636	1,257		180			13,347	1,631	491	320	775	85	120	370	0	0	3,792	7,093	4,754	869	2,411	1,342	120	550	0	0	17,139
1996	(7)	5,537	3,712	2,324	1,493	1,196		186			14,447	1,551	729	1,046	1,262	190	180	188	0	0	6,146	7,088	4,441	3,370	2,755	1,386	180	374	0	0	19,593
1997	(7)	5,505	3,317	3,611	1,893	1,261		203		15	16,005	1,987	805	1,095	925	150	75	326	0	0	5,763	7,492	3,922	5,506	2,818	1,411	75	529	0	15	21,768
1998	(7)	5,285	1,560	5,252	2,377	1,457		179		24	16,115	2,035	345	2,887	605	150	75	145	320	0	6,562	7,300	1,905	8,139	2,982	1,607	75	324	320	24	22,677
1999	(7)	6,097	1,033	5,505	2,166	1,704		215		28	16,718	2,380	345	2,954	540	45	75	70	480	0	6,559	8,477	1,378	8,182	2,706	1,749	75	285	480	28	23,277
2000	(7)	6,165	1,074	8,132	2,264	1,959		129		33	19,755	2,555	378	2,655	1,040	165	408	115	797	0	8,113	8,720	1,452	10,787	3,304	2,124	408	244	797	33	27,868
2001	(7)	5,705	1,160	7,417	1,697	2,023		117		49	18,167	2,103	464	2,068	1,295	120	265	120	598	0	7,033	7,808	1,624	9,485	2,992	2,143	265	237	598	49	25,200
2002	(7)	5,203	1,307	9,964	1,686	1,327		226		54	19,770	2,755	395	4,164	537	120	40	95	459	0	8,565	7,958	1,702	14,128	2,223	1,447	40	323	459	54	28,335
2003	(7)	5,461	1,371	8,555	2,758	1,340		136		63	19,684	1,800	175	3,227	1,020	70	80	80	665	0	7,117	7,261	1,546	11,782	3,778	1,410	80	216	665	63	26,801
2004	(7)	5,728	1,282	7,403	2,633	1,279		131		74	18,730	1,975	501	3,551	455	147	40	85	394	66	7,214	7,703	1,783	10,954	3,288	1,426	40	216	394	140	25,944
2005	(7)	5,583	1,520	5,361	2,623	1,293		101		107	16,585	1,491	1,106	4,548	735	70	40	130	470	0	8,590	7,074	2,626	9,909	3,358	1,363	40	231	470	107	25,175
2006	(7)	5,556	1,960	3,754	1,838	1,304		77		113	14,602	1,185	905	4,372	1,404	498	0	0	562	0	8,926	6,741	2,865	8,126	3,242	1,802	0	77	562	113	23,528

(1) Tait, S.E., 1912
(2) Snyder, J. Herbert, 1955
(3) California Division of Water Resources, 1947
(4) State Water Resources Board, 1955
(5) California Department of Water Resources, 1963
(6) California Department of Water Resources, 1965
(7) Los Angeles and Kern County Agricultural Commissioners, 1970 - 2006 and 1994-2006
(8) California Department of Water Resources, 1974
(9) California Department of Water Resources, 1990

(1): Area Northern Boundary Unknown
(2, 3, and 7): Area Northern Boundary at Cottonwood-Willow Springs-Rosamond Fault
(4, 5, 6, 8, and 9): Area Northern Boundary defined by Antelope Valley Hydrographic Unit (encompasses towns of Mojave and Boron)

Table D.3-1
Historical Agricultural Water Requirements by Investigator and Calculation Parameters
Antelope Valley Area of Adjudication
(all values in acre-feet)

	Reported Values (Snyder, 1955)[1]		Calculated from DWR Crop Acreages, DWR Crop Consumptive Use Values, and Irrigation Efficiencies of 70 - 90%[3]								Calculated from County Crop Report Acreages and CIMIS-Derived Applied Crop Water Duties (DU = 80%; Irrigation Efficiencies = 59 to 80%)												
	Total	Current Estimate[2]	Alfalfa	Other Pasture	Grain and Hay	Field	Deciduous	Truck	Vineyard	Total	Current Estimate[4]	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Subtotal	Unreported Farms	Total	Historical Total
Applied Water Duties (afa/c)	1.4 - 7.5		3.0 (7.2)	2.8 (7.7)	0.8 (2.6)	1.5 (4.5)	2.2 (5.6)	1.4 (4.0)	2.4 (4.2)			6.5	2.6	3.9	4.5	4.9	4.6	2.8	2.8	3.7		(5% of Subtotal)		
Year																								
1919	64,200	77,565																						77,565
1920	66,600	80,508																						80,508
1925	96,800	121,746																						121,746
1927	131,400	167,566																						167,566
1929	160,000	204,724																						204,724
1930	141,600	160,112																						160,112
1935	102,600	130,176																						130,176
1940	158,400	202,348																						202,348
1945	210,800	255,311	90,000		13,000		4,520	1,480		109,000	265,416													266,311
1949	226,000	273,960																						273,960
1947	261,400	296,757																						296,757
1948	304,800	322,497																						322,497
1949	322,900	327,685																						327,685
1950	350,500	347,676	207,000	311	3,733	333	11,000	156	0	222,533	485,310													347,676
1951	366,200	362,549																						362,549
1957			138,900	20,460	16,651	4,736	4,840	2,580	0	188,187	334,387													334,387
1961			177,086	10,520	5,589	4,907	4,431	4,220	206	206,959	357,362													357,362
1970												213,415	44,170	312	4,351	11,638	11,317	2,670	0	0	287,875	14,394	302,268	302,268
1971												197,971	66,522	349	4,557	11,994	11,833	3,089	0	0	296,315	14,816	311,131	311,131
1972			147,428	8,720	1,589	5,679	4,400	1,420	206	167,441	287,087	173,080	45,500	277	3,986	10,060	10,824	2,361	0	0	246,069	12,304	258,393	258,393
1973												162,859	50,993	260	4,737	10,075	9,570	2,337	0	0	240,550	12,043	252,693	252,693
1974												154,374	65,910	305	5,113	10,036	9,236	2,769	0	0	247,746	12,387	260,133	260,133
1975												150,713	75,166	325	7,404	9,482	10,124	3,051	0	0	256,264	12,813	269,078	269,078
1976												150,579	34,053	240	8,535	7,652	11,986	3,180	0	0	216,224	10,811	227,036	227,036
1977												177,138	52,785	4,857	15,605	8,414	21,734	3,502	1,400	0	285,434	14,272	299,706	299,706
1978												174,744	46,460	299	11,563	8,226	18,956	3,163	0	0	263,411	13,171	276,582	276,582
1979												167,031	29,589	600	10,972	8,006	13,642	2,326	224	0	232,390	11,620	244,010	244,010
1980												167,062	35,975	461	5,397	8,786	21,527	2,823	0	0	242,132	12,107	254,239	254,239
1981												148,782	33,271	552	7,530	6,931	18,157	3,011	0	0	216,234	10,812	227,046	227,046
1982												122,069	36,407	915	9,234	6,865	4,579	3,381	0	0	183,451	9,173	192,624	192,624
1983												106,651	41,226	211	10,898	6,639	4,438	3,250	0	0	173,313	8,666	181,978	181,978
1984												92,383	38,049	422	8,923	6,636	3,804	3,082	0	0	151,300	7,565	158,865	158,865
1985												81,381	32,817	441	9,133	6,219	2,344	2,789	0	0	135,123	6,756	141,879	141,879
1986			37,757	4,200	1,520	129	5,191	4,760	103	54,660	95,923	65,307	27,188	468	8,313	5,339	1,929	2,133	0	0	110,676	5,534	116,210	116,210
1987												55,033	8,240	455	7,880	5,385	1,384	1,438	0	0	89,815	4,491	94,306	94,306
1988												59,929	21,912	428	9,327	5,867	1,972	2,156	0	0	101,591	5,080	106,671	106,671
1989												46,680	3,311	415	8,455	5,591	1,157	755	0	0	66,365	3,318	69,683	69,683
1990												47,263	3,927	519	8,014	5,917	1,276	822	0	0	67,738	3,387	71,125	71,125
1991												44,804	3,281	195	8,547	5,717	1,293	968	0	0	64,725	3,236	67,961	67,961
1992												45,029	16,061	155	9,193	6,208	2,002	1,502	0	0	80,151	4,008	84,158	84,158
1993												45,075	6,353	179	8,417	7,395	1,645	1,239	0	0	70,305	3,515	73,820	73,820
1994												44,782	8,460	199	7,466	8,328	1,656	1,429	0	0	72,320	3,616	75,937	75,937
1995												45,103	12,360	3,389	10,848	6,577	552	1,540	0	0	81,369	4,068	85,438	85,438
1996												46,069	11,547	13,143	12,395	6,791	828	1,047	0	0	91,820	4,591	96,411	96,411
1997												48,695	10,198	21,473	12,683	6,916	345	1,480	0	55	101,845	5,092	106,937	106,937
1998												47,453	4,953	31,742	13,417	7,874	345	908	896	90	107,678	5,384	113,062	113,062
1999												54,713	3,582	31,832	12,176	8,566	345	797	1,344	96	113,452	5,673	119,125	119,125
2000												58,681	3,774	42,069	14,867	10,407	1,677	663	2,232	122	132,712	6,636	139,348	139,348
2001												50,750	4,222	36,992	13,456	10,500	1,219	664	1,674	179	119,656	5,983	125,649	125,649
2002												51,729	4,426	55,099	10,002	7,092	184	904	1,285	201	130,922	6,546	137,468	137,468
2003												47,197	4,020	45,950	17,000	6,910	368	604	1,652	232	124,143	6,207	130,350	130,350
2004												50,068	4,635	42,721	14,797	6,988	184	606	1,103	519	121,620	6,081	127,701	127,701
2005												45,982	6,827	38,645	15,113	6,677	184	845	1,316	397	115,787	5,789	121,576	121,576
2006												43,817	7,449	31,691	14,569	8,830	0	216	1,574	418	108,583	5,429	114,012	114,012

1) Calculated from Reported Crop Acreages, Crop Consumptive Use Values, and Irrigation Efficiencies (41 - 61%)
2) Calculated from Snyder Crop Acreages and CIMIS-Derived Applied Crop Water Duties (DU=70%)
3) Crop Water Values shown are Consumptive Use Values (Irrigation Efficiencies not incorporated); Calculated Water Requirements utilize Irrigation Efficiencies of 100% (1945), 90% (1950), and 70% (all other survey years)
4) Calculated from DWR Crop Acreages and CIMIS-Derived Applied Crop Water Values (DU=70%) shown in parentheses in crop column headings

Table D.4-4
Historical Total Water Supply
Antelope Valley Area of Adjudication
(Acre-Feet per Year)

	Municipal/Industrial					Agricultural						Environmental		Combined					Total
Year	Groundwater	Imported Surface Water (AVEK,PWD,LCID)	Local Surface Water (PWD)	Surface Water (Total)	Total Mkt Supply	Groundwater**	Imported Surface Water (AVEK)	Local Surface Water (LCID)	Surface Water (Total)	Recycled Water (LACSD,14 and 20)	Total Ag Supply**	Recycled Water (LACSD 14)	Total Environmental Supply	Groundwater	Imported Surface Water	Local Surface Water	Surface Water (Total)	Recycled Water (LACSD)	Total Antelope Valley Water Supply
1946	9,467	0	1,000	1,000	10,467	273,960	0	0	0	0	273,960	0	0	283,427	0	1,000	1,000	0	284,427
1947	9,167	0	1,000	1,000	10,167	296,757	0	0	0	0	296,757	0	0	305,924	0	1,000	1,000	0	306,924
1948	8,953	0	1,000	1,000	9,953	322,497	0	0	0	0	322,497	0	0	331,449	0	1,000	1,000	0	332,449
1949	11,369	0	1,000	1,000	12,369	327,685	0	0	0	0	327,685	0	0	339,054	0	1,000	1,000	0	340,054
1950	6,993	0	1,000	1,000	9,993	347,676	0	0	0	0	347,676	0	0	356,669	0	1,000	1,000	0	357,669
1951	7,566	0	1,000	1,000	8,566	362,549	0	0	0	0	362,549	0	0	370,116	0	1,000	1,000	0	371,116
1952	6,921	0	1,000	1,000	7,921	357,856	0	0	0	0	357,856	0	0	364,678	0	1,000	1,000	0	365,678
1953	11,445	0	1,000	1,000	12,445	353,162	0	0	0	0	353,162	0	0	364,607	0	1,000	1,000	0	365,607
1954	14,248	0	1,000	1,000	15,248	348,468	0	0	0	0	348,468	0	0	362,716	0	1,000	1,000	0	363,716
1955	15,072	0	1,000	1,000	16,072	343,774	0	0	0	0	343,774	0	0	358,847	0	1,000	1,000	0	359,847
1956	18,321	0	2,422	2,422	20,743	339,081	0	0	0	0	339,081	0	0	357,402	0	2,422	2,422	0	359,824
1957	14,770	0	1,752	1,752	16,522	334,387	0	0	0	0	334,387	0	0	349,157	0	1,752	1,752	0	350,909
1958	13,697	0	2,434	2,434	16,131	340,131	0	0	0	0	340,131	0	0	353,827	0	2,434	2,434	0	356,261
1959	20,976	0	1,311	1,311	22,287	345,792	0	0	0	83	345,875	0	0	366,767	0	1,311	1,311	83	368,161
1960	17,217	0	385	385	17,602	351,535	0	0	0	83	351,618	0	0	368,752	0	385	385	83	369,220
1961	26,982	0	0	0	26,982	357,279	0	0	0	83	357,362	—	—	384,261	0	0	0	83	384,344
1962	31,471	0	5,534	5,534	37,005	351,143	0	0	0	97	351,240	—	—	382,614	0	5,534	5,534	97	388,245
1963	22,801	0	136	136	22,937	345,022	0	0	0	97	345,119	—	—	367,823	0	136	136	97	368,056
1964	26,303	0	262	262	26,565	338,862	0	0	0	135	338,997	—	—	365,166	0	262	262	135	365,563
1965	24,432	0	1,318	1,318	25,750	332,652	0	0	0	224	332,876	—	—	357,084	0	1,318	1,318	224	358,626
1966	28,658	0	0	0	28,658	326,530	0	0	0	224	326,754	—	—	355,188	0	0	0	224	355,412
1967	26,416	0	0	0	26,416	320,209	0	0	0	424	320,633	—	—	346,625	0	0	0	424	347,049
1968	29,604	0	3,150	3,150	32,754	314,087	0	0	0	424	314,511	—	—	343,692	0	3,150	3,150	424	347,266
1969	31,451	0	2,105	2,105	33,556	307,878	0	0	0	512	308,390	—	—	339,329	0	2,105	2,105	512	341,946
1970	27,168	0	1,396	1,396	28,564	299,910	0	1,849	1,849	509	302,268		—	327,078	0	3,245	3,245	509	330,832
1971	30,656	0	1,389	1,389	32,245	308,768	0	1,663	1,663	700	311,131	—	—	339,624	0	3,052	3,052	700	343,376
1972	34,942	338	1,960	1,698	36,640	256,102	0	1,587	1,587	704	256,393	—	—	291,044	338	2,947	3,285	704	295,033
1973	32,210	290	1,523	1,813	34,023	250,330	0	1,672	1,672	891	252,893	—	—	282,540	290	3,195	3,485	891	286,916
1974	31,586	400	938	1,338	32,904	257,676	0	1,651	1,651	606	260,133	—	—	289,242	400	2,589	2,989	906	293,037
1975	30,092	520	1,586	2,106	32,198	266,674	0	1,513	1,513	891	269,078	927	927	296,766	520	3,099	3,619	1,818	302,203
1976	30,410	589	1,151	1,740	32,150	197,450	27,295	1,400	28,695	891	227,036	1,559	1,559	227,859	27,884	2,551	30,435	2,450	260,744
1977	27,972	111	468	579	28,551	266,132	32,133	500	32,633	941	299,706	1,978	1,978	294,104	32,244	968	33,212	2,919	330,235
1978	23,908	5,479	2,024	7,503	31,411	236,470	37,428	1,688	39,116	996	276,582	2,456	2,456	260,378	42,907	3,712	46,619	3,452	310,449
1979	25,015	7,381	913	8,294	33,309	190,089	50,934	1,950	52,884	1,036	244,010	2,226	2,226	215,104	58,316	2,863	61,179	3,262	279,545
1980	24,679	7,069	913	7,982	32,660	193,276	58,054	1,950	60,004	958	254,239	2,442	2,442	217,955	65,123	2,863	67,986	3,400	289,341
1981	22,341	10,643	1,638	12,281	34,622	161,563	63,894	1,040	64,934	548	227,045	2,601	2,601	183,904	74,537	2,678	77,215	3,149	264,268
1982	26,321	6,921	1,680	8,601	34,922	151,987	39,053	1,604	40,657	0	192,624	2,336	2,336	178,287	45,974	3,284	49,258	2,336	229,882
1983	21,147	6,576	714	7,290	28,436	157,187	23,505	1,199	24,704	88	181,978	2,958	2,958	179,334	30,081	1,913	31,994	3,046	213,374
1984	26,220	10,518	927	11,445	37,665	139,821	18,176	1,464	19,640	404	159,865	2,755	2,755	167,041	28,694	2,391	31,085	3,159	201,286
1985	26,906	14,485	1,460	15,945	42,831	119,522	21,583	1,375	22,958	399	141,079	3,258	3,258	145,406	36,067	2,835	38,902	3,657	187,966
1986	31,687	17,710	332	18,042	49,729	100,527	14,381	1,250	15,631	52	116,210	4,356	4,356	132,214	32,091	1,582	33,673	4,408	170,295
1987	33,122	22,107	0	22,107	55,228	79,327	13,916	1,000	14,916	64	94,306	5,271	5,271	112,448	36,022	1,000	37,022	5,335	154,805
1988	36,314	20,442	1,330	21,772	58,086	89,484	14,154	1,000	15,154	2,033	106,671	3,777	3,777	125,798	34,596	2,330	36,926	5,810	168,533
1989	38,284	31,285	1,400	32,685	70,968	50,150	16,100	700	16,800	2,726	69,683	2,134	2,134	88,441	47,385	2,100	49,485	4,859	142,785
1990	35,598	36,450	110	36,560	72,160	62,326	14,775	200	14,975	3,824	71,125	2,451	2,451	97,925	51,225	310	51,535	6,275	145,735
1991	38,272	21,245	286	21,531	59,803	77,936	922	750	1,672	4,011	83,619	2,567	2,567	116,208	22,167	1,036	23,203	6,578	145,989
1992	33,867	27,549	3,465	31,014	64,881	77,274	2,323	900	3,223	3,661	84,158	3,520	3,520	111,141	29,872	4,365	34,237	7,181	152,559
1993	39,301	39,391	2,239	41,630	80,931	61,853	8,115	725	8,840	3,127	73,820	5,279	5,279	101,154	47,506	2,964	50,470	8,406	160,030
1994	45,733	42,646	867	43,513	89,246	59,737	11,637	800	12,437	3,762	75,937	5,109	5,109	105,470	54,283	1,667	55,950	8,871	170,292
1995	49,320	36,468	3,771	40,259	89,578	69,298	12,846	0	12,846	3,294	85,438	7,141	7,141	118,618	49,334	3,771	53,104	10,435	182,157
1996	50,511	45,906	3,043	48,949	99,459	74,564	18,245	0	18,245	3,602	96,411	7,501	7,501	125,075	64,151	3,043	67,194	11,103	203,372
1997	50,470	47,070	2,363	49,433	99,903	79,407	23,691	0	23,691	3,838	106,937	6,877	6,877	129,877	70,762	2,363	73,124	10,715	213,717
1998	43,670	40,862	5,040	45,901	89,571	91,938	17,710	0	17,710	3,414	113,062	8,706	8,706	136,608	58,572	5,040	63,612	12,120	211,309
1999	48,609	52,873	3,050	55,923	104,531	90,211	25,235	0	25,235	3,678	119,125	7,638	7,638	138,820	78,109	3,050	81,158	11,316	231,294
2000	46,821	53,566	6,500	60,066	106,887	109,746	28,221	0	28,221	4,381	138,348	7,120	7,120	155,568	81,786	6,500	88,287	11,501	256,355
2001	57,818	48,110	5,851	54,961	112,779	101,409	19,643	0	19,643	4,597	125,649	7,550	7,550	159,227	67,763	6,851	74,004	12,147	245,979
2002	53,800	59,704	0	59,704	113,504	120,702	10,138	0	10,138	6,628	137,468	7,839	7,839	174,301	69,843	0	69,843	14,467	258,611
2003	48,001	58,532	3,499	62,031	110,032	116,459	6,390	0	6,390	7,501	130,350	8,382	8,382	164,460	64,922	3,499	68,421	15,883	248,764
2004	54,381	56,124	3,959	62,083	116,464	111,877	7,682	0	7,682	8,142	127,701	9,239	9,239	166,256	65,806	3,959	69,765	17,381	253,404
2005	50,901	57,265	6,900	64,165	115,066	102,296	9,282	0	9,282	9,998	121,576	9,957	9,957	153,197	66,547	6,900	73,447	19,955	245,599
2006	43,960	70,023	4,173	74,196	118,156	89,484	12,731	0	12,731	11,797	114,012	9,611	9,611	133,444	82,753	4,173	86,926	21,408	241,778

*Approximated
**1991 Ag Groundwater Pumpage and Total Ag Supply includes an additional 15,658 af pumped to export to the California Aqueduct
—Designates unknown amount

M&I Groundwater Usage (Source: Problem Statement Appendix D-7 Table 3)

Year	LA WWD #40	Palmdale WD	Littlerock Creek ID	Quartz Hill WD	RCSD	AV Water Co	Palm Ranch ID	Desert Lake CSD	Boron CSD	EAFB	Mutual and Private WC (1)	Rural Resident	SUB TOTAL
1995	19,788	11,086	1,650	1,798	826	677	758	353	0	3,815	2,227	6,342	49,321
1996	19,339	9,508	1,790	2,306	2,027	747	1,147	353	0	3,735	2,518	7,041	50,511
1997	19,644	9,138	1,760	2,030	1,973	757	1,147	353	0	3,781	2,814	7,073	50,471
1998	17,589	8,062	1,520	1,231	1,541	655	1,147	353	0	2,732	2,500	6,341	43,670
1999	18,698	9,568	1,820	1,496	1,463	757	1,147	353	0	3,199	2,708	7,400	48,608
2000	17,419	9,625	1,810	1,419	1,461	827	1,147	353	0	3,712	3,341	7,709	48,822
2001	21,736	11,261	1,830	3,040	2,165	811	1,147	353	0	4,104	3,387	7,984	57,818
2002	21,196	8,261	1,950	2,801	2,359	787	1,536	353	0	3,090	3,246	8,021	53,599
2003	16,791	10,567	1,930	1,554	1,767	602	1,558	353	0	1,935	3,152	7,790	48,001
2004	21,281	10,990	2,230	1,347	1,989	595	814	353	0	3,015	3,522	8,245	54,380
2005	19,201	11,045	1,870	1,244	1,701	614	1,139	353	0	2,356	3,271	8,107	50,902
2006	12,277	11,320	2,150	1,386	2,212	534	591	353	0	1,985	2,901	8,251	43,960
2007													
2008													

(1) Does not reflect estimated 5,000 - 6,000 AF of additional pumping by Mutual Water Companies (John Ukkestad)

Appendix D-7: Table 3
Historical Groundwater Supply
Municipal and Industrial Users
Antelope Valley Area of Adjudication
(pumpage in acre-feet per year)

Year	Los Angeles County Waterworks District 40: Req. 4 Lancaster	Code	Transfer from AVEK from Req. 4 Lancaster	Code	Req. 4 Lancaster Total	Code	Req. 24	Code	Req. 27	Code	Req. 71	Code	Req. 35	Code
1946	200.0	1	0	[illegible]	200.0	1	0	1	400.0	1	0	1	0	[illegible]
1947	250.0	1	0	[illegible]	250.0	1	0	1	0.0	1	0	[illegible]	0	[illegible]
1948	435.0	1	0	[illegible]	830.0	1	0	1	395.0	1	0	1	0	[illegible]
1949	1,137.0	1	0	[illegible]	1,137.0	1	0	1	0.0	1	0	1	0	[illegible]
1950	353.0	1	0	[illegible]	353.0	1	0	1	0.0	1	0	1	0	[illegible]
1951	300.0	1	0	[illegible]	393.0	1	0	1	420.0	1	318.0	1	0	[illegible]
1952	1,067.0	1	0	[illegible]	1,067.0	1	0	1	0.0	1	0	[illegible]	5	[illegible]
1953	3,136.0	1	0	[illegible]	3,136.0	1	0	1	269.0	1	914.0	1	5	[illegible]
1954	1,516.0	1	0	[illegible]	1,563.0	1	485.0	1	0.0	1	109.0	1	0	[illegible]
1955	1,702.0	1	0	[illegible]	1,702.0	1	0	1	208.0	1	162.5	1	0	[illegible]
1956	2,469.0	1	0	[illegible]	2,403.0	1	0	1	1,517.0	1	165.5	1	0	[illegible]
1957	4,398.0	1	0	[illegible]	4,393.0	1	0	1	782.0	1	58.0	1	0	[illegible]
1958	3,405.0	1	0	[illegible]	3,405.0	1	0	1	560.0	1	875.5	1	0	[illegible]
1959	4,157.0	1	0	[illegible]	4,157.0	1	0	1	1,350.0	1	54.0	1	0	[illegible]
1960	5,367.0	1	0	[illegible]	5,367.0	1	6.0	1	164.0	1	952.0	1	0	1
1961–2005	[illegible]													

* M&I estimated by historical total water required minus historical AVEK surface water deliveries; Rural estimated as historical total water requirement (no surface water deliveries).

Source Codes
1 DWR, Supply, W.E., et al. 1975
[illegible]
3 Lancaster
4 PWD
5 LCID
6 QHWD
7 RCSD
8 AVWC / Palmdale Annexation
9 Desert
10 EAFB
11 [illegible]

GW Usage Summary (AF)

	Problem Statement			U of C			
Year	M&I (1)	AG (1)	TOTAL	M&I (1)	AG (1)	TOTAL	Difference
1995	49,321	69,299	**118,620**	49,321	82,771	**132,091**	**13,471**
1996	50,511	74,570	**125,081**	50,511	89,880	**140,391**	**15,311**
1997	50,471	79,408	**129,879**	50,471	96,512	**146,983**	**17,104**
1998	43,670	92,535	**136,206**	43,670	110,675	**154,345**	**18,139**
1999	48,608	90,215	**138,824**	48,608	109,361	**157,969**	**19,145**
2000	48,822	106,748	**155,570**	48,822	128,997	**177,819**	**22,249**
2001	57,818	101,412	**159,230**	57,818	121,399	**179,217**	**19,987**
2002	53,599	120,699	**174,298**	53,599	143,139	**196,738**	**22,440**
2003	48,001	116,460	**164,461**	48,001	137,583	**185,584**	**21,124**
2004	54,380	111,876	**166,257**	54,380	132,526	**186,907**	**20,650**
2005	50,902	102,295	**153,197**	50,902	121,937	**172,839**	**19,642**
2006	43,960	89,484	**133,444**	43,960	107,710	**151,670**	**18,226**
2007							
2008							
High	**57,818**	**120,699**	**174,298**	**57,818**	**143,139**	**196,738**	**22,440**
Low	**43,670**	**69,299**	**118,620**	**43,670**	**82,771**	**132,091**	**13,471**
AVG	**50,005**	**96,250**	**146,255**	**50,005**	**115,208**	**165,213**	**18,957**

(1) Does not reflect estimated 5,000 - 6,000 AF of additional pumping by Mutual Water Companies (John Ukkestad)

			Total Applied Water Requirement (AF)													AVEK Surface Water Deliveries (AF)												
Parcel Group	Former Owner	Parcels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	Arcuri	83-87	309	309	309	309	309	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Bejulian	67	681	681	571	571	571	571	571	571	571	571	571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	eSolar	88-117	1,664	1,290	1,401	2,494	2,453	987	659	1,027	825	1,014	1,584	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Grimmway	0-24, 28-41,45	3,563	2,646	2,692	1,487	2,048	1,791	2,401	1,666	1,941	414	1,490	2,916	1,242	1,863	1,926	2,145	1,065	999	1,622	2,766	3,521	1,720	511	738	2,327	2,284
5	Harter	71-79	856	1,221	1,884	1,544	1,675	2,207	2,207	2,028	2,028	1,987	1,987	1,906	1,779	790	795	982	108	455	1.5	34.4	595.1	0.5	0	0	0.5	0
6	Robertson & Nikkel	25-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Sandhu	56	272	272	272	272	272	272	272	272	272	164	272	272	272	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Collins, Doyle, Wong	42-44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Bagnell, Faber	80-82	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Dennis	121	247	494	247	247	0	494	494	494	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Hemmerling	118,122,123,123A	1,339	1,584	797	792	0	547	547	1,089	542	542	542	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	O'Neil	124	275	275	275	275	0	275	275	275	275	275	275	275	275	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Reca	119	559	559	559	559	0	559	559	559	559	559	559	559	559	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Wilson	120	0	0	0	0	0	0	0	1,081	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Total	9,767	9,333	9,007	8,550	7,329	7,704	7,987	9,065	7,015	5,527	7,282	5,930	4,129	2,653	2,721	3,127	1,173	1,454	1,624	2,800	4,116	1,721	511	738	2,327	2,284

Land Use Data

				(* indicates change from data)						Crop 1 Applied Water (AF)														
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
0	4	Kern	359-011-02	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	59	59	35	81	0	0	81	0	0	0	0	81	0	0	0
1	4	Kern	359-011-03	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	59	59	35	81	0	0	81	0	0	0	0	81	0	0	0
2	4	Kern	359-011-04	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	59	59	35	81	0	0	81	0	0	0	0	81	0	0	0
3	4	Kern	359-011-05	Carrot	Onion	Fallow	Fallow	Carrot	Fallow	82	82	36	0	82	0	82	82	93	0	0	82	0	0	0
4	4	Kern	359-011-06	Carrot	Onion	Fallow	Fallow	Carrot	Fallow	82	82	36	0	82	0	0	82	93	0	0	82	0	0	0
5	4	Kern	359-011-07	Carrot	Onion	Fallow	Fallow	Carrot	Fallow	82	82	36	0	82	0	0	82	93	0	0	82	0	0	0
6	4	Kern	359-011-08	Carrot	Fallow	Fallow	Fallow	Carrot	Fallow	78	78	34	44	78	0	0	78	0	0	0	78	0	0	0
7	4	Kern	359-011-09	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	34	34	79	0	0	0	0	0	0	0	0	0	0	0	0
8	4	Kern	359-011-10	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	36	36	83	0	0	0	0	0	0	0	0	0	0	0	0
9	4	Kern	359-011-11	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	36	36	83	0	0	61	83	0	0	0	0	0	0	0	0
10	4	Kern	359-011-12	Fallow	Fallow	Fallow	Fallow	Fallow	Carrot	36	36	83	0	0	94	83	0	0	0	0	0	83	0	0
11	4	Kern	359-011-13	Fallow	Fallow	Parsnip	Barley	Fallow	Carrot	84	36	61	84	0	95	84	0	0	84	71	0	84	0	0
12	4	Kern	359-011-14	Parsnip	Fallow	Fallow	Parsnip	Parsnip	Fallow	84	36	61	84	0	0	84	84	0	0	84	84	0	0	0
13	4	Kern	359-011-15	Parsnip	Fallow	Fallow	Barley	Fallow	Fallow	95	36	61	0	84	84	0	84	0	0	71	0	0	0	0
14	4	Kern	359-011-16	Fallow	Parsnip	Fallow	Barley	Fallow	Parsnip	91	35	58	0	0	80	0	0	80	0	68	0	80	0	0
15	4	Kern	359-011-17	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	58	58	34	79	0	0	0	0	0	0	0	0	0	0	0
16	4	Kern	359-011-18	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	61	61	36	83	0	0	0	0	0	0	0	0	0	0	0
17	4	Kern	359-011-19	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	61	61	36	83	0	0	0	0	0	0	0	0	0	0	0
18	4	Kern	359-011-20	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	61	61	36	83	0	0	0	0	0	0	0	0	0	0	0
19	4	Kern	359-011-21	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	79	34	34	0	90	0	79	58	0	0	0	79	0	0	0
20	4	Kern	359-011-22	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	83	36	36	0	94	0	83	60	0	0	0	83	0	0	0
21	4	Kern	359-011-23	Carrot	Fallow	Fallow	Fallow	Carrot	Fallow	42	36	36	0	83	0	0	83	0	0	0	83	0	47	0
22	4	Kern	359-011-24	Carrot	Fallow	Fallow	Fallow	Carrot	Fallow	94	36	36	0	83	0	0	83	0	0	0	83	0	0	0
23	4	Kern	359-011-27	Cultural	Cultural	Cultural	Cultural	Cultural	Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	4	Kern	359-020-50	Fallow	Onion	Fallow	Fallow	Barley	Carrot	332	242	377	0	332	166	0	499	754	0	532	564	665	377	145
25	6	Kern	359-041-05	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	6	Kern	359-041-07	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	6	Kern	359-041-08	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	4	Kern	359-174-01	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	0	0	36	83	0	0	83	0	0	83	0	0	0
29	4	Kern	359-174-02	Barley	Fallow	Carrot	Fallow	Fallow	Carrot	60	60	0	0	36	0	83	70	0	83	70	0	83	0	0
30	4	Kern	359-174-03	Barley	Fallow	Carrot	Fallow	Fallow	Carrot	60	60	0	0	36	0	83	70	0	83	70	0	83	0	0
31	4	Kern	359-174-04	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	0	0	36	83	94	0	83	0	0	83	0	0	0
32	4	Kern	359-174-05	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	83	0	36	83	94	0	83	0	0	83	0	0	0

Land Use Data

				(indicates change from data)						Crop 1 Applied Water (AF)														
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
33	4	Kern	359-174-06	Sudangrass	Fallow	Carrot	Fallow	Fallow	Carrot	60	60	36	83	36	0	83	70	0	83	70	0	83	0	0
34	4	Kern	359-174-07	Potato	Fallow	Carrot	Fallow	Fallow	Carrot	58	58	34	79	34	0	79	58	0	79	67	0	79	0	0
35	4	Kern	359-174-08	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	79	34	79	0	34	79	90	0	79	0	0	79	0	0	0
36	4	Kern	359-174-09	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	83	0	60	83	94	0	83	0	0	83	0	0	0
37	4	Kern	359-174-10	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	60	60	36	83	60	0	83	60	0	0	0	83	0	0	0
38	4	Kern	359-174-11	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	60	60	36	83	60	0	83	60	0	0	0	83	0	0	0
39	4	Kern	359-174-12	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	85	32	75	0	54	75	85	0	75	0	0	75	0	0.83	0.83
40	4	Kern	359-174-14	Cultural	Cultural	Cultural	Cultural	Cultural	Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	4	Kern	359-240-04	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	339	339	339	144	192	385	339	0	339	0	385	678	0	0	147
42	8	Kern	359-331-17	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	8	Kern	359-331-19	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	8	Kern	359-331-25	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	4	Kern	359-011-01	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	29	29	18	40	0	0	40	0	0	0	0	40	0	0.83	0.83
56	7	Kern	359-041-30	Alfalfa	Alfalfa	Carrot	Alfalfa	Alfalfa	Alfalfa	272	272	272	272	272	272	272	272	272	164	272	272	272	0	0
67	2	Kern	261-196-10	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	571	571	571	571	571	571	571	571	571	571	571	0	0	110	110
68	15	Kern	359-041-29	Fallow	Alfalfa	Carrot	Alfalfa	Alfalfa	Alfalfa	272	231	272	272	272	272	272	0	272	164	272	272	272	0	0
69	15	Kern	359-041-31	Alfalfa	Alfalfa	Carrot	Alfalfa	Alfalfa	Alfalfa	272	272	272	272	272	272	272	272	272	164	272	272	272	0	0
70	15	Kern	359-041-32	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	245	245	245	245	245	245	245	0	245	147	245	245	245	0.83	0.83
71	5	Kern	359-175-01	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Barley	403	323	323	73	242	537	537	537	537	537	537	537	274	0	0
72	5	Kern	359-175-02	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Barley	18	11	11	12	18	18	18	18	18	18	18	18	9	0	0
73	5	Kern	359-175-03	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Barley	18	11	11	12	18	18	18	18	18	18	18	18	9	0	0
74	5	Kern	359-175-04	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0	0
75	5	Kern	359-321-01	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	0	234	71	296	296	593	593	593	593	593	593	593	593	0	0
76	5	Kern	359-321-02	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	0	195	71	296	296	593	593	593	593	593	593	593	593	0	0
77	5	Kern	359-324-18	Carrot	Carrot	Barley	Barley	Alfalfa	Alfalfa	147	147	147	147	147	147	147	88	88	75	75	147	147	0	0
78	5	Kern	359-324-20	Carrot	Carrot	Barley	Barley	Fallow	Barley	150	150	150	150	150	150	150	90	90	77	77	0	77	0	0
79	5	Kern	359-324-21	Carrot	Carrot	Barley	Barley	Fallow	Barley	120	151	151	151	151	151	151	91	91	77	77	0	77	0	0
80	9	Kern	359-331-24	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0	0
81	9	Kern	359-331-26	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	9	Kern	359-331-27	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	1	Kern	359-041-15	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	158	158	158	158	158	0	0	0	0	0	0	0	0	0	0
84	1	Kern	359-041-24	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0
85	1	Kern	359-041-25	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0
86	1	Kern	359-041-26	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0

Land Use Data

				(Indicates change from data)						Crop 1 Applied Water (AF)															
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
87	1	Kern	359-041-27	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	30	30	30	30	30	0	0	0	0	0	0	0	0	0.83	0.83
88	3	Kern	261-193-02	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	3	Kern	261-193-03	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	3	Kern	261-193-06	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	3	Kern	261-193-07	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	3	Kern	261-193-08	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	3	Kern	261-193-09	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	3	Kern	261-193-10	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	3	Kern	261-193-15	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
96	3	Kern	261-193-17	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
97	3	Kern	261-193-18	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
98	3	Kern	261-193-20	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0
99	3	Kern	261-193-22	Fallow	Fallow	Carrot	Carrot	Fallow	Fallow	0	0	0	41	0	0	0	0	0	83	83	0	0	0	0
100	3	Kern	261-193-23	Barley	Carrot	Fallow	Carrot	Fallow	Fallow	0	0	0	166	0	166	0	140	166	0	166	0	0	0	0
101	3	Kern	261-193-24	Fallow	Fallow	Barley	Barley	Fallow	Fallow	0	0	0	162	0	162	0	0	0	137	137	0	0	0	0
102	3	Kern	261-193-25	Fallow	Fallow	Carrot	Carrot	Fallow	Fallow	0	0	0	0	0	0	0	0	0	81	81	0	0	0	0
103	3	Kern	261-193-26	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	81	0	0	0	0	0
104	3	Kern	261-194-28	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	363	363	320	320	320	0	0	0	0	0	0	0	0	0	0
105	3	Kern	261-194-29	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	363	363	320	320	320	0	0	0	0	0	0	0	0	0	0
106	3	Kern	261-194-30	Carrot	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	162	0	0	162	0	0	0	0	0	0	0
107	3	Kern	261-194-36	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	95	95	84	84	84	0	0	0	0	0	0	0	0	0	0
108	3	Kern	261-194-37	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	95	95	84	84	84	0	0	0	0	0	0	0	0	0	0
109	3	Kern	261-194-38	Cultural	Cultural	Cultural	Cultural	Cultural	Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	3	Kern	261-194-39	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0	0
111	3	Kern	261-194-45	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	3	Kern	261-194-46	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	3	Kern	261-194-47	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	3	Kern	261-196-08	Fallow	Fallow	Fallow	Barley	Fallow	Fallow	747	374	593	1,317	1,317	659	659	558	659	558	1,117	0	0	0	0
115	3	Kern	261-193-05	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	3	Kern	261-193-19	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0
117	3	Kern	261-194-35	Carrot	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	166	0	0	166	0	0	0	0	0	0	0
118	11	LA	3258-001-038	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Fallow	Fallow	542	542	0	0	0	0	0	542	542	542	542	0	0	0	0

Land Use Data

				(indicates change from data)						Crop 1 Applied Water (AF)															
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
119	13	LA	3258-001-040	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	559	559	559	559	0	559	559	559	559	559	559	559	559	0	0
120	14	LA	3261-001-004	Alfalfa	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	1,081	0	0	0	0	0	0	0
121	10	LA	3261-001-002	Alfalfa	Fallow	Fallow	Fallow	Fallow	Fallow	247	247	247	247	0	494	494	494	0	0	0	0	0	0	247
122	11	LA	3261-001-003	Alfalfa	Fallow	Fallow	Fallow	Fallow	Fallow	547	547	547	547	0	547	547	547	0	0	0	0	0	0	0
123	11	LA	3258-001-001	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	245	490	245	245	0	0	0	0	0	0	0	0	0	0	0
124	12	LA	3258-001-024	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	275	275	275	275	0	275	275	275	275	275	275	275	275	0	0
126	15	LA	3258-001-031	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	3,211	2,408	3,211	3,211	3,211	2,151	3,211	3,211	3,211	3,211	3,211	3,211	3,211	0	0
127	15	LA	3258-001-030	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	1,084	1,084	1,084	1,084	1,084	1,084	542	1,084	1,084	1,084	1,084	1,084	1,084	0	0
128	11	LA	3258-001-025	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0

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Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)												
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	4	Kern	359-011-02	0	0	0	0	0	0	0	0	0	0	0	59	59	35	81	0	0	81	0	0	0	0	81	0
1	4	Kern	359-011-03	0	0	0	0	0	0	0	0	0	0	0	59	59	35	81	0	0	81	0	0	0	0	81	0
2	4	Kern	359-011-04	0	0	0	0	0	0	0	0	0	0	0	59	59	35	81	0	0	81	0	0	0	0	81	0
3	4	Kern	359-011-05	0	0	0	0	0	0	0	0	0	0	0	82	82	36	0	82	0	82	82	93	0	0	82	0
4	4	Kern	359-011-06	0	0	0	0	0	0	0	0	0	0	0	82	82	36	0	82	0	0	82	93	0	0	82	0
5	4	Kern	359-011-07	0	0	0	0	0	0	0	0	0	0	0	82	82	36	0	82	0	0	82	93	0	0	82	0
6	4	Kern	359-011-08	0	0	0	0	0	0	0	0	0	0	0	78	78	34	44	78	0	0	78	0	0	0	78	0
7	4	Kern	359-011-09	0	0	0	0	0	0	0	0	0	0	0	34	34	79	0	0	0	0	0	0	0	0	0	0
8	4	Kern	359-011-10	0	0	0	0	0	0	0	0	0	0	0	36	36	83	0	0	0	0	0	0	0	0	0	0
9	4	Kern	359-011-11	0	0	0	0	0	0	0	0	0	0	0	36	36	83	0	0	61	83	0	0	0	0	0	0
10	4	Kern	359-011-12	0	0	0	0	0	0	0	0	0	0	0	36	36	83	0	0	94	83	0	0	0	0	0	83
11	4	Kern	359-011-13	0	0	0	0	0	0	0	0	0	0	0	84	36	61	84	0	95	84	0	0	84	71	0	84
12	4	Kern	359-011-14	0	0	0	0	0	0	0	0	0	0	0	84	36	61	84	0	0	84	84	0	0	84	84	0
13	4	Kern	359-011-15	0	0	0	0	0	0	0	0	0	0	0	95	36	61	0	84	84	0	84	0	0	71	0	0
14	4	Kern	359-011-16	0	0	0	0	0	0	0	0	0	0	0	91	35	58	0	0	80	0	0	80	0	68	0	80
15	4	Kern	359-011-17	0	0	0	0	0	0	0	0	0	0	0	58	58	34	79	0	0	0	0	0	0	0	0	0
16	4	Kern	359-011-18	0	0	0	0	0	0	0	0	0	0	0	61	61	36	83	0	0	0	0	0	0	0	0	0
17	4	Kern	359-011-19	0	0	0	0	0	0	0	0	0	0	0	61	61	36	83	0	0	0	0	0	0	0	0	0
18	4	Kern	359-011-20	0	0	0	0	0	0	0	0	0	0	0	61	61	36	83	0	0	0	0	0	0	0	0	0
19	4	Kern	359-011-21	0	0	0	0	0	0	0	0	0	0	0	79	34	34	0	90	0	79	58	0	0	0	79	0
20	4	Kern	359-011-22	0	0	0	0	0	0	0	0	0	0	0	83	36	36	0	94	0	83	60	0	0	0	83	0
21	4	Kern	359-011-23	0	0	0	0	0	0	0	0	0	0	0	89	36	36	0	83	0	0	83	0	0	0	83	0
22	4	Kern	359-011-24	0	0	0	0	0	0	0	0	0	0	0	94	36	36	0	83	0	0	83	0	0	0	83	0
23	4	Kern	359-011-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	4	Kern	359-020-50	145	189	242	0	0	0	0	0	0	0	0	710	387	522	189	575	166	0	499	754	0	532	564	665
25	6	Kern	359-041-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	6	Kern	359-041-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	6	Kern	359-041-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	4	Kern	359-174-01	0	0	0	0	0	0	0	0	0	0	0	94	36	0	0	36	83	0	0	83	0	0	83	0
29	4	Kern	359-174-02	0	0	0	0	0	0	0	0	0	0	0	60	60	0	0	36	0	83	70	0	83	70	0	83
30	4	Kern	359-174-03	0	0	0	0	0	0	0	0	0	0	0	60	60	0	0	36	0	83	70	0	83	70	0	83
31	4	Kern	359-174-04	0	0	0	0	0	0	0	0	0	0	0	94	36	0	0	36	83	94	0	83	0	0	83	0
32	4	Kern	359-174-05	0	0	0	0	0	0	0	0	0	0	0	94	36	83	0	36	83	94	0	83	0	0	83	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)												
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
33	4	Kern	359-174-06	0	0	0	0	0	0	0	0	0	0	0	60	60	36	83	36	0	83	70	0	83	70	0	83
34	4	Kern	359-174-07	0	0	0	0	0	0	0	0	0	0	0	58	58	34	79	34	0	79	58	0	79	67	0	79
35	4	Kern	359-174-08	0	0	0	0	0	0	0	0	0	0	0	79	34	79	0	34	79	90	0	79	0	0	79	0
36	4	Kern	359-174-09	0	0	0	0	0	0	0	0	0	0	0	94	36	83	0	60	83	94	0	83	0	0	83	0
37	4	Kern	359-174-10	0	0	0	0	0	0	0	0	0	0	0	60	60	36	83	60	0	83	60	0	0	0	83	0
38	4	Kern	359-174-11	0	0	0	0	0	0	0	0	0	0	0	60	60	36	83	60	0	83	60	0	0	0	83	0
39	4	Kern	359-174-12	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	86	33	76	1	55	76	86	1	76	1	1	76	1
40	4	Kern	359-174-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	4	Kern	359-240-04	247	0	0	339	247	0	0	0	0	0	0	339	486	586	144	192	723	586	0	339	0	385	678	0
42	8	Kern	359-331-17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	8	Kern	359-331-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	8	Kern	359-331-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	4	Kern	359-011-01	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	30	30	18	41	1	1	41	1	1	1	1	41	1
56	7	Kern	359-041-30	0	0	0	0	0	0	0	0	0	0	0	272	272	272	272	272	272	272	272	272	164	272	272	272
67	2	Kern	261-196-10	0	0	0	0	0	0	0	0	0	0	0	681	681	571	571	571	571	571	571	571	571	571	0	0
68	15	Kern	359-041-29	0	0	0	0	0	0	0	0	0	0	0	272	231	272	272	272	272	272	0	272	164	272	272	272
69	15	Kern	359-041-31	0	0	0	0	0	0	0	0	0	0	0	272	272	272	272	272	272	272	272	272	164	272	272	272
70	15	Kern	359-041-32	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	246	246	246	246	246	246	246	1	246	148	246	246	246
71	5	Kern	359-175-01	0	0	0	0	0	0	0	0	0	0	0	403	323	323	73	242	537	537	537	537	537	537	537	274
72	5	Kern	359-175-02	0	0	0	0	0	0	0	0	0	0	0	18	11	11	12	18	18	18	18	18	18	18	18	9
73	5	Kern	359-175-03	0	0	0	0	0	0	0	0	0	0	0	18	11	11	12	18	18	18	18	18	18	18	18	9
74	5	Kern	359-175-04	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
75	5	Kern	359-321-01	474	202	178	0	0	0	0	0	0	0	0	0	234	546	499	475	593	593	593	593	593	593	593	593
76	5	Kern	359-321-02	474	202	178	0	0	0	0	0	0	0	0	0	195	546	499	475	593	593	593	593	593	593	593	593
77	5	Kern	359-324-18	0	0	0	0	0	0	0	0	0	0	0	147	147	147	147	147	147	147	88	88	75	75	147	147
78	5	Kern	359-324-20	0	0	0	0	0	0	0	0	0	0	0	150	150	150	150	150	150	150	90	90	77	77	0	77
79	5	Kern	359-324-21	0	0	0	0	0	0	0	0	0	0	0	120	151	151	151	151	151	151	91	91	77	77	0	77
80	9	Kern	359-331-24	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
81	9	Kern	359-331-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	9	Kern	359-331-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	1	Kern	359-041-15	0	0	0	0	0	0	0	0	0	0	0	158	158	158	158	158	0	0	0	0	0	0	0	0
84	1	Kern	359-041-24	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	0	0	0	0	0	0	0	0
85	1	Kern	359-041-25	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	0	0	0	0	0	0	0	0
86	1	Kern	359-041-26	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	0	0	0	0	0	0	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)											
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
87	1	Kern	359-041-27	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	31	31	31	31	31	1	1	1	1	1	1	1	1
88	3	Kern	261-193-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	3	Kern	261-193-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	3	Kern	261-193-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	3	Kern	261-193-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	3	Kern	261-193-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	3	Kern	261-193-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	3	Kern	261-193-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	3	Kern	261-193-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
96	3	Kern	261-193-17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
97	3	Kern	261-193-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
98	3	Kern	261-193-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0
99	3	Kern	261-193-22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	0	0	0	0	0	83	83	0	0
100	3	Kern	261-193-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166	0	166	0	140	166	0	166	0	0	
101	3	Kern	261-193-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	0	162	0	0	0	137	137	0	0	
102	3	Kern	261-193-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	81	0	0
103	3	Kern	261-193-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	0	0	0
104	3	Kern	261-194-28	0	0	0	0	0	0	0	0	0	0	0	363	363	320	320	320	0	0	0	0	0	0	0	0	0
105	3	Kern	261-194-29	0	0	0	0	0	0	0	0	0	0	0	363	363	320	320	320	0	0	0	0	0	0	0	0	0
106	3	Kern	261-194-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	0	0	162	0	0	0	0	0	0
107	3	Kern	261-194-36	0	0	0	0	0	0	0	0	0	0	0	95	95	84	84	84	0	0	0	0	0	0	0	0	0
108	3	Kern	261-194-37	0	0	0	0	0	0	0	0	0	0	0	95	95	84	84	84	0	0	0	0	0	0	0	0	0
109	3	Kern	261-194-38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	3	Kern	261-194-39	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
111	3	Kern	261-194-45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	3	Kern	261-194-46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	3	Kern	261-194-47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	3	Kern	261-196-08	0	0	0	0	0	0	0	0	0	0	0	747	374	593	1,317	1,317	659	659	558	659	558	1,117	0	0	
115	3	Kern	261-193-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	3	Kern	261-193-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0
117	3	Kern	261-194-35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166	0	0	166	0	0	0	0	0	0
118	11	LA	3258-001-038	0	0	0	0	0	0	0	0	0	0	0	542	542	0	0	0	0	0	542	542	542	542	0	0	

Land Use Data

Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)											
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
119	13	LA	3258-001-040	0	0	0	0	0	0	0	0	0	0	0	559	559	559	559	0	559	559	559	559	559	559	559	559
120	14	LA	3261-001-004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,081	0	0	0	0	0
121	10	LA	3261-001-002	0	0	0	0	0	0	0	0	0	0	0	247	494	247	247	0	494	494	494	0	0	0	0	0
122	11	LA	3261-001-003	0	0	0	0	0	0	0	0	0	0	0	547	547	547	547	0	547	547	547	0	0	0	0	0
123	11	LA	3258-001-001	0	0	0	0	0	0	0	0	0	0	0	245	490	245	245	0	0	0	0	0	0	0	0	0
124	12	LA	3258-001-024	0	0	0	0	0	0	0	0	0	0	0	275	275	275	275	0	275	275	275	275	275	275	275	275
126	15	LA	3258-001-031	0	0	0	0	0	0	0	0	0	0	0	3,211	2,408	3,211	3,211	3,211	2,151	3,211	3,211	3,211	3,211	3,211	3,211	3,211
127	15	LA	3258-001-030	0	0	0	0	0	0	0	0	0	0	0	1,084	1,084	1,084	1,084	1,084	1,084	542	1,084	1,084	1,084	1,084	1,084	1,084
128	11	LA	3258-001-025	0	0	0	0	0	0	0	0	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0	0

Crop	AW (AF/yr)	Source
Alfalfa	7.65	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Barley	3.9	Irrigation Technology Reasearch Center, Fresno State (2008) indicates same as sudangrass
Carrot	4.6	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Cultural	0	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Domestic	0.83	Palmdale single family home water usage (2005)
Fallow	0	
Garlic	5.22	Irrigation Technology Reasearch Center, Fresno State (2008) indicates same as Onion
Oat	2.0	Actual reported AW requirement on that farm by Grimmway (9/28/12) due t Aug-Nov growing season
Onion	5.22	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Parsnip	4.6	Assumed to be equal to carrot
Pasture	7.45	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Peach	5.36	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Potato	3.35	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Rye	2.0	Actual reported AW requirement on that farm by Grimmway (9/28/12) due t Aug-Nov growing season
Sugar beet	4.96	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Sudangrass	3.9	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Watermelon	3.11	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Wheat	2.0	Actual reported AW requirement on that farm by Grimmway (9/28/12) due t Aug-Nov growing season

From: Carl Voss
To: "davedorrance@westerndev.com"
Subject: RE: Farming in the AV
Date: Friday, September 28, 2012 10:06:49 AM

Yes

Carl

From: Dave Dorrance [mailto:ddorrance@comcast.net]
Sent: Friday, September 28, 2012 8:05 AM
To: Carl Voss
Subject: RE: Farming in the AV

Carl – sorry about this. Would you say that the 2 AF/acre would also apply to the oats and wheat?

Dave Dorrance
832-212-4589
davedorrance@westerndev.com

From: Carl Voss [mailto:CVoss@grimmway.com]
Sent: Thursday, September 27, 2012 6:01 PM
To: 'davedorrance@westerndev.com'
Subject: RE: Farming in the AV

Based on additional records – the vetch/oats were grown in the later part of the year – the maps were created 11 years ago and my memory is not that good! I would disregard map (2).

Carl

From: Dave Dorrance [mailto:ddorrance@comcast.net]
Sent: Thursday, September 27, 2012 3:53 PM
To: Carl Voss; davedorrance@westerndev.com
Subject: RE: Farming in the AV

OK – thanks Carl. So to make sure I understand. In 2002, when you have 2 maps and one shows Vetch/Oats for a parcel and the second map shows fallow for the same parcel....what should I assume happened in that year?

Dave Dorrance
832-212-4589
davedorrance@westerndev.com

From: Carl Voss [mailto:CVoss@grimmway.com]
Sent: Thursday, September 27, 2012 5:35 PM
To: 'davedorrance@westerndev.com'
Subject: RE: Farming in the AV

Dave:

The vetch rye was watered from August through November – about 2 acft per acre. If you look closely I do not believe anything was double cropped – just the status of land was updated when the map was

created.

Thanks

Carl

From: Dave Dorrance [mailto:ddorrance@comcast.net]
Sent: Thursday, September 27, 2012 3:26 PM
To: Carl Voss
Cc: Andrew Werner (Westerndev)
Subject: Farming in the AV

Carl – I hope you are doing well. Thanks for sending over the historical crop patterns the other day. I had a few questions:

- On fields that were "vetch/rye" did you actively irrigate or only do a pre-wetting followed by dry land farming for whatever rainfall allowed?
- In 2002 and 2003 you show 2 crop plans. I assume you double cropped in those years...is that correct? If not, which crop plan did you go with?

Thanks so much

Dave Dorrance
832-212-4589
davedorrance@westerndev.com

APN's 359-041-05; 359-041-07; 359-041-08; 359-331-17; 359-331-19; 359-331-25; 359-041-30; 261-196-10; 359-175-01; 359-175-02; 359-175-03; 359-175-04; 359-321-01; 359-321-02; 359-324-18; 359-324-20; 359-324-21; 359-331-24; 359-331-26; 359-331-27; 359-041-15; 359-041-24; 359-041-25; 359-041-26; 359-041-27; 359-193-02; 359-193-03; 359-193-06; 359-193-07; 359-193-08; 359-193-09; 359-193-10; 359-193-15; 359-193-17; 359-193-18; 359-193-20; 261-193-24; 261-193-25; 261-193-26; 261-194-28; 261-194-29; 261-194-30; 261-194-36; 261-194-37; 261-194-38; 261-194-39; 261-194-45; 261-194-46; 261-194-47; 261-196-08; 261-193-05; 261-193-19; 261-194-35;

3258-001-038; 3258-001-040; 3261-001-004; 3261-001-002; 3261-001-003; 3258-001-001; 3258-001-024; 3258-001-25

	Used in Adjudication		Actual Precip at Rosamond, CA				
Month	Assumed Total Precip (in)	Assumed Effective Precip (in)	2000 (in)	2001 (in)	2002 (in)	2003 (in)	2004 (in)
J	1.05	0.53	0.05	1.18	0.2	0.01	0.01
F	1.95	0.98	0.8	3.74	0.06	3.55	1.86
M	0.8	0	0.96	0.66	0.3	0.72	0.24
A	0.48	0	0.1	0.58	0	0.96	0.05
M	0.12	0	0	0	0.02	0.27	0
J	0.05	0	0	0	0	0	0
J	0.12	0	0.01	0.02	0	0.11	0
A	0.04	0	0	0	0	0	0
S	0.16	0	0	0	0.01	0	0
O	0.16	0	0.01	0.24	0.01	0.23	1.93
N	0.37	0	0	0.6	0.66	0.32	0.16
D	0.54	0.27	0	0.64	1.04	0.22	3.63
Total	**5.84**		**1.93**	**7.66**	**2.3**	**6.39**	**7.88**
% above normal			-67%	31%	-61%	9%	35%

Land Use Data

Map ID	Parcel Group	County	Parcel #	PERCENT OF TOTAL WELL PUMPAGE FOR GROUP													AMOUNT OF GROUNDWATER APPLI							
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
0	4	Kern	359-011-02	2%	2%	1%	5%	0%	0%	3%	0%	0%	0%	0%	3%	0%	28	16	9	25	0	0	27	0
1	4	Kern	359-011-03	2%	2%	1%	5%	0%	0%	3%	0%	0%	0%	0%	3%	0%	28	16	9	25	0	0	27	0
2	4	Kern	359-011-04	2%	2%	1%	5%	0%	0%	3%	0%	0%	0%	0%	3%	0%	28	16	9	25	0	0	27	0
3	4	Kern	359-011-05	2%	3%	1%	0%	4%	0%	3%	5%	5%	0%	0%	3%	0%	39	22	9	0	41	0	27	19
4	4	Kern	359-011-06	2%	3%	1%	0%	4%	0%	0%	5%	5%	0%	0%	3%	0%	39	22	9	0	41	0	0	19
5	4	Kern	359-011-07	2%	3%	1%	0%	4%	0%	0%	5%	5%	0%	0%	3%	0%	39	22	9	0	41	0	0	19
6	4	Kern	359-011-08	2%	3%	1%	3%	4%	0%	0%	5%	0%	0%	0%	3%	0%	37	21	8	14	39	0	0	18
7	4	Kern	359-011-09	1%	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	16	9	19	0	0	0	0	0
8	4	Kern	359-011-10	1%	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17	10	20	0	0	0	0	0
9	4	Kern	359-011-11	1%	1%	3%	0%	0%	3%	3%	0%	0%	0%	0%	0%	0%	17	10	20	0	0	31	27	0
10	4	Kern	359-011-12	1%	1%	3%	0%	0%	5%	3%	0%	0%	0%	0%	0%	7%	17	10	20	0	0	49	27	0
11	4	Kern	359-011-13	2%	1%	2%	6%	0%	5%	3%	0%	0%	20%	5%	0%	7%	40	10	15	26	0	49	28	0
12	4	Kern	359-011-14	2%	1%	2%	6%	0%	0%	3%	5%	0%	0%	6%	3%	0%	40	10	15	26	0	0	28	19
13	4	Kern	359-011-15	3%	1%	2%	0%	4%	5%	0%	5%	0%	0%	5%	0%	0%	45	10	15	0	42	43	0	19
14	4	Kern	359-011-16	3%	1%	2%	0%	0%	4%	0%	0%	4%	0%	5%	0%	6%	43	9	14	0	0	41	0	0
15	4	Kern	359-011-17	2%	2%	1%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	28	16	8	24	0	0	0	0
16	4	Kern	359-011-18	2%	2%	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	29	16	9	26	0	0	0	0
17	4	Kern	359-011-19	2%	2%	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	29	16	9	26	0	0	0	0
18	4	Kern	359-011-20	2%	2%	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	29	16	9	26	0	0	0	0
19	4	Kern	359-011-21	2%	1%	1%	0%	4%	0%	3%	3%	0%	0%	0%	3%	0%	38	9	8	0	45	0	26	13
20	4	Kern	359-011-22	2%	1%	1%	0%	5%	0%	3%	4%	0%	0%	0%	3%	0%	40	10	9	0	47	0	27	14
21	4	Kern	359-011-23	2%	1%	1%	0%	4%	0%	0%	5%	0%	0%	0%	3%	0%	42	10	9	0	42	0	0	19
22	4	Kern	359-011-24	3%	1%	1%	0%	4%	0%	0%	5%	0%	0%	0%	3%	0%	45	10	9	0	42	0	0	19
23	4	Kern	359-011-27	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
24	4	Kern	359-020-50	20%	15%	19%	13%	28%	9%	0%	30%	39%	0%	36%	19%	54%	339	105	126	58	288	85	0	114
25	6	Kern	359-041-05	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
26	6	Kern	359-041-07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
27	6	Kern	359-041-08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
28	4	Kern	359-174-01	3%	1%	0%	0%	2%	5%	0%	0%	4%	0%	0%	3%	0%	45	10	0	0	18	43	0	0
29	4	Kern	359-174-02	2%	2%	0%	0%	2%	0%	3%	4%	0%	20%	5%	0%	7%	29	16	0	0	18	0	27	16
30	4	Kern	359-174-03	2%	2%	0%	0%	2%	0%	3%	4%	0%	20%	5%	0%	7%	29	16	0	0	18	0	27	16
31	4	Kern	359-174-04	3%	1%	0%	0%	2%	5%	4%	0%	4%	0%	0%	3%	0%	45	10	0	0	18	43	31	0
32	4	Kern	359-174-05	3%	1%	3%	0%	2%	5%	4%	0%	4%	0%	0%	3%	0%	45	10	20	0	18	43	31	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	PERCENT OF TOTAL WELL PUMPAGE FOR GROUP													AMOUNT OF GROUNDWATER APPLI							
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
33	4	Kern	359-174-06	2%	2%	1%	6%	2%	0%	3%	4%	0%	20%	5%	0%	7%	29	16	9	25	18	0	27	16
34	4	Kern	359-174-07	2%	2%	1%	5%	2%	0%	3%	3%	0%	19%	5%	0%	6%	28	16	8	24	17	0	26	13
35	4	Kern	359-174-08	2%	1%	3%	0%	2%	4%	4%	0%	4%	0%	0%	3%	0%	38	9	19	0	17	41	30	0
36	4	Kern	359-174-09	3%	1%	3%	0%	3%	5%	4%	0%	4%	0%	0%	3%	0%	45	10	20	0	30	43	31	0
37	4	Kern	359-174-10	2%	2%	1%	6%	3%	0%	3%	4%	0%	0%	0%	3%	0%	29	16	9	25	30	0	27	14
38	4	Kern	359-174-11	2%	2%	1%	6%	3%	0%	3%	4%	0%	0%	0%	3%	0%	29	16	9	25	30	0	27	14
39	4	Kern	359-174-12	2%	1%	3%	0%	3%	4%	4%	0%	4%	0%	0%	3%	0%	41	9	18	0	28	39	28	0
40	4	Kern	359-174-14	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
41	4	Kern	359-240-04	10%	18%	22%	10%	9%	40%	24%	0%	17%	0%	26%	23%	0%	162	132	141	44	96	372	193	0
42	8	Kern	359-331-17	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
43	8	Kern	359-331-19	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
44	8	Kern	359-331-25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
45	4	Kern	359-011-01	1%	1%	1%	3%	0%	0%	2%	0%	0%	0%	0%	1%	0%	14	8	4	13	0	0	14	0
56	7	Kern	359-041-30	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	272	272	272	272	272	272	272	272
67	2	Kern	261-196-10	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	#DIV/0!	#DIV/0!	681	681	571	571	571	571	571	571
68	15	Kern	359-041-29	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
69	15	Kern	359-041-31	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	25%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	272
70	15	Kern	359-041-32	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	1
71	5	Kern	359-175-01	47%	26%	17%	5%	14%	24%	24%	26%	26%	27%	27%	28%	15%	10	118	171	53	177	254	254	266
72	5	Kern	359-175-02	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0	4	6	9	13	8	8	9
73	5	Kern	359-175-03	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0	4	6	9	13	8	8	9
74	5	Kern	359-175-04	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	1	1	0	0	0
75	5	Kern	359-321-01	0%	19%	29%	32%	28%	27%	27%	29%	29%	30%	30%	31%	33%	0	85	289	361	348	281	281	293
76	5	Kern	359-321-02	0%	16%	29%	32%	28%	27%	27%	29%	29%	30%	30%	31%	33%	0	71	289	361	348	281	281	293
77	5	Kern	359-324-18	17%	12%	8%	10%	9%	7%	7%	4%	4%	4%	4%	8%	8%	3	54	78	106	108	70	70	44
78	5	Kern	359-324-20	18%	12%	8%	10%	9%	7%	7%	4%	4%	4%	4%	0%	4%	4	55	80	109	110	71	71	45
79	5	Kern	359-324-21	14%	12%	8%	10%	9%	7%	7%	4%	4%	4%	4%	0%	4%	3	55	80	109	110	71	71	45
80	9	Kern	359-331-24	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	1	1	1	1	1	1	1	1
81	9	Kern	359-331-26	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
82	9	Kern	359-331-27	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
83	1	Kern	359-041-15	51%	51%	51%	51%	51%	0%	0%	0%	0%	0%	0%	0%	0%	158	158	158	158	158	0	0	0
84	1	Kern	359-041-24	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	40	40	40	40	40	0	0	0
85	1	Kern	359-041-25	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	40	40	40	40	40	0	0	0
86	1	Kern	359-041-26	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	40	40	40	40	40	0	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	PERCENT OF TOTAL WELL PUMPAGE FOR GROUP													AMOUNT OF GROUNDWATER APPLI							
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
87	1	Kern	359-041-27	10%	10%	10%	10%	10%	100%	100%	100%	100%	100%	100%	100%	100%	31	31	31	31	31	1	1	1
88	3	Kern	261-193-02	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
89	3	Kern	261-193-03	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
90	3	Kern	261-193-06	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
91	3	Kern	261-193-07	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
92	3	Kern	261-193-08	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
93	3	Kern	261-193-09	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
94	3	Kern	261-193-10	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
95	3	Kern	261-193-15	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0	0	0	0	0	0	0	0
96	3	Kern	261-193-17	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0	0	0	0	0	0	0	0
97	3	Kern	261-193-18	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0	0	0	0	0	0	0	0
98	3	Kern	261-193-20	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0	0	0	0	0	0	0	0
99	3	Kern	261-193-22	0%	0%	0%	2%	0%	0%	0%	0%	0%	8%	5%	0%	0%	0	0	0	41	0	0	0	0
100	3	Kern	261-193-23	0%	0%	0%	7%	0%	17%	0%	14%	20%	0%	10%	0%	0%	0	0	0	166	0	206	0	183
101	3	Kern	261-193-24	0%	0%	0%	6%	0%	16%	0%	0%	0%	14%	9%	0%	0%	0	0	0	162	0	201	0	0
102	3	Kern	261-193-25	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%	5%	0%	0%	0	0	0	0	0	0	0	0
103	3	Kern	261-193-26	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0	0	0	0	0	0	0	0
104	3	Kern	261-194-28	22%	28%	23%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	363	363	320	320	320	0	0	0
105	3	Kern	261-194-29	22%	28%	23%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	363	363	320	320	320	0	0	0
106	3	Kern	261-194-30	0%	0%	0%	0%	7%	0%	0%	16%	0%	0%	0%	0%	0%	0	0	0	0	162	0	0	211
107	3	Kern	261-194-36	6%	7%	6%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	95	95	84	84	84	0	0	0
108	3	Kern	261-194-37	6%	7%	6%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	95	95	84	84	84	0	0	0
109	3	Kern	261-194-38	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
110	3	Kern	261-194-39	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	100%	1	1	1	1	1	1	2	1
111	3	Kern	261-194-45	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
112	3	Kern	261-194-46	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
113	3	Kern	261-194-47	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
114	3	Kern	261-196-08	45%	29%	42%	53%	54%	67%	100%	54%	80%	55%	70%	0%	0%	747	374	593	1,317	1,317	820	1,754	728
115	3	Kern	261-193-05	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
116	3	Kern	261-193-19	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0	0	0	0	0	0	0	0
117	3	Kern	261-194-35	0%	0%	0%	0%	7%	0%	0%	16%	0%	0%	0%	0%	0%	0	0	0	0	166	0	0	216
118	11	LA	3258-001-038	40%	34%	0%	0%	#DIV/0!	0%	0%	50%	100%	100%	100%	#DIV/0!	#DIV/0!	542	542	0	0	0	0	0	542

Land Use Data

				PERCENT OF TOTAL WELL PUMPAGE FOR GROUP												AMOUNT OF GROUNDWATER APPLI							
Map ID	Parcel Group	County	Parcel #	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
119	13	LA	3258-001-040	100%	100%	100%	100%	#DIV/0!	100%	100%	100%	100%	100%	100%	100%	100%	559	559	559	559	0	559	559	559
120	14	LA	3261-001-004	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	1,081
121	10	LA	3261-001-002	100%	100%	100%	100%	#DIV/0!	100%	100%	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	247	494	247	247	0	494	494	494
122	11	LA	3261-001-003	41%	35%	69%	69%	#DIV/0!	100%	100%	50%	0%	0%	0%	#DIV/0!	#DIV/0!	547	547	547	547	0	547	547	547
123	11	LA	3258-001-001	18%	31%	31%	31%	#DIV/0!	0%	0%	0%	0%	0%	0%	#DIV/0!	#DIV/0!	245	490	245	245	0	0	0	0
124	12	LA	3258-001-024	100%	100%	100%	100%	#DIV/0!	100%	100%	100%	100%	100%	100%	100%	100%	275	275	275	275	0	275	275	275
126	15	LA	3258-001-031	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	297%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	3,211
127	15	LA	3258-001-030	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	1,084
128	11	LA	3258-001-025	0%	0%	1%	0%	#DIV/0!	0%	0%	0%	0%	0%	0%	#DIV/0!	#DIV/0!	5	5	5	0	0	0	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
0	4	Kern	359-011-02	0	0	0	20	0
1	4	Kern	359-011-03	0	0	0	20	0
2	4	Kern	359-011-04	0	0	0	20	0
3	4	Kern	359-011-05	28	0	0	20	0
4	4	Kern	359-011-06	28	0	0	20	0
5	4	Kern	359-011-07	28	0	0	20	0
6	4	Kern	359-011-08	0	0	0	19	0
7	4	Kern	359-011-09	0	0	0	0	0
8	4	Kern	359-011-10	0	0	0	0	0
9	4	Kern	359-011-11	0	0	0	0	0
10	4	Kern	359-011-12	0	0	0	0	33
11	4	Kern	359-011-13	0	151	47	0	33
12	4	Kern	359-011-14	0	0	55	20	0
13	4	Kern	359-011-15	0	0	47	0	0
14	4	Kern	359-011-16	24	0	45	0	32
15	4	Kern	359-011-17	0	0	0	0	0
16	4	Kern	359-011-18	0	0	0	0	0
17	4	Kern	359-011-19	0	0	0	0	0
18	4	Kern	359-011-20	0	0	0	0	0
19	4	Kern	359-011-21	0	0	0	19	0
20	4	Kern	359-011-22	0	0	0	20	0
21	4	Kern	359-011-23	0	0	0	20	0
22	4	Kern	359-011-24	0	0	0	20	0
23	4	Kern	359-011-27	0	0	0	0	0
24	4	Kern	359-020-50	228	0	352	137	266
25	6	Kern	359-041-05	0	0	0	0	0
26	6	Kern	359-041-07	0	0	0	0	0
27	6	Kern	359-041-08	0	0	0	0	0
28	4	Kern	359-174-01	25	0	0	20	0
29	4	Kern	359-174-02	0	150	47	0	33
30	4	Kern	359-174-03	0	150	47	0	33
31	4	Kern	359-174-04	25	0	0	20	0
32	4	Kern	359-174-05	25	0	0	20	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
33	4	Kern	359-174-06	0	150	47	0	33
34	4	Kern	359-174-07	0	143	44	0	32
35	4	Kern	359-174-08	24	0	0	19	0
36	4	Kern	359-174-09	25	0	0	20	0
37	4	Kern	359-174-10	0	0	0	20	0
38	4	Kern	359-174-11	0	0	0	20	0
39	4	Kern	359-174-12	23	1	1	18	0
40	4	Kern	359-174-14	0	0	0	0	0
41	4	Kern	359-240-04	102	0	254	165	0
42	8	Kern	359-331-17	0	0	0	0	0
43	8	Kern	359-331-19	0	0	0	0	0
44	8	Kern	359-331-25	0	0	0	0	0
45	4	Kern	359-011-01	0	1	1	10	0
56	7	Kern	359-041-30	272	164	272	272	272
67	2	Kern	261-196-10	571	571	571	0	0
68	15	Kern	359-041-29	0	0	0	0	0
69	15	Kern	359-041-31	0	0	0	0	0
70	15	Kern	359-041-32	0	0	0	0	0
71	5	Kern	359-175-01	300	423	351	355	274
72	5	Kern	359-175-02	10	14	12	12	9
73	5	Kern	359-175-03	10	14	12	12	9
74	5	Kern	359-175-04	0	1	1	1	1
75	5	Kern	359-321-01	331	468	388	392	593
76	5	Kern	359-321-02	331	468	388	392	593
77	5	Kern	359-324-18	49	59	49	97	147
78	5	Kern	359-324-20	51	61	50	0	77
79	5	Kern	359-324-21	51	61	50	0	77
80	9	Kern	359-331-24	1	1	1	1	1
81	9	Kern	359-331-26	0	0	0	0	0
82	9	Kern	359-331-27	0	0	0	0	0
83	1	Kern	359-041-15	0	0	0	0	0
84	1	Kern	359-041-24	0	0	0	0	0
85	1	Kern	359-041-25	0	0	0	0	0
86	1	Kern	359-041-26	0	0	0	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
87	1	Kern	359-041-27	1	1	1	1	1
88	3	Kern	261-193-02	0	0	0	0	0
89	3	Kern	261-193-03	0	0	0	0	0
90	3	Kern	261-193-06	0	0	0	0	0
91	3	Kern	261-193-07	0	0	0	0	0
92	3	Kern	261-193-08	0	0	0	0	0
93	3	Kern	261-193-09	0	0	0	0	0
94	3	Kern	261-193-10	0	0	0	0	0
95	3	Kern	261-193-15	0	28	0	0	0
96	3	Kern	261-193-17	0	28	0	0	0
97	3	Kern	261-193-18	0	28	0	0	0
98	3	Kern	261-193-20	0	56	0	0	0
99	3	Kern	261-193-22	0	225	83	0	0
100	3	Kern	261-193-23	504	0	166	0	0
101	3	Kern	261-193-24	0	372	137	0	0
102	3	Kern	261-193-25	0	220	81	0	0
103	3	Kern	261-193-26	0	220	0	0	0
104	3	Kern	261-194-28	0	0	0	0	0
105	3	Kern	261-194-29	0	0	0	0	0
106	3	Kern	261-194-30	0	0	0	0	0
107	3	Kern	261-194-36	0	0	0	0	0
108	3	Kern	261-194-37	0	0	0	0	0
109	3	Kern	261-194-38	0	0	0	0	0
110	3	Kern	261-194-39	3	2	1	1	1
111	3	Kern	261-194-45	0	0	0	0	0
112	3	Kern	261-194-46	0	0	0	0	0
113	3	Kern	261-194-47	0	0	0	0	0
114	3	Kern	261-196-08	2,006	1,516	1,117	0	0
115	3	Kern	261-193-05	0	0	0	0	0
116	3	Kern	261-193-19	0	56	0	0	0
117	3	Kern	261-194-35	0	0	0	0	0
118	11	LA	3258-001-038	542	542	542	0	0

WC500073

Land Use Data

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
119	13	LA	3258-001-040	559	559	559	559	559
120	14	LA	3261-001-004	0	0	0	0	0
121	10	LA	3261-001-002	0	0	0	0	0
122	11	LA	3261-001-003	0	0	0	0	0
123	11	LA	3258-001-001	0	0	0	0	0
124	12	LA	3258-001-024	275	275	275	275	275
126	15	LA	3258-001-031	0	0	0	0	0
127	15	LA	3258-001-030	0	0	0	0	0
128	11	LA	3258-001-025	0	0	0	0	0

INTRODUCTION

At the Antelope Valley Groundwater Adjudication Settlement Meeting facilitated by Randy Williams on October 7, 2009, the group selected Steve Dassler, Andrew Werner and Gene Nebeker to recalculate the total groundwater pumping in the Antelope Valley based on 1) crop water requirements prepared by experts in Antelope Valley crop water use primarily from the University of California and 2) recommendations from mutual water companies regarding the mutuals' groundwater pumping.

The historical water use by agriculture was calculated by multiplying these crop water requirements by the acres of the various crops reported in the "Problem Statement" prepared by a Technical Committee. To be consistent with the procedure in the "Problem Statement," an extra 5% was added to take into account water use that may have been unreported. In these crop water use calculations, nothing was changed from the "Problem Statement" except the crop water requirements. Any other data taken from the "Problem Statement" has not been confirmed or vetted. A relatively arbitrary twelve year time period was examined because the "Problem Statement" separates data into five-year periods and the data ended with 2006. The overall result indicating under-valuing of the groundwater pumping in the "Problem Statement" is insensitive to the period that was chosen.

When the groundwater adjudication began, no reliable crop water requirements for the Antelope Valley, prepared by rigorous peer-reviewed analysis, existed. As a result, in April 19, 2007, the "Estimate of Crop Water Requirements in the Antelope Valley" was prepared by Grant Poole, former Los Angeles County Farm Advisor in Antelope Valley, Steve Orloff, Los Angeles County Farm Advisor in Antelope Valley just prior to Mr. Poole and current Farm Advisor in Siskiyou County, Blake Sanden, Kern County Farm Advisor in Antelope Valley, Tim Hays, Agricultural Consultant and California Licensed Pest Control Advisor in Antelope Valley, Blaine Hansen, Ph.D., Irrigation and Drainage Specialist at University of California at Davis, and Eugene B. Nebeker, Ph.D., grower in Antelope Valley and licensed Professional Engineer in Chemical and Agricultural Engineering. The resulting crop water requirements compare closely to the experiences of growers in Antelope Valley.

Crop water requirements for grapes do not appear in these University of California crop water requirements because grapes represent a very small consumption of water because the acreages of grapes are small. In these calculations, the crop water requirements for grapes used in the "Problem Statement" were retained because any inaccuracies do not significantly affect the results.

The information for mutual water company groundwater use was furnished by Mr. John Ukkestad of the Antelope Valley United Water Purveyors.

The results of these analyses show the "Problem Statement" under-valued groundwater pumping in the Antelope Valley by 13,471 to 22,440 acre-feet per year or an average of 18,957 acre-feet per year. Total groundwater pumping varied between 132,091 to 196,738 acre-feet per year for an average of 165,213 per year.

Crop Water Requirements and Applied Water

Crop	Problem Statement (AF) (1)	U of C (AF) (2)
Alfalfa	6.5	7.65
Carrots	3.9	4.60
Grain	2.6	3.05
Melons and Squash	2.8	3.11
Onions	4.5	5.22
Orchard	4.9	5.36
Pasture	6.7	7.45
Potatoes	2.8	3.35
Sugar Beets	4.6	4.96
Vinyard	3.7	

(1) Problem Statement Appendix D-3, Table 4
(2) University of CA, Table 4 (2007)

Appendix D-3

Applied Crop Water Duties, Irrigation Efficiencies, and Agricultural Return Flows

In order to estimate water requirements for agricultural irrigation in some detail over recent time (since 1970), and as a basis for assessing historical as well as current agricultural water requirements, applied water duties for individual crops were developed and utilized as follows. As part of the development and utilization of crop water duties, it was recognized that irrigation practices and other farming practices require the application of more water than is simply required for plant growth. Of the additional applied water, some of it deep percolates and thus contributes to groundwater recharge as so-called return flow, while some of it is lost to evaporation and does not contribute to recharge. The fate of water applied in excess of plant water requirements was tracked as part of the overall development of crop water duties, primarily to estimate the amounts of applied water that contribute to groundwater recharge.

Applied Crop Water Duties

Included within the Los Angeles County annual crop reports and the Kern County annual pesticide use reports are crop acreage subdivisions applicable to the Antelope Valley for vegetable crops (notably onions and root vegetables), field crops (notably alfalfa), and fruit and nut crops. Those annual land use and crop acreage data were converted to water requirements using a CIMIS-based (California Irrigation Management Information System) approach where reference evapotranspiration data were coupled with various crop coefficients to first estimate the total annual evapotranspirative water requirements of the various crops grown in the Valley. Those requirements were then factored to consider any effective precipitation that would have reduced the need for applied water to meet the respective evapotranspirative water requirements. The resultant crop evapotranspirative water requirements were then converted to applied crop water requirements by considering irrigation system distribution uniformity values. Finally, applied water for cultural practices that involve the application of water for field preparation, pre-irrigation, and erosion control was added to the applied water for consumption of the crops to develop applied crop water duties (AW_T).

In sequential equation form, the preceding approach to estimating applied crop water requirements can be expressed as follows. The results are summarized in Appendix D-3: Tables 1 through 5.

Crop Water Requirement

$$ET_C = K_C * ET_O$$

where

ET_C = crop evapotranspirative requirement

K_C = crop coefficient

ET_O = reference evapotranspiration

Crop Evapotranspiration of Applied Water

$$ET_{AW} = ET_C - P_e$$

where

ET_{AW} = evapotranspiration of applied water

P_e = effective precipitation

Total Applied Water

$$AW_T = \frac{ET_{AW}}{DU} + AW_{er} + AW_{pr}$$

where

AW_T = total applied crop water duty

DU = distribution uniformity of irrigation system[1]

AW_{er} = applied water for erosion control

AW_{pr} = applied water for field preparation and pre-irrigation

The crops grown in the Antelope Valley, as reported by the Los Angeles and Kern County Agricultural Commissioners, were grouped into the following crop categories for purposes of estimating annual applied water requirements: alfalfa and irrigated pasture, carrots, deciduous orchard, grain (barley, wheat, hay, sorghum, sudan), melons and squash, onions, potatoes, sugar beets, and grapes. The daily reference evapotranspiration (ET_o) data reported for the nearest CIMIS station, at Victorville, shows only small fluctuation from year to year, so they were utilized to develop average ET_o values for each bimonthly and monthly period of the growth stages for each crop grown in the Antelope Valley. These values were calculated as the average of the daily data within each of the growth stage periods from each year of available data at the Victorville CIMIS station. The resultant bimonthly (and monthly) average ET_o values are tabulated in Appendix D-3: Table 1.

Crop coefficients (K_c) specific to the high desert of California for each of the growth stage periods of each crop category were derived from the University of California Cooperative Extension as listed in Appendix D-3: Table 5. Those crop coefficients were then combined with

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[1] *DU is a term relating to the evenness of water application to plants throughout a field and is defined as:*

$$\frac{\text{Minimum depth of water applied to plants in a field}}{\text{Average amount of water applied to plants}} \times 100$$

where the minimum equals the average of the lowest quarter of the values. (ITRC, California Polytechnic State University, 1994).

the corresponding average ET_o values to estimate crop water requirements in the Antelope Valley. Specifically, the products of the K_c value and average ET_o for each bimonthly growth stage period were summed to estimate the total annual evapotranspirative water requirements (ET_c) of the various crops grown in the Valley (Appendix D-3: Table 2). Crop coefficients and growth stage periods for vineyard (grape crops) grown in California's high desert were not available; available monthly coefficients and growth stage periods specific to Yolo and Solano Counties were utilized with the Victorville ET_o values to estimate the annual crop water requirement ET_c for grapes grown in the Valley.

Interpretation of the seasonal variation in the relative amounts of precipitation and evaporation in the Valley indicated that, typically, evaporative losses exceed the amount of precipitation in all months from March through November so rainfall during those months was considered to be lost to evaporation and thus not available for uptake by the crops. Consequently, only the precipitation occurring in December through February would be available for the crops and approximately one-half of that was considered to be "effective precipitation" (P_e) that contributed to meeting ET_c of the various crops, and thus reduce applied water requirements. After allowing for effective precipitation (P_e) (up to the ET_c value), the remainder is the average amount of applied water required to directly meet crop evapotranspirative requirements (ET_{AW}), as summarized in Appendix D-3: Table 3.

The amount of total applied water needed to meet crop water requirements (ET_{AW}), specifically to accommodate irrigation distribution uniformities (DU) and cultural practices in the Valley, was then calculated. For all crops, there are no known data on DU values; anecdotal information suggests that there have been widespread efforts to utilize irrigation equipment and practices to increase DU values into the range of 80 percent. For purposes of converting the applied water needed to meet crop water requirements (ET_{AW}) to applied crop water requirements (AW_c), irrigation system DU was assumed to be 80 percent for all crops. Ultimately, that value was checked by computing overall irrigation efficiencies as described below, and then assessing the resultant values in the context of generally reported values in the Valley. For those crops where water is used for field preparation and pre-irrigation (all except pasture, orchard, and grapes) and/or are subject to damage from soil erosion in the Valley (carrots and onions), respective amounts of water were added to that applied at the estimated distribution uniformity for irrigation systems in the Valley. Anecdotal information suggests that, for alfalfa, carrot, grain, melon/squash, onion, potato, and sugar beet crops grown in the Antelope Valley, an additional 2 to 6.5 inches of water are applied for field preparation and pre-irrigation purposes (AW_{pr}); and for carrot and onion crops, an additional 3 to 6 inches of water are applied for erosion control (AW_{er}). Accordingly, the applied water requirements for those crops were increased by these amounts to arrive at estimates of total applied water (applied crop water duties, AW_T) as summarized in Appendix D-3: Table 4. Overall, the resultant values of total applied water in Appendix D-3: Table 4 are within ranges typically reported for crops and irrigation practices in the Antelope Valley.

Irrigation Efficiency

Historically, the term "irrigation efficiency" has been used to describe the fraction of total applied water that was consumptively used by a crop. With time, the definition of the term has been broadened to recognize that other uses of water associated with the growing and harvesting of crops are also beneficial. Thus, a modern definition of "irrigation efficiency" can be considered to be the ratio of that portion of applied water that is beneficially used for farming operations divided by total applied water, expressed as a percentage. In the Antelope Valley setting, the application of water for cultural practices that include field preparation, pre-irrigation, and erosion control can be considered a beneficial use of water. Thus, in this analysis, irrigation efficiency is defined as the fraction of total applied water that is consumptively used by a crop plus water used for field preparation, pre-irrigation, and erosion control.

In equation form, the preceding can be expressed as follows, where ET_{AW}, ET_{cr} and ET_{pr} are as defined above.

Overall Irrigation Efficiency

$$E_{irr} = \frac{ET_{AW} + AW_{cr} + AW_{pr}}{AW_T}$$

where

E_{irr} = overall efficiency of irrigation

Utilizing the preceding definition, the total beneficial use of water results in irrigation efficiency values in the range of 80 to 85 percent for the crops grown and the associated farming practices in the Antelope Valley, as delineated in Appendix D-3: Table 4.

Return Flows

As introduced above, most of the applied water in crop irrigation is consumptively used in plant growth. Additional water is applied for beneficial purposes such as field preparation, pre-irrigation, and erosion control. Some of the applied water not consumptively used by crops deep percolates and ultimately becomes groundwater recharge, while other of the additional applied water evaporates. Since the main focus of tracking the fate of applied water in excess of plant consumptive use was to estimate return flow contributions to groundwater recharge, the return flow component was estimated by first recognizing that applied irrigation in excess of plant water requirements contributes to return flow, and then separately considering the individual components of additional water applied to irrigated areas. Respectively, in the Antelope Valley, those components are for the purposes of erosion control, field preparation, and pre-irrigation.

Erosion Control – As delineated in Appendix D-3: Table 4, about 3 to 6 inches of water are applied during certain stages of plant growth for carrots and onions to resist the sand-blasting

effects of wind and the granular soils in the area. Over the course of overall plant growth cycles, those amounts of water are quite small since they are for the purpose of wetting only the uppermost soil profile to keep seedlings from being damaged by wind. Thus, that applied water is not expected to infiltrate to a sufficient depth to contribute to soil moisture that ultimately deep percolates. Consequently, water applied for erosion control is considered to be lost to evaporation from the uppermost soil profile, and not part of return flow.

Field Preparation and Pre-Irrigation – As delineated in Appendix D-3: Table 4, for certain crops, between 2 and 6.5 inches of additional water are applied for some combination of field preparation and pre-irrigation. In the one case of alfalfa, where soil moisture is maintained near field capacity throughout the year, the application of any water above crop water requirements is considered to contribute to an increase in soil moisture that, in turn, precipitates deep percolation past the crop root zone. Thus, all additional applied water is considered to be part of return flows that ultimately become groundwater recharge. For all other crops where additional water is applied for field preparation or pre-irrigation outside the period of active plant growth, all water is considered to contribute to soil moisture which can be later captured by the plants, or can be deep percolated as a result of subsequent application of water during the plant growing season. However, recognizing that the application of water outside the plant growing season results in shallow soil moisture being susceptible to evaporation, water in the uppermost 6 inches of soil is considered to be lost to evaporation and thus not part of the return flows that ultimately become groundwater recharge. For average Antelope Valley soil conditions, field capacity is about one inch per foot of depth. Thus, the application of 4 to 6 inches of water for field preparation and pre-irrigation of certain crops will tend to wet several feet of soil; of that, evaporation will consume water stored in the uppermost half-foot of soil profile (about one-half inch of water) and the balance is in the soil profile from which it can ultimately deep percolate as return flow to groundwater recharge.

Derivations of individual quantities of return flows on a per-crop basis, following the methodology described above, are delineated in Appendix D-3: Table 6. Total amounts of agricultural return flows, for selected years prior to 1970 (when the preceding level of detail was not available, and for which return flows were estimated to be 30 percent of total applied water) and for each year since 1970, are summarized in Appendix D-3: Table 7 and illustrated in Appendix D-3: Figure 1.

References

California Department of Water Resources, CIMIS Program, 1994-2003. Records of Reference Evapotranspiration, Victorville Station, California.

California Polytechnic State University, Irrigation Training and Research Center, 1994. *Drip and Microirrigation for Trees, Vines, and Row Crops*, 261 pp.

Kern County Agricultural Commissioner, 1994-2003. Annual Pesticide Use Reports (available online).

Los Angeles County Agricultural Commissioner, 1970-2006. Annual Crop and Livestock Reports.

Univ. of California, Cooperative Extension Program, date not available. *Table 2: "Normal Year" grass potential evapotranspiration (ETo), forage crop coefficients and ET for the High Desert.*

Appendix D-3: Table 1
Reference Evapotranspiration and Crop Coefficients by Growth Stage
Antelope Valley Area of Adjudication

		Reference Evapotranspiration*		Crop Coefficients**											
Growth Stage Periods		Monthly	Bimonthly	Alfalfa	Pasture	Deciduous	Grain	Fall Silage	Sugar Beets	Melons	Onions	Spring Carrots	Summer Carrots	Potatoes	Grapes***
		ET_o (in)	ET_o (in)	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c
January	1	2.02	0.91	0.40	1.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.11	0.40	1.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	1	2.61	1.18	0.40	1.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.43	1.00	1.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
March	1	4.55	2.05	1.15	1.00	0.25	0.66	0.00	0.00	0.00	0.30	0.31	0.00	0.55	0.35
	2		2.50	1.15	1.00	0.54	0.92	0.00	0.15	0.18	0.30	0.55	0.00	0.61	
April	1	6.19	2.89	0.95	1.00	0.60	1.00	0.00	0.15	0.18	0.30	0.82	0.00	0.88	0.55
	2		3.30	0.95	1.00	0.66	1.00	0.00	0.37	0.34	0.53	1.03	0.00	1.16	
May	1	7.30	3.45	0.95	1.00	0.72	1.15	0.00	0.61	0.72	0.83	1.11	0.00	1.21	0.73
	2		3.85	0.95	1.00	0.79	1.10	0.00	0.88	1.11	1.14	1.13	0.31	1.19	
June	1	8.85	4.29	0.95	1.00	0.84	0.78	0.14	1.11	1.11	1.14	1.05	0.53	0.87	0.82
	2		4.56	0.95	1.00	0.86	0.00	0.25	1.11	1.11	1.14	1.00	0.82	0.55	
July	1	9.77	4.90	0.95	1.00	0.92	0.00	0.56	1.11	0.78	1.04	0.00	1.03	0.00	0.82
	2		4.87	0.95	1.00	0.94	0.00	1.00	1.07	0.29	0.92	0.00	1.11	0.00	
August	1	8.99	4.61	0.95	1.00	0.94	0.00	1.15	1.04	0.00	0.80	0.00	1.13	0.00	0.72
	2		4.38	0.95	1.00	0.94	0.00	1.20	1.00	0.00	0.68	0.00	1.05	0.00	
September	1	6.52	3.48	0.95	1.00	0.94	0.00	1.20	0.97	0.00	0.00	0.00	0.00	0.00	0.50
	2		3.04	0.95	1.00	0.91	0.00	1.06	0.00	0.00	0.00	0.00	0.00	0.00	
October	1	4.66	2.51	0.95	1.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		2.15	0.95	1.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
November	1	2.68	1.64	0.95	1.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.04	0.95	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	1	2.05	1.06	0.95	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.99	0.95	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (inches)		66.19	66.19												
Total (feet)		5.52	5.52												

* Avg ET_o for specified periods, based on available historical and daily data at the Victorville CIMIS Station, 1994 - 2003

** Crop growth stages and coefficients from Univ. California Cooperative Extension; values for the California High Desert.

*** Crop coefficients for grapes from Univ. California Cooperative Extension; monthly values for Yolo and Solano Counties (High Desert value not available)

Appendix D-3: Table 2
Evapotranspiration of Crops
Antelope Valley Area of Adjudication

		Evapotranspiration of Crops											
Growth Stage Periods		Alfalfa	Pasture	Deciduous	Grain	Fall Silage	Sugar Beets	Melons	Onions	Spring Carrots	Summer Carrots	Potatoes	Grapes
		ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)
January	1	0.36	0.91	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.44	1.11	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	1	0.47	1.18	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	1.43	1.43	0.00	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
March	1	2.36	2.05	0.51	1.35	0.00	0.00	0.00	0.62	0.64	0.00	1.13	1.59
	2	2.88	2.50	1.35	2.30	0.00	0.38	0.45	0.75	1.38	0.00	1.53	
April	1	2.75	2.89	1.73	2.89	0.00	0.43	0.52	0.87	2.37	0.00	2.54	3.40
	2	3.14	3.30	2.18	3.30	0.00	1.22	1.12	1.75	3.40	0.00	3.83	
May	1	3.28	3.45	2.48	3.97	0.00	2.10	2.48	2.86	3.83	0.00	4.17	5.33
	2	3.66	3.85	3.04	4.24	0.00	3.39	4.27	4.39	4.35	1.19	4.58	
June	1	4.08	4.29	3.60	3.35	0.60	4.76	4.76	4.89	4.50	2.27	3.73	7.26
	2	4.33	4.56	3.92	0.00	1.14	5.06	5.06	5.20	4.56	3.74	2.51	
July	1	4.66	4.90	4.51	0.00	2.74	5.44	3.82	5.10	0.00	5.05	0.00	8.01
	2	4.63	4.87	4.58	0.00	4.87	5.21	1.41	4.48	0.00	5.41	0.00	
August	1	4.38	4.61	4.33	0.00	5.30	4.79	0.00	3.69	0.00	5.21	0.00	6.47
	2	4.16	4.38	4.12	0.00	5.26	4.38	0.00	2.98	0.00	4.60	0.00	
September	1	3.31	3.48	3.27	0.00	4.18	3.38	0.00	0.00	0.00	0.00	0.00	3.26
	2	2.89	3.04	2.77	0.00	3.22	0.00	0.00	0.00	0.00	0.00	0.00	
October	1	2.38	2.51	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	2.04	2.15	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
November	1	1.56	1.64	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.99	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	1	1.01	1.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.94	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (inches)		62.10	66.19	47.38	22.94	27.31	40.55	23.91	37.57	25.02	27.47	24.02	35.33
Total (feet)		5.18	5.52	3.95	1.91	2.28	3.38	1.99	3.13	2.09	2.29	2.00	2.94

Appendix D-3: Table 3
Evapotranspiration of Applied Water
Antelope Valley Area of Adjudication

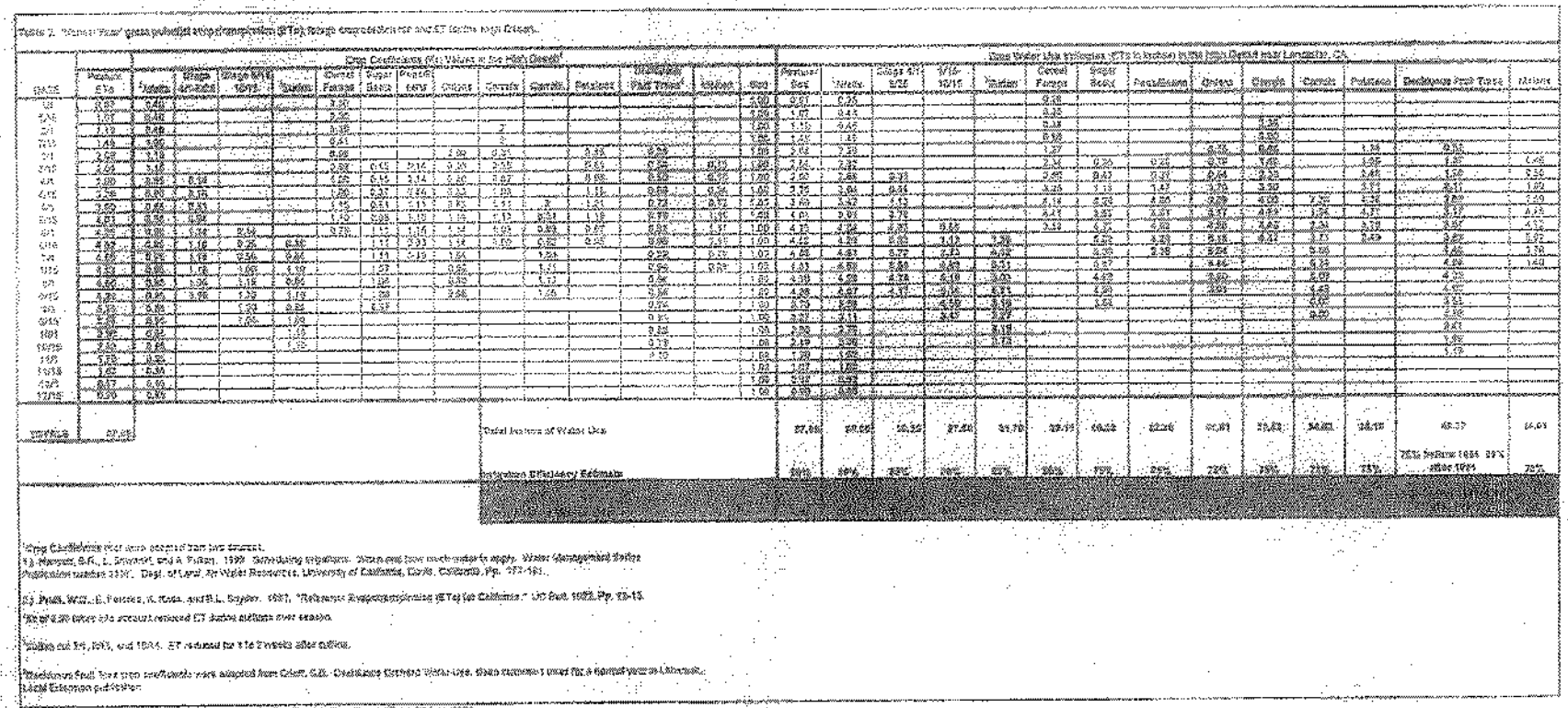
Growth Stage Periods		Monthly Precipitation (in)	Bimonthly Precipitation (in)	Effective Precipitation P_e (in)	Evapotranspiration of Applied Water											
					Alfalfa	Pasture	Deciduous	Grain	Fall Silage	Sugar Beets	Melons	Onions	Spring Carrots	Summer Carrots	Potatoes	Grapes
					ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)
January	1	1.05	0.47	0.24	0.13	0.68	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.58	0.29	0.15	0.82	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	1	1.95	0.88	0.44	0.03	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.07	0.54	0.90	0.90	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
March	1	0.8	0.44	0.00	2.36	2.05	0.51	1.35	0.00	0.00	0.00	0.62	0.64	0.00	1.13	1.59
	2		0.36	0.00	2.88	2.50	1.35	2.30	0.00	0.38	0.45	0.75	1.38	0.00	1.53	
April	1	0.48	0.26	0.00	2.75	2.89	1.73	2.89	0.00	0.43	0.52	0.87	2.37	0.00	2.54	3.40
	2		0.22	0.00	3.14	3.30	2.18	3.30	0.00	1.22	1.12	1.75	3.40	0.00	3.83	
May	1	0.12	0.06	0.00	3.28	3.45	2.48	3.97	0.00	2.10	2.48	2.86	3.83	0.00	4.17	5.33
	2		0.06	0.00	3.66	3.85	3.04	4.24	0.00	3.39	4.27	4.39	4.35	1.19	4.58	
June	1	0.05	0.03	0.00	4.08	4.29	3.60	3.35	0.60	4.76	4.76	4.89	4.50	2.27	3.73	7.26
	2		0.02	0.00	4.33	4.56	3.92	0.00	1.14	5.06	5.06	5.20	4.56	3.74	2.51	
July	1	0.12	0.06	0.00	4.66	4.90	4.51	0.00	2.74	5.44	3.82	5.10	0.00	5.05	0.00	8.01
	2		0.06	0.00	4.63	4.87	4.58	0.00	4.87	5.21	1.41	4.48	0.00	5.41	0.00	
August	1	0.04	0.02	0.00	4.38	4.61	4.33	0.00	5.30	4.79	0.00	3.69	0.00	5.21	0.00	6.47
	2		0.02	0.00	4.16	4.38	4.12	0.00	5.26	4.38	0.00	2.98	0.00	4.60	0.00	
September	1	0.16	0.08	0.00	3.31	3.48	3.27	0.00	4.18	3.38	0.00	0.00	0.00	0.00	0.00	3.26
	2		0.08	0.00	2.89	3.04	2.77	0.00	3.22	0.00	0.00	0.00	0.00	0.00	0.00	
October	1	0.16	0.08	0.00	2.38	2.51	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.08	0.00	2.04	2.15	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
November	1	0.37	0.14	0.00	1.56	1.64	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.23	0.00	0.99	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	1	0.54	0.26	0.13	0.88	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.28	0.14	0.80	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (inches)		5.84	5.84	1.77	60.33	64.42	47.38	21.52	27.31	40.55	23.91	37.57	25.02	27.47	24.02	35.33
Total (feet)		0.49	0.49	0.15	5.03	5.37	3.95	1.79	2.28	3.38	1.99	3.13	2.09	2.29	2.00	2.94

Appendix D-3: Table 4
Applied Crop Water Duties and Irrigation Efficiency Values
(DU = 80%)
Antelope Valley Area of Adjudication

Crop	ET_c[1] (in)	P_e[2] (in)	ET_{AW}[3] (in)	DU[4] (%)	AW_c[5] (in)	AW_{er}[6] (in)	AW_{pr}[7] (in)	AW_T[8] (in)	(ft)	E_{irr}[9] (%)
Alfalfa	62.10	1.77	60.33	80	75.42	0	2.0	77.42	6.5	81
Carrots	27.47	0.00	27.47	80	34.33	6	6.5	46.83	3.9	85
Grain	22.94	1.42	21.52	80	26.90	0	4.0	30.90	2.6	83
Melons/Squash	23.91	0.00	23.91	80	29.88	0	4.0	33.88	2.8	82
Onions	37.57	0.00	37.57	80	46.96	3	4.0	53.96	4.5	83
Orchard (Deciduous)	47.38	0.00	47.38	80	59.22	0	0.0	59.22	4.9	80
Pasture	66.19	1.77	64.42	80	80.53	0	0.0	80.53	6.7	80
Potatoes	24.02	0.00	24.02	80	30.03	0	4.0	34.03	2.8	82
Silage	27.31	0.00	27.31	80	34.14	0	4.0	38.14	3.2	82
Sugar Beets	40.55	0.00	40.55	80	50.68	0	4.0	54.68	4.6	81
Vineyard (Grapes)	35.33	0.00	35.33	80	44.16	0	0.0	44.16	3.7	80

[1] $ET_c = K_c * ET_o$ where ET_o = average ET_o for specified periods, based on data from Victorville CIMIS Station, 1994-2003); K_c values from Univ. California Cooperative Extension
[2] P_e = effective precipitation offsetting ET_c, up to 1/2 of the average precipitation, in Dec. - Feb., inclusive
[3] ET_{AW} = evapotranspiration of applied water = $ET_c - P_e$
[4] DU = irrigation distribution uniformity
[5] AW_c = applied water for crop requirement = $ET_{AW} \div DU$
[6] AW_{er} = applied water for erosion control (after Nebeker, 4-19-07)
[7] AW_{pr} = applied water for field preparation and pre-irrigation (after Nebeker, 4-19-07)
[8] AW_T = applied crop water duty = $AW_c + AW_{er} + AW_{pr}$
[9] E_{irr} = overall irrigation efficiency for beneficial uses = $(ET_{AW} + AW_{er} + AW_{pr}) \div AW_T$

Appendix D-3: Table 5
Crop Coefficients and Growth Stages
California High Desert



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4/19/07

AN ESTIMATE OF CROP WATER REQUIREMENTS IN THE ANTELOPE VALLEY

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DISCUSSION

The irrigation challenges in Antelope Valley are perhaps unique to all of California because solid set irrigation is one of the most popular types, sandy soils are common, and heavy winds prevail.

The calculations below are the best estimates of average crop water usage assuming all irrigations perform as anticipated with no unexpected problems such as equipment failure, the irrigation sets finishing when expected, etc. and no severe weather events such as excessive heat, high winds, etc. Otherwise, more water is required than these estimates represent. These calculations account for planting dates, harvesting dates, and end-of-season dates.

Historical data from Palmdale and Littlerock were used to estimate the amount of reference or "normal year" potential evapotranspiration (ETo) for Antelope Valley as shown in Table 2. ETo data from the CIMIS weather station in Victorville, CA is very similar to the Palmdale and Littlerock data and the Victorville is shown in Table 1 for comparison.. Climatic conditions largely

determine evapotranspiration and observations over many years by local Farm Advisors have indicated that Victorville data closely represent the climatic conditions in Antelope Valley.

Once the reference evapotranspiration ETo is known, the evapotranspiration for each crop (ETc) can be determined by

$$ETc = Kc\ (ETo)$$

where Kc is the crop coefficient. The crop coefficient varies with the crop, its stage of development, and the frequency of irrigation at less than full crop cover. Since these coefficients are practically independent of location, they can be used over a wide area.

ETc is the amount of water that must be supplied to the plant for proper growth, sometimes called net water requirements. Unfortunately, irrigation systems are not perfect and some additional water losses occur in the form of deep percolation, ponding, runoff, etc. The total amount of water that must be applied to the crop, often called gross water requirements, is calculated by

$$\text{Gross Water Requirement} = \text{Net Water Requirement} / (\text{Irrigation System Efficiency})$$

These irrigation system efficiencies have been developed over the years from field studies by University of California researchers and the Natural Resources Conservation Service (NRCS). With rare exceptions, irrigation system efficiencies for each particular type of irrigation method have not varied significantly from 1970 to the present. However, because the cost of irrigation water was less during these earlier periods, the amount of water wasted during these periods was greater than today. Some growers in the Antelope Valley area estimate their total water usage per acre was 25% greater during these earlier periods.

The following tables represent the "normal year" potential evapotranspiration, ETo , Crop Coefficients, and Evapotranspiration Requirements for various crops currently and historically grown in the Lancaster, CA area. Note that a heavy rainfall winter, which produces "effective rainfall," that is, rainfall that soaks into the soil and is not dissipated by evaporation, runoff, etc. may slightly reduce these requirements.

Table 4 lists the water requirements to reduce wind erosion damage in onion and carrot crops and the water applied when no crop is growing to facilitate field preparation and other cultural practices. These water requirements are not included in the crop evaporation estimates. Table 4 also shows the total crop water requirements in Antelope Valley.

Table 1. Plant evapotranspiration data for Jan. to December 2003, collected from Victorville, CA CIMIS weather station number 117, to be used as an estimate for ET near Palmdale, CA.

January	ETo(in)	February	ETo(in)	March	ETo(in)	April	ETo(in)	May	ETo(in)	June	ETo(in)	July	ETo(in)	August	ETo(in)	September	ETo(in)	October	ETo(in)	November	ETo(in)	December	ETo	January	ETo
1/1	0.07	2/1	0.13	3/1	0.12	4/1	0.24	5/1	0.21	6/1	0.29	7/1	0.34	8/1	0.22	9/1	0.26	10/1	0.21	11/1	0.07	12/1	0.1	1/1	0.09
1/2	0.07	2/2	0.11	3/2	0.13	4/2	0.18	5/2	0.21	6/2	0.31	7/2	0.32	8/2	0.27	9/2	0.16	10/2	0.2	11/2	0.08	12/2	0.07	1/2	0.08
1/3	0.06	2/3	0.09	3/3	0.09	4/3	0.17	5/3	0.16	6/3	0.32	7/3	0.38	8/3	0.28	9/3	0.17	10/3	0.16	11/3	0.08	12/3	0.08	1/3	0.08
1/4	0.07	2/4	0.11	3/4	0.10	4/4	0.18	5/4	0.20	6/4	0.31	7/4	0.31	8/4	0.32	9/4	0.23	10/4	0.16	11/4	0.08	12/4	0.07	1/4	0.06
1/5	0.08	2/5	0.10	3/5	0.12	4/5	0.19	5/5	0.22	6/5	0.29	7/5	0.32	8/5	0.32	9/5	0.22	10/5	0.17	11/5	0.09	12/5	0.07	1/5	0.06
1/6	0.13	2/6	0.11	3/6	0.15	4/6	0.19	5/6	0.22	6/6	0.30	7/6	0.32	8/6	0.32	9/6	0.25	10/6	0.17	11/6	0.08	12/6	0.11	1/6	0.05
1/7	0.14	2/7	0.11	3/7	0.14	4/7	0.20	5/7	0.21	6/7	0.30	7/7	0.31	8/7	0.31	9/7	0.27	10/7	0.17	11/7	0.1	12/7	0.06	1/7	0.08
1/8	0.06	2/8	0.08	3/8	0.15	4/8	0.23	5/8	0.14	6/8	0.31	7/8	0.3	8/8	0.33	9/8	0.26	10/8	0.17	11/8	0.07	12/8	0.07	1/8	0.07
1/9	0.07	2/9	0.09	3/9	0.16	4/9	0.22	5/9	0.25	6/9	0.31	7/9	0.32	8/9	0.32	9/9	0.25	10/9	0.19	11/9	0.1	12/9	0.08	1/9	0.06
1/10	0.03	2/10	0.12	3/10	0.16	4/10	0.24	5/10	0.21	6/10	0.30	7/10	0.31	8/10	0.32	9/10	0.21	10/10	0.16	11/10	0.09	12/10	0.08	1/10	0.07
1/11	0.06	2/11	0.02	3/11	0.16	4/11	0.21	5/11	0.25	6/11	0.28	7/11	0.32	8/11	0.24	9/11	0.22	10/11	0.15	11/11	0.09	12/11	0.06	1/11	0.07
1/12	0.07	2/12	0.00	3/12	0.16	4/12	0.23	5/12	0.28	6/12	0.27	7/12	0.31	8/12	0.31	9/12	0.23	10/12	0.17	11/12	0	12/12	0.05	1/12	0.07
1/13	0.07	2/13	0.01	3/13	0.19	4/13	0.19	5/13	0.22	6/13	0.28	7/13	0.32	8/13	0.27	9/13	0.23	10/13	0.16	11/13	0.08	12/13	0.04	1/13	0.07
1/14	0.06	2/14	0.08	3/14	0.17	4/14	0.06	5/14	0.18	6/14	0.30	7/14	0.33	8/14	0.28	9/14	0.27	10/14	0.19	11/14	0.08	12/14	0.06	1/14	0.08
1/15	0.08	2/15	0.11	3/15	0.04	4/15	0.18	5/15	0.25	6/15	0.32	7/15	0.33	8/15	0.3	9/15	0.27	10/15	0.2	11/15	0.08	12/15	0.06	1/15	0.07
1/16	0.08	2/16	0.11	3/16	0.10	4/16	0.20	5/16	0.28	6/16	0.29	7/16	0.25	8/16	0.29	9/16	0.27	10/16	0.15	11/16	0.08	12/16	0.08	1/16	0.07
1/17	0.09	2/17	0.08	3/17	0.18	4/17	0.18	5/17	0.27	6/17	0.30	7/17	0.21	8/17	0.28	9/17	0.25	10/17	0.15	11/17	0.07	12/17	0.05	1/17	0.08

1/18	0.08	2/18	0.10	3/18	0.18	4/18	0.16	5/18	0.26	6/18	0.32	7/18	0.28	8/18	0.3	9/18	0.21	10/18	0.16	11/18	0.08	12/18	0.06	1/18	0.08
January	**ETo(in)**	**February**	**ETo(in)**	**March**	**ETo(in)**	**April**	**ETo(in)**	**May**	**ETo(in)**	**June**	**ETo(in)**	**July**	**ETo(in)**	**August**	**ETo(in)**	**September**	**ETo(in)**	**October**	**ETo(in)**	**November**	**ETo(in)**	**December**	**ETo**	**January**	**ETo**
1/19	0.08	2/19	0.12	3/19	0.15	4/19	0.19	5/19	0.25	6/19	0.29	7/19	0.29	8/19	0.32	9/19	0.21	10/19	0.15	11/19	0.07	12/19	0.06	1/19	0.07
1/20	0.10	2/20	0.11	3/20	0.18	4/20	0.20	5/20	0.27	6/20	0.25	7/20	0.3	8/20	0.24	9/20	0.22	10/20	0.15	11/20	0.12	12/20	0.07	1/20	0.07
1/21	0.10	2/21	0.13	3/21	0.16	4/21	0.18	5/21	0.28	6/21	0.26	7/21	0.31	8/21	0.22	9/21	0.22	10/21	0.15	11/21	0.11	12/21	0.07	1/21	0.09
1/22	0.07	2/22	0.15	3/22	0.19	4/22	0.15	5/22	0.31	6/22	0.27	7/22	0.26	8/22	0.29	9/22	0.21	10/22	0.17	11/22	0.09	12/22	0.07	1/22	0.1
1/23	0.06	2/23	0.09	3/23	0.19	4/23	0.20	5/23	0.31	6/23	0.27	7/23	0.29	8/23	0.28	9/23	0.23	10/23	0.14	11/23	0.07	12/23	0.03	1/23	0.08
1/24	0.09	2/24	0.11	3/24	0.16	4/24	0.22	5/24	0.30	6/24	0.26	7/24	0.32	8/24	0.23	9/24	0.17	10/24	0.14	11/24	0.04	12/24	0.06	1/24	0.07
1/25	0.10	2/25	0.02	3/25	0.18	4/25	0.21	5/25	0.29	6/25	0.31	7/25	0.31	8/25	0.25	9/25	0.2	10/25	0.16	11/25	0.11	12/25	0.06	1/25	0.08
1/26	0.10	2/26	0.07	3/26	0.23	4/26	0.23	5/26	0.27	6/26	0.28	7/26	0.22	8/26	0.2	9/26	0.2	10/26	0.16	11/26	0.07	12/26	0.09	1/26	0.08
1/27	0.10	2/27	0.11	3/27	0.19	4/27	0.26	5/27	0.30	6/27	0.30	7/27	0.28	8/27	0.22	9/27	0.2	10/27	0.14	11/27	0.09	12/27	0.05	1/27	0.1
1/28	0.08	2/28	0.12	3/28	0.23	4/28	0.23	5/28	0.31	6/28	0.32	7/28	0.28	8/28	0.24	9/28	0.23	10/28	0.13	11/28	0.05	12/28	0.05	1/28	0.08
1/29	0.09			3/29	0.23	4/29	0.22	5/29	0.32	6/29	0.34	7/29	0.19	8/29	0.27	9/29	0.22	10/29	0.17	11/29	0.06	12/29	0.06	1/29	0.08
1/30	0.10			3/30	0.22	4/30	0.21	5/30	0.31	6/30	0.35	7/30	0.24	8/30	0.24	9/30	0.22	10/30	0.14	11/30	0.07	12/30	0.07	1/30	0.13
1/31	0.11			3/31	0.23			5/31	0.30			7/31	0.24	8/31	0.29			10/31	0.11			12/31	0.06	1/31	0.09
January	2.55	February	2.59	March	5.04	April	5.95	May	7.84	June	8.90	July	9.11	August	8.57	September	6.76	October	5.00	November	2.31	December	2.05	January	2.41
Daily Ave.	0.08	Daily Ave.	0.09	Daily Ave.	0.16	Daily Ave.	0.20	Daily Ave.	0.25	Daily Ave.	0.30	Daily Ave.	0.29	Daily Ave.	0.28	Daily Ave.	0.23	Daily Ave.	0.16	Daily Ave.	0.08	Daily Ave.	0.07	Daily Ave.	0.08

TABLE 2. CROP COEFFICIENTS (Kc) IN THE HIGH DESERT[1,5]

Date	Pasture ETo	Alfalfa[2]	Silage 4/1-8/25	Silage 6/15-10/15	Sudan[3]	Cereal Forage	Sugar Beets	Peas/ Beans	Onions	Carrots	Carrots	Potatoes	Deciduous[4] Fruit Trees	Melons	Sod
1/1	0.87	0.40				0.30									1.00
1/15	1.07	0.40				0.30									1.00
2/1	1.19	0.40				0.30				0.31					1.00
2/15	1.45	1.00				0.41				0.31					1.00
3/1	2.08	1.15				0.66			0.30	0.31		0.55	0.25		1.00
3/15	2.54	1.15				0.92	0.15	0.14	0.30	0.55		0.61	0.54	0.18	1.00
4/1	2.80	1.05	0.14			1.00	0.15	0.14	0.30	0.82		0.88	0.60	0.18	1.00
4/15	3.20	1.05	0.18			1.00	0.37	0.46	0.53	1.03		1.16	0.66	0.34	1.00
5/1	3.60	1.05	0.31			1.15	0.61	1.11	0.83	1.11	0.31	1.21	0.72	0.72	1.00
5/15	4.01	1.05	0.94			1.10	0.88	1.15	1.14	1.13	0.31	1.19	0.79	1.11	1.00
6/1	4.25	1.05	1.14	0.14		0.78	1.11	1.15	1.14	1.05	0.55	0.87	0.84	1.11	1.00
6/15	4.52	1.05	1.18	0.25	0.30		1.11	0.93	1.14	1.00	0.82	0.55	0.86	1.11	1.00
7/1	4.85	1.05	1.18	0.56	0.85		1.11	0.49	1.04		1.03		0.92	0.78	1.00
7/15	4.83	1.05	1.15	1.00	1.10		1.07		0.92		1.11		0.94	0.29	1.00
8/1	4.50	1.05	1.06	1.15	0.85		1.04		0.80		1.13		0.94		1.00
8/15	4.28	1.05	0.98	1.20	1.10		1.00		0.68		1.05		0.94		1.00
9/1	3.75	1.05		1.20	0.85		0.97						0.94		1.00
9/15	3.27	1.05		1.06	1.00								0.91		1.00
10/1	2.90	1.05			1.10								0.85		1.00
10/15	2.48	1.05			1.10								0.79		1.00
11/1	1.70	1.05											0.70		1.00
11/15	1.07	0.40													1.00
12/1	0.97	0.40													1.00
12/15	0.90	0.40													1.00
Total	67.08														

TABLE 3. CROP EVAPOTRANSPIRATION (ET_C IN INCHES) IN ANTELOPE VALLEY

Date	Pasture/ Sod	Alfalfa	Silage 4/1-8/25	Silage 6/15-10/15	Sudan	Cereal Forage	Sugar Beets	Peas/ Beans	Onions	Carrots	Carrots	Potatoes	Deciduous Fruit Trees	Melons
1/1	0.87	0.35				0.26								
1/15	1.07	0.43				0.32								
2/1	1.19	0.48				0.36				0.37				
2/15	1.45	1.45				0.60				0.45				
3/1	2.08	2.39				1.37			0.62	0.64		1.14	0.52	
3/15	2.54	2.92				2.34	0.38	0.36	0.76	1.40		1.55	1.37	0.46
4/1	2.80	2.94	0.39			2.80	0.42	0.39	0.84	2.30		2.46	1.68	0.50
4/15	3.20	3.36	0.56			3.20	1.18	1.47	1.70	3.30		3.71	2.11	1.09
5/1	3.60	3.78	1.13			4.14	2.20	4.00	2.99	4.00	1.12	4.36	2.59	2.59
5/15	4.01	4.21	3.76			4.41	3.53	4.61	4.57	4.53	1.24	4.77	3.17	4.45
6/1	4.25	4.46	4.83	0.58		3.32	4.72	4.89	4.85	4.46	2.34	3.70	3.57	4.72
6/15	4.52	4.75	5.33	1.13	1.36		5.02	4.20	5.15	4.52	3.71	2.49	3.89	5.02
7/1	4.85	5.09	5.72	2.73	4.12		5.38	2.38	5.04		5.00		4.46	3.78
7/15	4.83	5.07	5.55	4.83	5.31		5.17		4.44		5.36		4.54	1.40
8/1	4.50	4.73	4.78	5.18	3.83		4.68		3.60		5.09		4.23	
8/15	4.28	4.49	4.17	5.14	4.71		4.28		2.91		4.49		4.02	
9/1	3.75	3.94		4.50	3.19		3.64				0.00		3.53	
9/15	3.27	3.43		3.47	3.27						0.00		2.98	
10/1	2.90	3.05			3.19								2.47	
10/15	2.48	2.60			2.73								1.96	
11/1	1.70	1.79											1.19	
11/15	1.07	0.43												
12/1	0.97	0.39												
12/15	0.90	0.36												
Total Inches Of Net Water Use	67.08	66.89	36.22	27.56	31.71	23.12	40.60	22.30	37.47	25.97	28.35	24.18	48.28	24.01

TABLE 4. GROSS AND NET CROP WATER REQUIREMENTS (IN INCHES) IN ANTELOPE VALLEY

	Pasture/ Sod	Alfalfa	Silage 4/1-8/25	Silage 6/15-10/15	Sudan	Cereal Forage	Sugar Beets	Peas/ Beans	Onions	Carrots	Carrots	Potatoes	Deciduous Fruit Trees	Melons
Net Evapo-transpiration Water Requirement	67.08	66.89	36.22	27.56	31.71	23.12	40.60	22.30	37.47	25.97	28.35	24.18	48.28	24.01
Net Soil Erosion Water Requirement									3.54	4.46	6.08			
Net Non-Growing Water Requirement[10]	0.00	2.00	4.00	4.00	4.00	4.00	4.00	4.00	6.00[7]	6.50[8]	6.50[8]	4.00	0.00	4.00
Total Net Water Requirement	67.08	68.89	40.22	31.56	35.71	27.12	44.60	26.30	47.01	36.93	40.93	30.18	48.28	28.01
Irrigation Efficiency	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%[9]	75%
Gross Water Requirement														
Inches	89.44	91.85	53.63	42.08	46.80	36.16	59.47	35.07	62.68	49.24	54.57	40.24	64.37	37.35
Acre Feet	7.45	7.65	4.47	3.51	3.90	3.01	4.96	2.92	5.22	4.10	4.55	3.35	5.36	3.11

References

1) Crop Coefficients were adapted from two references: Hansen, B.R., Shwannkl, L., and Fulton, A. "Scheduling Irrigations: When and How Much Water to Apply," Water Management Series Publication Number 3396, Dept. of Land, Air & Water Resources, University of California, Davis, California and Pruitt, W. O., Fereres, E., Kelta, K., and Snyder, R. L., "Reference Evapotransppiration (ETo) for California," UC Bull. 1922
2) Kc of 1.05 takes into account reduced ET during the cuttings throughout the season. Since some alfalfa varieties go dormant during major portions of December and January and some rainfall may occur during this period, perhaps about 3 inches of applied water need not be applied during this period.
3) Sudan was cut on 7/1, 8/16, and 10/16. ET was reduced for 1 to 2 weeks after cutting.
4) Deciduous Fruit Tree Crop Coefficients were adapted from Orloff, S. B. "Deciduous Orchard Water Use, clean cultivated trees for a normal year in Littlerock, Local Extension Publication
5) Pasture ETo and Forage Crop Coefficients were drafted by B. L. Sanden, Kern County Farm Advisor, 2002, and modified by G. J. Poole, Los Angeles County Farm Advisor, 2004
6) Assumes a 5-year life of an alfalfa stand and includes the water requirement for pre-irrigation before field preparation and planting.
7) Water is required for pre-irrigation before field preparation, fumigation and "water capping" after fumigation.
8) Water is required for pre-irrigation before field preparation, fumigation and "water capping" after fumigation.
9) From 1991 on, drip irrigation in orchards became popular and the irrigation efficiency increased to 90%.
10) These water requirements are not included elsewhere.

NEBEKER RANCH, INC.
LANCASTER, CALIFORNIA

MAIL ADDRESS:
400 N. Rockingham Avenue
Los Angeles, CA 90049
310-440-8862

March 25, 2008

Dr, Blaine Hanson
Extension Irrigation and Drainage Specialist
Department of Land, Air and Water Resources
113 Veihmeyer Hall
University of California, Davis

Dear Dr. Hanson:

I would appreciate it if you and your colleagues would comment on:

Crop Water Requirements for Antelope Valley

You and your colleagues helped me assemble the document "An Estimate of Crop Water Requirements in the Antelope Valley" dated April 19, 2007. Are these values accurate and reasonable estimates of crop water requirements for this area?

Relation Between Applied Water and Net Water Required for Irrigation

The relation between Applied Water and Net Water is:

Applied Water = Net Water/(Distribution Uniformity – Miscellaneous Unavoidable Losses)

where Distribution Uniformity is the "catch-can" distribution uniformity and Miscellaneous Unavoidable Losses include scheduling difficulties, maintenance, breaks, unexpected pressure losses, and other problems often encountered in the field. The denominator in the above equation is often referred to as the "Irrigation Efficiency." This denominator is only Distribution Uniformity for an ideal system in which Irrigation Management Practices are zero and not for a real system in the field.

Net Water

Net Water in the above equation is the sum of all beneficial uses of water not simply water for evapotranspiration. Other beneficial uses include water to control soil erosion when the plants are small and all water used during the non-growing time periods that include water preceding field preparation, fumigation and "water capping."

Fate of the Difference Between Applied Water and Net Water

All of the difference between Applied Water and Net Water is not return flow. This difference needs to be divided between at least four factors including losses between the sprinkler nozzles and the soil, pooling in the fields, runoff, and return flows. Quantifying these values is a challenge. After discussing this issue with University of California specialists, I estimated the following ranges of these values as a percent of Applied Water that may occur in the Antelope Valley:

Return Flow	4% to 25% [1]
Losses Between the Sprinkler Nozzles and the Soil	3% to 15% [2]
Pooling in the Fields	0% to 3%
Runoff	0% to 3%

1 Minimum Leaching Requirements are Estimated at 4%
2 These losses may be 2 to 5% greater during the hot, dry winds in Antelope Valley

Thank you for your assistance in this matter.

Eugene B. Nebeker, Ph.D., P.E.
President

cc: Mr. Steve Orloff, University of California Cooperative Extension Farm Advisor

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ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616-8628

April 22, 2008

Dr. Gene Nebeker
400 N. Rockingham
Los Angeles, CA 90049

Dear Gene:

In response to your letter of March 25, 2008, the following are offered:

1. Crop Water Requirements for Antelope Valley

Crop evapotranspiration (ET) is by far the largest beneficial use. The potential ET is calculated as the product of crop coefficients and a reference crop ET, obtained from the CIMIS network. Crop coefficients are developed from field studies, either on an agricultural experiment station or in commercial fields, by making direct measurements of the crop ET using lysimeters or meteorological methods and then calculating the ratio of the crop ET to the reference crop ET.

You assembled the document "An Estimate of Crop Water Requirements in the Antelope Valley" dated April 19, 2007 with assistance from University of California farm advisors or former advisors and UC specialists working in crop ET. The document lists estimates of crop coefficients of crops grown in the area in question and historical reference crop ET. After reviewing these data, in our opinion, they are the best available information on this matter and are as accurate as possible for your area. For example, your estimate of the seasonal alfalfa ET is reasonable when compared to estimates for the Imperial Valley or Arizona, both of which have extremely hot summer climates.

2. Relation between Applied Water and Net Water Required for Irrigation

You have described a relation between Applied Water and Net Water as:

> Applied Water = Net Water/(Distribution Uniformity – Miscellaneous Unavoidable Losses)

You have defined Miscellaneous Unavoidable Losses to include scheduling difficulties, maintenance, breaks, unexpected pressure losses, and other problems often encountered in the field. In theory, we feel that including the Miscellaneous Unavoidable Losses in the efficiency equation is appropriate, but caution should be used in promoting these losses as necessary adjustments to the water supply. For example, one could argue that losses due to irrigation scheduling difficulties could be avoided if growers paid more attention to water management. Note that in your equation, these losses are expressed as a fraction of the total amount of applied water. Confusion can exist in the appropriate value to be used for distribution uniformity (DU) because of the different definitions of DU. One definition is the catch can uniformity which accounts for the nonuniform water applications due to the sprinkler spacings. However, the field-wide DU not only includes the catch can

uniformity (which is usually the dominate factor in the field-wide DU in the valley), but also nonuniformity due to pressure losses throughout the field, leaks, non-vertical risers, and mixed nozzle sizes (which should be avoided).

The field wide DU should be used in your equation. The article, "Practical Potential Irrigation Efficiencies", (B. Hanson, Proceedings of the First International Conference, American Society of Civil Engineers, August 14-18, 1995) lists estimates of practical maximum irrigation efficiencies based on the practical maximum attainable field-wide uniformities (sometimes called the global uniformity) for different irrigation methods. These estimates are based on irrigation system evaluations conducted by mobile irrigation evaluation laboratories throughout the state.

A reasonable estimate of the field-wide DU of portable solid set sprinkler systems is about 75% under low wind conditions. This means that about 25% of the water reaching the ground surface would be deep percolation assuming no other losses, which in your case, you feel that there are other losses that do not become deep percolation. However, as the wind speed increases above about 5 miles per hour, the catch can DU decreases rapidly, as does the field wide DU.

3. Net Water

We agree that the Net Water in the above equation is the sum of all beneficial uses of water not simply water for evapotranspiration. Other beneficial uses include water to control soil erosion when the plants are small and all water used during the non-growing time periods that include water preceding field preparation, fumigation and "water capping." These additional beneficial uses can reflect the site specific conditions of your area and grower experience. In our opinion, these additional beneficial uses are reasonable.

4. Fate of the Difference between Applied Water and Net Water

It is frequently assumed that the difference between Applied Water and Net Water is deep percolation. However, you feel that this difference needs to be divided between at least four sinks including losses between the sprinkler nozzles and the soil, pooling in the fields, runoff, and return flows or deep percolation. As you stated, quantifying these values is a challenge, and some cases can only be based on grower experience. Your estimates of these values for the Antelope Valley are:

Return Flow	4% to 25%[1]
Losses between the Sprinkler Nozzles and the Soil	3% to 15%[2]
Pooling in the Fields	0% to 3%
Runoff	0% to 3%

1 Minimum Leaching Requirements are estimated at 4%

2 These losses may be 2 to 5% greater during the hot, dry winds in Antelope Valley

We feel that these sinks are reasonable descriptions of the partitioning. However, the return flow minimum value (based on a leaching requirement of 4%) needs to be adjusted upward. No irrigation method can apply water such that 4% of the applied water is return flow unless the field is severely under irrigated. Basing irrigation water management on minimum leaching requirements is not very practical, in our opinion. A rough guess for the minimum return flow is 15 to 20%. The values for evaporation losses can be justified from research results. A commonly used value is 10% (based on research results); however, it could be more under the Antelope Valley conditions. No research data exists on the other sinks, and thus, grower experience is the only source of these estimates.

Sincerely,

Blaine Hanson
Extension Irrigation and Drainage Specialist
Dept. of Land, Air and Water Resources
University of California, Davis

Steve Orloff
Farm Advisor, Siskiyou County and former Farm Advisor, Los Angeles County
University of California Cooperative Extension

APPLIED AG WATER (Problem Statement)

ACREAGE TOTAL (1)

Year	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	TOTAL
1995	7,093	4,754	869	2,411	1,342	120	550	0	0	17,139
1996	7,088	4,441	3,370	2,755	1,386	180	374	0	0	19,593
1997	7,492	3,922	5,506	2,818	1,411	75	529	0	15	21,768
1998	7,300	1,905	8,139	2,982	1,607	75	324	320	24	22,677
1999	8,417	1,378	8,162	2,706	1,749	75	285	480	26	23,277
2000	8,720	1,452	10,787	3,304	2,124	408	244	797	33	27,868
2001	7,808	1,624	9,485	2,992	2,143	265	237	598	49	25,200
2002	7,958	1,702	14,128	2,223	1,447	40	323	459	54	28,335
2003	7,261	1,546	11,782	3,778	1,410	80	216	665	63	26,801
2004	7,703	1,783	10,954	3,288	1,426	40	216	394	140	25,944
2005	7,074	2,626	9,909	3,358	1,363	40	231	470	107	25,178
2006	6,741	2,865	8,126	3,242	1,802	0	77	562	113	23,528
2007										
2008										

WATER APPLICATION TOTAL (AF)

	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	SUB TOTAL	PLUS Unreported Farms (3)	MINUS Surface Water (4)	MINUS Reclaim Water (4)	TOTAL APPLIED GROUND-WATER
Applied Water Rqrmnt /acre (2)	6.5	2.6	3.9	4.5	4.9	4.6	2.8	2.8	3.7					
1995	46,105	12,360	3,389	10,850	6,576	552	1,540	0	0	81,371	4,068	(12,846)	(3,294)	**69,299**
1996	46,072	11,547	13,143	12,398	6,791	828	1,047	0	0	91,826	4,591	(18,245)	(3,602)	**74,570**
1997	48,698	10,197	21,473	12,681	6,914	345	1,481	0	56	101,845	5,092	(23,691)	(3,838)	**79,408**
1998	47,450	4,953	31,742	13,419	7,874	345	907	896	89	107,675	5,384	(17,110)	(3,414)	**92,535**
1999	54,711	3,583	31,832	12,177	8,570	345	798	1,344	96	113,455	5,673	(25,235)	(3,678)	**90,215**
2000	56,680	3,775	42,069	14,868	10,408	1,877	683	2,232	122	132,714	6,636	(28,221)	(4,381)	**106,748**
2001	50,752	4,222	36,992	13,464	10,501	1,219	664	1,674	181	119,669	5,983	(19,643)	(4,597)	**101,412**
2002	51,727	4,425	55,099	10,004	7,090	184	904	1,285	200	130,919	6,546	(10,138)	(6,628)	**120,699**
2003	47,197	4,020	45,950	17,001	6,909	368	605	1,862	233	124,144	6,207	(6,390)	(7,501)	**116,460**
2004	50,070	4,636	42,721	14,796	6,987	184	605	1,103	518	121,619	6,081	(7,682)	(8,142)	**111,876**
2005	45,981	6,828	38,645	15,111	6,679	184	647	1,316	396	115,786	5,789	(9,282)	(9,998)	**102,295**
2006	43,817	7,449	31,691	14,589	8,830	0	216	1,574	418	108,583	5,429	(12,731)	(11,797)	**89,484**
2007														
2008														

(1) Problem Statement Appendix D, Table D.2-1b
(2) Problem Statement Appendix D-3, Table 4
(3) 5% of Subtotal, Problem Statement Appendix D, Table D.3-1
(4) Problem Statement Appendix D, Table D.4-4

APPLIED AG WATER (U of C)

ACREAGE TOTAL (1)

Year	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	TOTAL
1995	7,093	4,754	869	2,411	1,342	120	550	0	0	17,139
1996	7,088	4,441	3,370	2,755	1,386	180	374	0	0	19,593
1997	7,492	3,922	5,506	2,818	1,411	75	529	0	15	21,768
1998	7,300	1,905	8,139	2,982	1,607	75	324	320	24	22,677
1999	8,417	1,378	8,162	2,706	1,749	75	285	480	26	23,277
2000	8,720	1,452	10,787	3,304	2,124	408	244	797	33	27,868
2001	7,808	1,624	9,485	2,992	2,143	265	237	598	49	25,200
2002	7,958	1,702	14,128	2,223	1,447	40	323	459	54	28,335
2003	7,261	1,546	11,782	3,778	1,410	80	216	665	63	26,801
2004	7,703	1,783	10,954	3,288	1,426	40	216	394	140	25,944
2005	7,074	2,626	9,909	3,358	1,363	40	231	470	107	25,178
2006	6,741	2,865	8,126	3,242	1,802	0	77	562	113	23,528
2007										
2008										

WATER APPLICATION TOTAL (AF)

	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	SUB TOTAL	PLUS Unreported Farms (3)	MINUS Surface Water (4)	MINUS Reclaim Water (4)	TOTAL APPLIED GROUND-WATER	Difference (U of C - Prob Stmt)
Applied Water Rqrmnt /acre (2)	7.65	3.05	4.6	5.22	5.36	4.96	3.11	3.35	3.7						
1995	54,261	14,500	3,997	12,585	7,193	595	1,711	0	0	94,843	4,068	(12,846)	(3,294)	**82,771**	**13,471**
1996	54,223	13,545	15,502	14,381	7,429	893	1,163	0	0	107,136	4,591	(18,245)	(3,602)	**89,880**	**15,311**
1997	57,314	11,962	25,328	14,710	7,563	372	1,645	0	56	118,949	5,092	(23,691)	(3,838)	**96,512**	**17,104**
1998	55,845	5,810	37,439	15,566	8,614	372	1,008	1,072	89	125,815	5,384	(17,110)	(3,414)	**110,675**	**18,139**
1999	64,390	4,203	37,545	14,125	9,375	372	886	1,608	96	132,601	5,673	(25,235)	(3,678)	**109,361**	**19,145**
2000	66,708	4,429	49,620	17,247	11,385	2,024	759	2,670	122	154,963	6,636	(28,221)	(4,381)	**128,997**	**22,249**
2001	59,731	4,953	43,631	15,618	11,486	1,314	737	2,003	181	139,656	5,983	(19,643)	(4,597)	**121,399**	**19,987**
2002	60,879	5,191	64,989	11,604	7,756	198	1,005	1,538	200	153,359	6,546	(10,138)	(6,628)	**143,139**	**22,440**
2003	55,547	4,715	54,197	19,721	7,558	397	672	2,228	233	145,267	6,207	(6,390)	(7,501)	**137,583**	**21,124**
2004	58,928	5,438	50,388	17,163	7,643	198	672	1,320	518	142,269	6,081	(7,682)	(8,142)	**132,526**	**20,650**
2005	54,116	8,009	45,581	17,529	7,306	198	718	1,575	396	135,428	5,789	(9,282)	(9,998)	**121,937**	**19,642**
2006	51,569	8,738	37,380	16,923	9,659	0	239	1,883	418	126,809	5,429	(12,731)	(11,797)	**107,710**	**18,226**
2007															
2008															

(1) Problem Statement Appendix D, Table D.2-1b
(2) University of CA, Table 4 (2007)
(3) 5% of Subtotal, Problem Statement Appendix D, Table D.3-1
(4) Problem Statement Appendix D, Table D.4-4

Table D.2-1b
Summary of Historical Crop Acreages Grouped by Applied Crop Water Requirements
Crop Acreages Shown by County and in Total for the Antelope Valley

		Los Angeles County Portion of Antelope Valley										Kern County Portion of Antelope Valley										Total Acreage for Antelope Valley									
Year	Source	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Total	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Total	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Total
1910	(1)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	4,629
1919	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7,155	----	----	----	----	----	----	----	----	11,960
1920	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7,400	----	----	----	----	----	----	----	----	----
1922	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7,000	----	----	----	----	----	----	----	----	----
1924	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	12,000	----	----	----	----	----	----	----	----	16,780
1925	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	14,000	----	----	----	----	----	----	----	----	----
1927	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	20,250	----	----	----	----	----	----	----	----	----
1929	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	25,000	----	----	----	----	----	----	----	----	31,420
1930	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	22,000	----	----	----	----	----	----	----	----	----
1931	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	21,700	----	----	----	----	----	----	----	----	----
1934	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15,317	----	----	----	----	----	----	----	----	23,800
1935	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	16,000	----	----	----	----	----	----	----	----	----
1938	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	23,000	----	----	----	----	----	----	----	----	----
1939	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	20,000	----	----	----	----	----	----	----	----	----
1945	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	29,600	----	----	----	----	----	----	----	----	37,795
1945	(3)	30,000	9,000	----	----	2,280	----	740	----	----	42,000	----	4,000	----	----	----	----	----	----	----	4,000	30,000	13,000	----	----	2,280	----	740	----	----	46,000
1946	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	31,500	----	----	----	----	----	----	----	----	40,027
1947	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	34,700	----	----	----	----	----	----	----	----	----
1948	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	37,700	----	----	----	----	----	----	----	----	----
1949	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	38,900	----	----	----	----	----	----	----	----	52,497
1950	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	39,525	----	----	----	----	----	----	----	----	54,066
1950	(4)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	62,200	4,200	----	----	4,500	200	100	----	0	71,200
1951	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	39,645	----	----	----	----	----	----	----	----	54,455
1957	(5)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	37,530	14,570	----	----	1,540	2,210	1,290	----	0	57,140
1961	(6)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	43,950	4,890	----	----	1,410	2,290	2,110	----	60	54,710
1970	(7)	29,200	15,300	----	50	1,855	1,300	100	----	----	48,015	3,633	1,889	80	907	520	980	854	0	0	8,643	32,833	16,989	80	957	2,375	2,460	954	0	0	56,658
1971	(7)	26,400	23,700	----	----	1,867	1,300	150	----	----	53,617	4,057	1,886	89	1,013	581	1,072	953	0	0	9,561	30,457	25,586	89	1,013	2,448	2,572	1,103	0	0	63,268
1972	(7)	23,400	16,000	----	80	1,591	1,500	85	----	----	42,656	3,228	1,500	71	806	462	953	758	0	0	7,678	26,628	17,500	71	886	2,053	2,353	843	0	0	50,334
1972	(8)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	36,080	1,390	----	----	1,400	----	----	----	60	42,290
1973	(7)	21,800	18,100	----	240	1,580	1,220	70	----	----	43,020	3,255	1,513	72	813	466	860	765	0	0	7,744	25,055	19,613	72	1,053	2,056	2,080	835	0	0	50,764
1974	(7)	20,200	23,700	----	250	1,540	1,070	155	----	----	46,915	3,550	1,650	78	886	508	938	834	0	0	8,445	23,750	25,350	78	1,136	2,048	2,008	989	0	0	55,360
1975	(7)	19,400	27,150	----	700	1,393	1,200	200	----	----	50,043	3,787	1,760	83	945	542	1,001	890	0	0	9,008	23,187	28,910	83	1,645	1,935	2,201	1,090	0	0	59,051
1976	(7)	20,375	11,800	----	1,200	1,162	1,868	480	----	----	36,885	2,791	1,297	61	697	400	738	656	0	0	6,639	23,166	13,097	61	1,897	1,562	2,606	1,136	0	0	43,524
1977	(7)	23,375	18,500	1,160	2,500	1,162	3,700	340	500	----	51,237	3,677	1,802	85	968	555	1,025	911	0	0	9,223	27,252	20,302	1,245	3,468	1,717	4,725	1,251	500	0	60,460
1978	(7)	23,400	16,250	----	1,700	1,180	3,200	311	----	----	46,041	3,484	1,619	77	870	499	921	819	0	0	8,287	26,884	17,869	77	2,570	1,679	4,121	1,130	0	0	54,328
1979	(7)	22,800	10,034	90	1,715	1,219	2,200	150	80	----	38,288	2,897	1,346	64	723	415	766	681	0	0	6,892	25,697	11,380	154	2,438	1,634	2,966	831	80	0	45,180
1980	(7)	22,600	12,395	50	425	1,349	3,880	315	----	----	40,994	3,102	1,442	68	774	444	820	729	0	0	7,379	25,702	13,837	118	1,199	1,793	4,680	1,044	0	0	48,373
1981	(7)	20,100	11,500	80	977	1,015	2,775	420	----	----	36,867	2,790	1,296	61	696	399	737	655	0	0	6,636	22,890	12,796	141	1,673	1,414	3,512	1,075	0	0	43,503
1982	(7)	16,300	12,850	180	1,433	1,046	340	625	----	----	32,774	2,480	1,153	55	619	355	655	583	0	0	5,899	18,780	14,003	235	2,052	1,401	995	1,208	0	0	38,673
1983	(7)	13,957	14,717	----	1,810	1,004	317	585	----	----	32,390	2,451	1,139	54	812	351	648	576	0	0	5,830	16,408	15,856	54	2,422	1,355	965	1,161	0	0	38,220
1984	(7)	12,068	12,868	61	1,447	1,047	280	597	----	----	28,348	2,145	997	47	535	307	567	504	0	0	5,103	14,213	13,865	108	1,983	1,354	827	1,101	0	0	33,451
1985	(7)	10,593	11,726	71	1,548	993	0	543	----	----	25,474	1,928	896	42	481	278	509	453	0	0	4,585	12,520	12,622	113	2,030	1,269	509	996	0	0	30,059
1986	(7)	8,481	9,719	85	1,451	882	----	389	----	----	20,968	1,587	737	35	396	227	419	373	0	0	3,774	10,047	10,457	120	1,847	1,090	419	762	0	0	24,742
1986	(9)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	9,860	1,330	----	----	1,870	----	----	----	30	15,530
1987	(7)	8,867	2,641	92	1,467	936	----	246	----	----	14,248	1,138	529	25	284	163	301	267	0	0	2,707	10,005	3,169	117	1,751	1,099	301	514	0	0	16,956
1988	(7)	7,598	7,674	74	1,668	965	----	389	----	----	18,369	1,622	754	36	405	232	429	381	0	0	3,857	9,220	8,428	110	2,073	1,197	429	770	0	0	22,226
1989	(7)	6,230	931	86	1,642	1,005	----	46	----	----	9,840	951	442	21	237	136	251	224	0	0	2,263	7,182	1,373	106	1,879	1,141	251	270	0	0	12,103
1990	(7)	6,223	1,023	110	1,519	1,057	----	47	----	----	9,979	1,049	487	23	262	150	277	246	0	0	2,495	7,271	1,511	133	1,781	1,208	277	294	0	0	12,474
1991	(7)	5,799	788	27	1,656	1,015	----	103	----	----	9,367	1,063	494	23	265	152	281	250	0	0	2,529	6,862	1,282	50	1,922	1,167	281	353	0	0	11,896
1992	(7)	5,281	5,412	4	1,632	1,031	----	149	----	----	13,509	1,647	765	36	411	236	435	387	0	0	3,918	6,928	6,177	40	2,043	1,267	435	536	0	0	17,426
1993	(7)	5,582	1,815	16	1,533	1,315	----	125	----	----	10,385	1,353	629	30	338	194	358	318	0	0	3,219	6,935	2,444	46	1,871	1,509	358	442	0	0	13,604
1994	(7)	5,528	2,621	21	1,319	1,505	----	191	----	----	11,184	1,362	633	30	340	195	360	320	0	0	3,240	6,890	3,254	51	1,659	1,700	360	511	0	0	14,424
1995	(7)	5,462	4,283	549	1,636	1,257	----	180	----	----	13,347	1,631	491	320	775	85	120	370	0	0	3,792	7,093	4,754	869	2,411	1,342	120	550	0	0	17,139
1996	(7)	5,537	3,712	2,324	1,493	1,186	----	186	----	----	14,447	1,551	729	1,046	1,262	190	180	188	0	0	5,148	7,088	4,441	3,370	2,755	1,386	180	374	0	0	19,593
1997	(7)	5,505	3,317	3,811	1,893	1,261	----	203	----	15	16,005	1,987	805	1,895	925	150	75	326	0	0	5,763	7,492	3,922	5,506	2,818	1,411	75	529	0	15	21,768
1998	(7)	5,265	1,560	5,252	2,377	1,457	----	179	----	24	16,114	2,035	345	2,887	605	150	75	145	320	0	6,562	7,300	1,905	8,139	2,982	1,607	75	324	320	24	22,677
1999	(7)	6,087	1,093	5,508	2,166	1,704	----	215	----	26	16,718	2,350	345	2,854	540	45	75	70	460	0	6,559	8,417	1,378	8,162	2,706	1,749	75	285	460	26	23,277
2000	(7)	6,165	1,074	8,132	2,264	1,959	----	129	----	33	19,755	2,555	378	2,655	1,040	166	408	115	797	0	8,113	8,720	1,452	10,787	3,304	2,124	408	244	797	33	27,868
2001	(7)	5,705	1,150	7,417	1,697	2,023	----	117	----	49	18,167	2,103	464	2,068	1,295	120	265	120	598	0	7,033	7,808	1,614	9,485	2,992	2,143	265	237	598	49	25,200
2002	(7)	5,203	1,307	9,864	1,686	1,327	----	228	----	54	19,770	2,755	395	4,164	537	120	40	95	459	0	8,565	7,958	1,702	14,128	2,223	1,447	40	323	459	54	28,335
2003	(7)	5,461	1,371	8,555	2,758	1,340	----	136	----	63	19,684	1,800	175	3,227	1,020	70	80	80	665	0	7,117	7,261	1,546	11,782	3,778	1,410	80	216	665	63	25,801
2004	(7)	5,728	1,282	7,403	2,633	1,279	----	131	----	74	18,730	1,975	501	3,551	455	147	40	85	394	66	7,214	7,703	1,783	10,954	3,288	1,426	40	216	394	140	25,944
2005	(7)	5,583	1,520	5,361	2,623	1,293	----	101	----	107	16,588	1,491	1,108	4,548	735	70	40	130	470	0	8,590	7,074	2,626	9,909	3,358	1,393	40	231	470	107	25,178
2006	(7)	5,556	1,960	3,754	1,838	1,304	----	77	----	113	14,602	1,185	905	4,372	1,404	466	0	0	562	0	8,926	6,741	2,865	8,126	3,242	1,802	0	77	562	113	23,528

(1) Tait, A.E., 1912
(2) Snyder, J. Herbert, 1955
(3) California Division of Water Resources, 1947
(4) State Water Resources Board, 1955
(5) California Department of Water Resources, 1963
(6) California Department of Water Resources, 1965
(7) Los Angeles and Kern County Agricultural Commissioners, 1970 - 2006 and 1994-2006
(8) California Department of Water Resources, 1974
(9) California Department of Water Resources, 1990

(1): Area Northern Boundary Unknown
(2, 3, and 7): Area Northern Boundary at Cottonwood-Willow Springs-Rosamond Fault
(4, 5, 6, and 9): Area Northern Boundary defined by Antelope Valley Hydrographic Unit (encompasses towns of Mojave and Boron)

Table D.3-1
Historical Agricultural Water Requirements by Investigator and Calculation Parameters
Antelope Valley Area of Adjudication
(all values in acre-feet)

	Reported Values (Snyder, 1955)[1]		Calculated from DWR Crop Acreages, DWR Crop Consumptive Use Values, and Irrigation Efficiencies of 70 - 90%[3]								Calculated from County Crop Report Acreages and CIMIS-Derived Applied Crop Water Duties (DU = 80%; Irrigation Efficiencies = 59 to 80%)												
	Total	Current Estimate[2]	Alfalfa	Other Pasture	Grain and Hay	Field	Deciduous	Truck	Vineyard	Total	Current Estimate[4]	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Subtotal	Unreported Farms	Total	Historical Total
Applied Water Duties (af/ac)	1.4 - 7.5		3.0 (7.2)	2.8 (7.7)	0.8 (2.6)	1.5 (4.5)	2.2 (5.6)	1.4 (4.0)	2.4 (4.2)			6.5	2.6	3.9	4.5	4.9	4.6	2.8	2.8	3.7		(5% of Subtotal)		
Year																								
1919	64,200	77,565																						77,565
1920	66,600	80,606																						80,606
1926	96,600	121,746																						121,746
1927	131,400	167,566																						167,566
1929	160,000	204,724																						204,724
1930	141,600	180,112																						180,112
1936	102,600	130,176																						130,176
1940	168,400	202,348																						202,348
1945	210,800	255,311	90,000		13,000		4,520	1,480		109,000	265,416													255,311
1946	226,000	273,960																						273,960
1947	261,400	296,757																						296,757
1948	304,800	322,497																						322,497
1949	322,900	327,685																						327,685
1950	350,500	347,676	207,000	311	3,733	333	11,000	156	0	222,533	486,310													347,676
1951	386,200	362,549																						362,549
1957			138,900	20,480	15,651	4,736	4,840	2,580	0	188,187	334,387													334,387
1961			177,986	10,520	5,589	4,907	4,431	4,220	206	206,959	357,362													357,362
1970												213,415	44,170	312	4,351	11,638	11,317	2,670	0	0	287,875	14,394	302,268	302,268
1971												197,971	66,522	349	4,557	11,994	11,833	3,089	0	0	296,315	14,816	311,131	311,131
1972			147,429	5,720	1,589	5,679	4,400	1,420	206	167,441	287,087	173,080	45,600	277	3,988	10,060	10,824	2,361	0	0	246,089	12,304	258,393	258,393
1973												162,859	50,993	280	4,737	10,075	9,570	2,337	0	0	240,850	12,043	252,893	262,893
1974												154,374	65,910	305	5,113	10,036	9,238	2,769	0	0	247,745	12,387	260,133	260,133
1975												150,713	75,186	325	7,404	9,482	10,124	3,051	0	0	256,264	12,813	269,078	269,078
1976												150,579	34,053	240	8,535	7,652	11,986	3,160	0	0	216,224	10,811	227,036	227,036
1977												177,138	52,785	4,857	15,605	8,414	21,734	3,502	1,400	0	285,434	14,272	299,706	299,706
1978												174,744	46,460	299	11,563	8,226	18,956	3,163	0	0	263,411	13,171	276,582	276,582
1979												167,031	29,589	600	10,972	8,006	13,642	2,326	224	0	232,390	11,620	244,010	244,010
1980												167,062	35,976	461	5,397	8,786	21,627	2,923	0	0	242,132	12,107	254,239	254,239
1981												148,782	33,271	552	7,530	6,931	18,157	3,011	0	0	216,234	10,812	227,045	227,045
1982												122,069	36,407	916	9,234	6,865	4,579	3,361	0	0	183,451	9,173	192,624	192,624
1983												106,651	41,226	211	10,898	6,639	4,436	3,250	0	0	173,313	8,656	181,978	181,978
1984												92,383	36,049	422	8,923	6,636	3,804	3,062	0	0	151,300	7,565	158,865	158,865
1985												81,361	32,617	441	9,133	6,219	2,344	2,789	0	0	135,123	6,756	141,879	141,879
1986			37,757	4,200	1,520	129	6,191	4,790	103	54,660	95,923	65,307	27,138	468	6,313	5,339	1,929	2,133	0	0	110,676	5,534	116,210	116,210
1987												55,033	8,240	455	7,860	5,385	1,384	1,435	0	0	89,815	4,491	94,306	94,306
1988												58,929	21,912	428	9,327	5,867	1,972	2,156	0	0	101,591	5,080	106,671	106,671
1989												46,880	3,311	415	8,455	5,591	1,157	755	0	0	66,365	3,318	69,683	69,683
1990												47,263	3,927	519	8,014	5,917	1,275	822	0	0	67,735	3,387	71,125	71,125
1991												44,604	3,281	195	8,647	5,717	1,283	988	0	0	64,725	3,236	67,961	67,961
1992												45,029	16,061	155	9,193	6,208	2,002	1,502	0	0	80,151	4,008	84,158	84,158
1993												46,076	6,353	179	8,417	7,395	1,645	1,239	0	0	70,305	3,515	73,820	73,820
1994												44,782	8,460	199	7,456	8,328	1,656	1,429	0	0	72,320	3,616	75,937	75,937
1995												46,103	12,360	3,389	10,848	6,577	552	1,540	0	0	81,369	4,068	85,438	85,438
1996												46,069	11,547	13,143	12,395	6,791	828	1,047	0	0	91,820	4,591	96,411	96,411
1997												48,695	10,198	21,473	12,683	6,916	345	1,480	0	55	101,845	5,092	106,937	106,937
1998												47,453	4,953	31,742	13,417	7,874	345	908	896	90	107,678	5,384	113,062	113,062
1999												54,713	3,582	31,832	12,176	8,568	345	797	1,344	96	113,452	5,673	119,125	119,125
2000												56,681	3,774	42,069	14,867	10,407	1,877	683	2,232	122	132,712	6,636	139,348	139,348
2001												50,750	4,222	36,992	13,466	10,500	1,219	664	1,674	179	119,666	5,983	125,649	125,649
2002												51,729	4,426	55,099	10,002	7,082	184	904	1,285	201	130,922	6,546	137,468	137,468
2003												47,197	4,020	45,950	17,000	6,910	368	604	1,862	232	124,143	6,207	130,350	130,350
2004												50,068	4,635	42,721	14,797	6,988	184	606	1,103	519	121,620	6,081	127,701	127,701
2005												45,982	6,827	38,645	15,113	5,677	184	645	1,316	397	115,787	5,789	121,576	121,576
2006												43,817	7,449	31,691	14,588	8,830	0	216	1,574	418	108,583	5,429	114,012	114,012

1) Calculated from Reported Crop Acreages, Crop Consumptive Use Values, and Irrigation Efficiencies (41 - 51%)
2) Calculated from Snyder Crop Acreages and CIMIS-Derived Applied Crop Water Duties (DU=70%)
3) Crop Water Values shown are Consumptive Use Values (Irrigation Efficiencies not incorporated); Calculated Water Requirements utilize Irrigation Efficiencies of 100% (1946), 90% (1950), and 70% (all other survey years)
4) Calculated from DWR Crop Acreages and CIMIS-Derived Applied Crop Water Values (DU=70%) shown in parentheses in crop column headings

Table D.4-4
Historical Total Water Supply
Antelope Valley Area of Adjudication
(Acre-Feet per Year)

	Municipal/Industrial					Agricultural						Environmental		Combined					Total
Year	Groundwater	Imported Surface Water (AVEK,PWD,LCID)	Local Surface Water (PWD)	Surface Water (Total)	Total Mkt Supply	Groundwater**	Imported Surface Water (AVEK)	Local Surface Water (LCID)	Surface Water (Total)	Recycled Water (LACSD 14 and 20)	Total Ag Supply**	Recycled Water (LACSD 14)	Total Environmental Supply	Groundwater	Imported Surface Water	Local Surface Water	Surface Water (Total)	Recycled Water (LACSD)	Antelope Valley Water Supply
1946	9,467	0	1,000	1,000	10,467	273,960	0	0	0	0	273,960	0	0	283,427	0	1,000	1,000	0	284,427
1947	9,167	0	1,000	1,000	10,167	296,757	0	0	0	0	296,757	0	0	305,924	0	1,000	1,000	0	306,924
1948	8,953	0	1,000	1,000	9,953	322,497	0	0	0	0	322,497	0	0	331,449	0	1,000	1,000	0	332,449
1949	11,369	0	1,000	1,000	12,369	327,685	0	0	0	0	327,685	0	0	339,054	0	1,000	1,000	0	340,054
1950	8,993	0	1,000	1,000	9,993	347,676	0	0	0	0	347,676	0	0	356,669	0	1,000	1,000	0	357,669
1951	7,566	0	1,000	1,000	8,566	362,549	0	0	0	0	362,549	0	0	370,116	0	1,000	1,000	0	371,116
1952	6,821	0	1,000	1,000	7,821	357,855	0	0	0	0	357,855	0	0	364,676	0	1,000	1,000	0	365,676
1953	11,445	0	1,000	1,000	12,445	353,162	0	0	0	0	353,162	0	0	364,607	0	1,000	1,000	0	365,607
1954	14,249	0	1,000	1,000	15,249	348,468	0	0	0	0	348,468	0	0	362,716	0	1,000	1,000	0	363,716
1955	15,072	0	1,000	1,000	16,072	343,774	0	0	0	0	343,774	0	0	358,847	0	1,000	1,000	0	359,847
1956	18,321	0	2,422	2,422	20,743	339,081	0	0	0	0	339,081	0	0	357,402	0	2,422	2,422	0	359,824
1957	14,770	0	1,752	1,752	16,522	334,387	0	0	0	0	334,387	0	0	349,157	0	1,752	1,752	0	350,909
1958	13,597	0	2,434	2,434	16,131	340,131	0	0	0	0	340,131	0	0	353,827	0	2,434	2,434	0	356,261
1959	20,976	0	1,311	1,311	22,287	345,792	0	0	0	83	345,875	0	0	366,767	0	1,311	1,311	83	368,161
1960	17,217	0	385	385	17,602	351,535	0	0	0	83	351,618	0	0	368,752	0	385	385	83	369,220
1961	26,982	0	0	0	26,982	357,279	0	0	0	83	357,362	—	—	384,261	0	0	0	83	384,344
1962	31,471	0	5,534	5,534	37,005	351,143	0	0	0	97	351,240	—	—	382,614	0	5,534	5,534	97	388,245
1963	22,901	0	136	136	23,037	345,022	0	0	0	97	345,119	—	—	367,923	0	136	136	97	368,056
1964	26,903	0	262	262	26,565	338,902	0	0	0	135	338,997	—	—	365,166	0	262	262	135	365,563
1965	24,432	0	1,318	1,318	25,750	332,652	0	0	0	224	332,876	—	—	357,084	0	1,318	1,318	224	358,626
1966	28,658	0	0	0	28,658	326,530	0	0	0	224	326,754	—	—	355,188	0	0	0	224	355,412
1967	26,416	0	0	0	26,416	320,209	0	0	0	424	320,633	—	—	346,625	0	0	0	424	347,049
1968	29,604	0	3,150	3,150	32,754	314,087	0	0	0	424	314,511	—	—	343,692	0	3,150	3,150	424	347,266
1969	31,451	0	2,105	2,105	33,556	307,878	0	0	0	512	308,390	—	—	339,329	0	2,105	2,105	512	341,946
1970	27,168	0	1,396	1,396	28,564	299,910	0	1,649	1,649	509	302,268	—	—	327,078	0	3,245	3,245	509	330,832
1971	30,850	0	1,389	1,389	32,245	308,768	0	1,663	1,663	700	311,131	—	—	339,624	0	3,052	3,052	700	343,376
1972	34,942	338	1,360	1,698	36,640	256,102	0	1,567	1,567	704	258,393	—	—	291,044	338	2,947	3,285	704	295,033
1973	32,210	290	1,523	1,813	34,023	250,330	0	1,672	1,672	891	252,893	—	—	282,540	290	3,195	3,485	891	286,916
1974	31,566	400	938	1,338	32,904	257,676	0	1,851	1,851	806	260,133	—	—	289,242	400	2,589	2,989	806	293,037
1975	30,092	520	1,586	2,106	32,198	266,574	0	1,613	1,613	891	269,078	927	927	296,766	520	3,099	3,619	1,818	302,203
1976	30,416	589	1,151	1,740	32,156	197,450	27,295	1,400	28,695	891	227,036	1,559	1,559	227,859	27,884	2,551	30,435	2,450	260,744
1977	27,972	111	468	579	28,551	266,132	32,133	500	32,633	941	299,706	1,978	1,978	294,104	32,244	968	33,212	2,919	330,235
1978	23,908	5,479	2,024	7,503	31,411	236,470	37,428	1,888	39,116	996	276,582	2,456	2,456	260,378	42,907	3,712	46,619	3,452	310,449
1979	26,015	7,361	913	8,294	33,309	190,069	60,934	1,950	62,884	1,036	244,010	2,226	2,226	216,104	68,316	2,863	81,179	3,262	279,545
1980	24,679	7,089	913	7,982	32,660	193,276	58,054	1,950	60,004	958	254,239	2,442	2,442	217,955	65,123	2,863	67,986	3,400	289,341
1981	22,341	10,643	1,638	12,281	34,622	161,503	63,894	1,040	64,934	548	227,045	2,601	2,601	183,904	74,537	2,678	77,215	3,149	264,268
1982	26,321	6,921	1,580	8,501	34,822	151,967	39,053	1,804	40,857	0	192,824	2,336	2,336	178,287	45,974	3,284	49,258	2,336	229,882
1983	21,147	6,576	714	7,290	28,438	157,187	23,505	1,199	24,704	88	181,978	2,958	2,958	178,334	30,081	1,913	31,994	3,046	213,374
1984	26,220	10,518	927	11,445	39,665	138,821	18,176	1,464	19,640	404	158,865	2,755	2,755	167,041	28,694	2,391	31,085	3,158	201,288
1985	26,986	14,485	1,460	15,945	42,931	116,522	21,563	1,375	22,938	399	141,879	3,258	3,258	145,408	36,067	2,835	38,902	3,667	187,968
1986	31,687	17,710	332	18,042	49,729	100,527	14,981	1,250	15,691	52	116,210	4,356	4,356	132,214	32,091	1,582	33,673	4,408	170,295
1987	33,122	22,107	0	22,107	55,229	79,327	13,916	1,000	14,916	64	94,306	5,271	5,271	112,448	36,022	1,000	37,022	5,335	154,806
1988	36,314	20,442	1,330	21,772	58,086	89,484	14,154	1,000	15,154	2,033	106,671	3,777	3,777	125,798	34,596	2,330	36,926	5,810	168,533
1989	38,284	31,285	1,400	32,685	70,968	60,156	16,100	700	16,800	2,726	89,683	2,134	2,134	88,441	47,385	2,100	49,485	4,859	142,785
1990	35,599	36,450	110	36,560	72,159	52,326	14,775	200	14,975	3,824	71,126	2,451	2,451	87,925	51,225	310	51,535	6,275	145,735
1991	38,272	21,245	286	21,531	59,803	77,936	922	750	1,672	4,011	83,619	2,567	2,567	116,208	22,167	1,036	23,203	6,578	145,989
1992	33,867	27,549	3,465	31,014	64,881	77,274	2,323	900	3,223	3,661	84,158	3,520	3,520	111,141	29,872	4,365	34,237	7,181	152,559
1993	39,301	39,391	2,239	41,630	80,931	61,853	8,115	725	8,840	3,127	73,820	5,279	5,279	101,154	47,506	2,964	50,470	8,406	160,030
1994	45,733	42,646	867	43,513	89,246	59,737	11,637	800	12,437	3,762	75,937	5,109	5,109	105,470	54,283	1,667	55,950	8,871	170,292
1995	48,320	36,488	3,771	40,259	88,578	69,298	12,846	0	12,846	3,294	85,438	7,141	7,141	118,618	49,334	3,771	53,104	10,435	182,157
1996	50,511	45,908	3,043	48,948	99,459	74,564	18,245	0	18,245	3,602	96,411	7,501	7,501	125,075	64,151	3,043	67,194	11,103	203,372
1997	50,470	47,070	2,363	49,433	99,903	79,407	23,691	0	23,691	3,838	106,937	6,877	6,877	129,877	70,762	2,363	73,124	10,715	213,717
1998	43,670	40,862	5,040	45,901	89,571	91,936	17,710	0	17,710	3,414	113,062	8,706	8,706	135,608	58,572	5,040	63,612	12,120	211,339
1999	48,609	52,873	3,050	55,923	104,531	90,211	25,235	0	25,235	3,678	119,125	7,638	7,638	138,820	78,109	3,050	81,159	11,316	231,294
2000	48,821	53,566	6,500	60,066	108,887	106,746	28,221	0	28,221	4,381	139,348	7,120	7,120	155,568	81,786	6,500	88,287	11,501	255,355
2001	57,818	48,110	6,851	54,961	112,779	101,409	19,643	0	19,643	4,597	125,649	7,550	7,550	159,227	67,753	6,851	74,604	12,147	245,979
2002	53,600	59,704	0	59,704	113,304	120,702	10,138	0	10,138	6,628	137,468	7,839	7,839	174,301	69,843	0	69,843	14,487	258,611
2003	48,031	56,532	3,499	62,031	110,062	116,459	6,390	0	6,390	7,501	130,350	8,382	8,382	164,460	64,922	3,499	68,421	15,883	248,764
2004	54,381	58,124	3,959	62,083	116,464	111,877	7,692	0	7,692	8,142	127,701	9,239	9,239	166,258	66,806	3,959	69,765	17,381	253,404
2005	50,901	57,265	6,900	64,165	115,066	102,296	9,282	0	9,282	9,998	121,576	9,957	9,957	153,197	66,547	6,900	73,447	19,955	246,599
2006	43,960	70,023	4,173	74,196	118,156	89,484	12,731	0	12,731	11,797	114,012	9,611	9,611	133,444	82,753	4,173	86,926	21,408	241,778

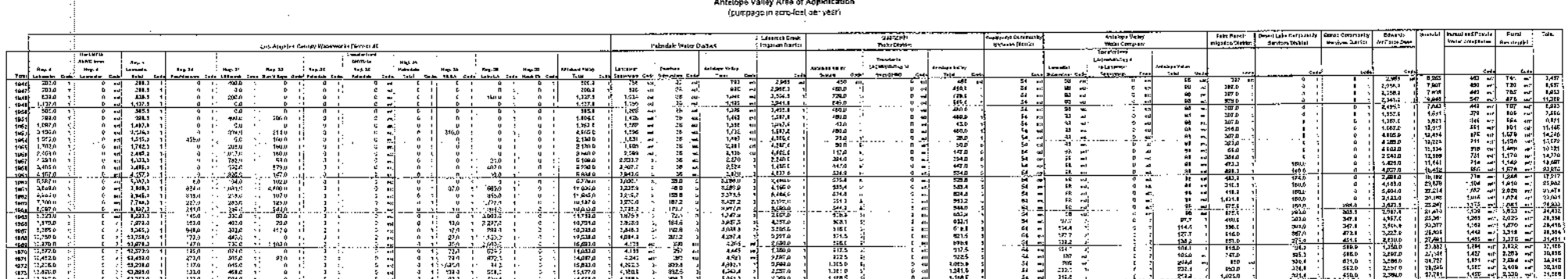
Approximated
1991 Ag Groundwater Pumpage and Total Ag Supply includes an additional 15,668 af pumped to export to the California Aqueduct
— designates unknown amount

M&I Groundwater Usage (Source: Problem Statement Appendix D-7 Table 3)

Year	LA WWD #40	Palmdale WD	Littlerock Creek ID	Quartz Hill WD	RCSD	AV Water Co	Palm Ranch ID	Desert Lake CSD	Boron CSD	EAFB	Mutual and Private WC (1)	Rural Resident	SUB TOTAL
1995	19,788	11,086	1,650	1,798	826	677	758	353	0	3,815	2,227	6,342	49,321
1996	19,339	9,508	1,790	2,306	2,027	747	1,147	353	0	3,735	2,518	7,041	50,511
1997	19,644	9,138	1,760	2,030	1,973	757	1,147	353	0	3,781	2,814	7,073	50,471
1998	17,589	8,062	1,520	1,231	1,541	655	1,147	353	0	2,732	2,500	6,341	43,670
1999	18,698	9,568	1,820	1,496	1,463	757	1,147	353	0	3,199	2,708	7,400	48,608
2000	17,419	9,625	1,810	1,419	1,461	827	1,147	353	0	3,712	3,341	7,709	48,822
2001	21,736	11,261	1,830	3,040	2,165	811	1,147	353	0	4,104	3,387	7,984	57,818
2002	21,196	8,261	1,950	2,801	2,359	787	1,536	353	0	3,090	3,246	8,021	53,599
2003	16,791	10,567	1,930	1,554	1,767	602	1,558	353	0	1,935	3,152	7,790	48,001
2004	21,281	10,990	2,230	1,347	1,989	595	814	353	0	3,015	3,522	8,245	54,380
2005	19,201	11,045	1,870	1,244	1,701	614	1,139	353	0	2,356	3,271	8,107	50,902
2006	12,277	11,320	2,150	1,386	2,212	534	591	353	0	1,985	2,901	8,251	43,960
2007													
2008													

(1) Does not reflect estimated 5,000 - 6,000 AF of additional pumping by Mutual Water Companies (John Ukkestad)

Appendix D-7: Table 3
Historical Groundwater Supply
Municipal and Industrial Users
Antelope Valley Area of Adjudication
(pumpage in acre-feet per year)



* AWWA estimated an historical total water requirement—historical AVEK surface water deliveries [Note] was derived as a historical total water requirement [no subtypes were defined].

Source Codes
1 water levels, GIS, etc. (pre-1990)
10 USGS, Lightner, Phelps, 2000
2 Lawsuit
3 DWR
4 Use
5 USBR
6 none
7 AVEK (AVEK or Geiba Gal)
8 Well
9 Exp
11 other

GW Usage Summary (AF)

	Problem Statement			U of C			
	M&I (1)	AG (1)	TOTAL	M&I (1)	AG (1)	TOTAL	Difference
Year							
1995	49,321	69,299	**118,620**	49,321	82,771	**132,091**	**13,471**
1996	50,511	74,570	**125,081**	50,511	89,880	**140,391**	**15,311**
1997	50,471	79,408	**129,879**	50,471	96,512	**146,983**	**17,104**
1998	43,670	92,535	**136,206**	43,670	110,675	**154,345**	**18,139**
1999	48,608	90,215	**138,824**	48,608	109,361	**157,969**	**19,145**
2000	48,822	106,748	**155,570**	48,822	128,997	**177,819**	**22,249**
2001	57,818	101,412	**159,230**	57,818	121,399	**179,217**	**19,987**
2002	53,599	120,699	**174,298**	53,599	143,139	**196,738**	**22,440**
2003	48,001	116,460	**164,461**	48,001	137,583	**185,584**	**21,124**
2004	54,380	111,876	**166,257**	54,380	132,526	**186,907**	**20,650**
2005	50,902	102,295	**153,197**	50,902	121,937	**172,839**	**19,642**
2006	43,960	89,484	**133,444**	43,960	107,710	**151,670**	**18,226**
2007							
2008							
High	**57,818**	**120,699**	**174,298**	**57,818**	**143,139**	**196,738**	**22,440**
Low	**43,670**	**69,299**	**118,620**	**43,670**	**82,771**	**132,091**	**13,471**
AVG	**50,005**	**96,250**	**146,255**	**50,005**	**115,208**	**165,213**	**18,957**

(1) Does not reflect estimated 5,000 - 6,000 AF of additional pumping by Mutual Water Companies (John Ukkestad)

			Total Applied Water Requirement (AF)													AVEK Surface Water Deliveries (AF)												
Parcel Group	Former Owner	Parcels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	Arcuri	83-87	309	309	309	309	309	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Bejulian	67	681	681	571	571	571	571	571	571	571	571	571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	eSolar	88-117	1,664	1,290	1,401	2,494	2,453	987	659	1,027	825	1,014	1,584	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Grimmway	0-24, 28-41,45	3,563	2,646	2,692	1,487	2,048	1,791	2,401	1,666	1,941	414	1,490	2,916	1,242	1,863	1,926	2,145	1,065	999	1,622	2,766	3,521	1,720	511	738	2,327	2,284
5	Harter	71-79	856	1,221	1,884	1,544	1,675	2,207	2,207	2,028	2,028	1,987	1,987	1,906	1,779	790	795	982	108	455	1.5	34.4	595.1	0.5	0	0	0.5	0
6	Robertson & Nikkel	25-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Sandhu	56	272	272	272	272	272	272	272	272	272	164	272	272	272	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Collins, Doyle, Wong	42-44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Bagnell, Faber	80-82	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Dennis	121	247	494	247	247	0	494	494	494	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Hemmerling	118,122,123,123A	1,339	1,584	797	792	0	547	547	1,089	542	542	542	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	O'Neil	124	275	275	275	275	0	275	275	275	275	275	275	275	275	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Reca	119	559	559	559	559	0	559	559	559	559	559	559	559	559	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Wilson	120	0	0	0	0	0	0	0	1,081	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Total	**9,767**	**9,333**	**9,007**	**8,550**	**7,329**	**7,704**	**7,987**	**9,065**	**7,015**	**5,527**	**7,282**	**5,930**	**4,129**	**2,653**	**2,721**	**3,127**	**1,173**	**1,454**	**1,624**	**2,800**	**4,116**	**1,721**	**511**	**738**	**2,327**	**2,284**

Land Use Data

Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	Crop 1 Applied Water (AF) 2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
				(Indicates change from data)																				
0	4	Kern	359-011-02	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	59	59	35	81	0	0	81	0	0	0	0	81	0	0	0
1	4	Kern	359-011-03	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	59	59	35	81	0	0	81	0	0	0	0	81	0	0	0
2	4	Kern	359-011-04	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	59	59	35	81	0	0	81	0	0	0	0	81	0	0	0
3	4	Kern	359-011-05	Carrot	Onion	Fallow	Fallow	Carrot	Fallow	82	82	36	0	82	0	82	82	93	0	0	82	0	0	0
4	4	Kern	359-011-06	Carrot	Onion	Fallow	Fallow	Carrot	Fallow	82	82	36	0	82	0	0	82	93	0	0	82	0	0	0
5	4	Kern	359-011-07	Carrot	Onion	Fallow	Fallow	Carrot	Fallow	82	82	36	0	82	0	0	82	93	0	0	82	0	0	0
6	4	Kern	359-011-08	Carrot	Fallow	Fallow	Fallow	Carrot	Fallow	78	78	34	44	78	0	0	78	0	0	0	78	0	0	0
7	4	Kern	359-011-09	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	34	34	79	0	0	0	0	0	0	0	0	0	0	0	0
8	4	Kern	359-011-10	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	36	36	83	0	0	0	0	0	0	0	0	0	0	0	0
9	4	Kern	359-011-11	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	36	36	83	0	0	61	83	0	0	0	0	0	0	0	0
10	4	Kern	359-011-12	Fallow	Fallow	Fallow	Fallow	Fallow	Carrot	36	36	83	0	0	94	83	0	0	0	0	0	83	0	0
11	4	Kern	359-011-13	Fallow	Fallow	Parsnip	Barley	Fallow	Carrot	84	36	61	84	0	95	84	0	0	84	71	0	84	0	0
12	4	Kern	359-011-14	Parsnip	Fallow	Fallow	Parsnip	Parsnip	Fallow	84	36	61	84	0	0	84	84	0	0	84	84	0	0	0
13	4	Kern	359-011-15	Parsnip	Fallow	Fallow	Barley	Fallow	Fallow	95	36	61	0	84	84	0	84	0	0	71	0	0	0	0
14	4	Kern	359-011-16	Fallow	Parsnip	Fallow	Barley	Fallow	Parsnip	91	35	58	0	0	80	0	0	80	0	68	0	80	0	0
15	4	Kern	359-011-17	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	58	58	34	79	0	0	0	0	0	0	0	0	0	0	0
16	4	Kern	359-011-18	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	61	61	36	83	0	0	0	0	0	0	0	0	0	0	0
17	4	Kern	359-011-19	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	61	61	36	83	0	0	0	0	0	0	0	0	0	0	0
18	4	Kern	359-011-20	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	61	61	36	83	0	0	0	0	0	0	0	0	0	0	0
19	4	Kern	359-011-21	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	79	34	34	0	90	0	79	58	0	0	0	79	0	0	0
20	4	Kern	359-011-22	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	83	36	36	0	94	0	83	60	0	0	0	83	0	0	0
21	4	Kern	359-011-23	Carrot	Fallow	Fallow	Fallow	Carrot	Fallow	42	36	36	0	83	0	0	83	0	0	0	83	0	47	0
22	4	Kern	359-011-24	Carrot	Fallow	Fallow	Fallow	Carrot	Fallow	94	36	36	0	83	0	0	83	0	0	0	83	0	0	0
23	4	Kern	359-011-27	Cultural	Cultural	Cultural	Cultural	Cultural	Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	4	Kern	359-020-50	Fallow	Onion	Fallow	Fallow	Barley	Carrot	332	242	377	0	332	166	0	499	754	0	532	564	665	377	145
25	6	Kern	359-041-05	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	6	Kern	359-041-07	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	6	Kern	359-041-08	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	4	Kern	359-174-01	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	0	0	36	83	0	0	83	0	0	83	0	0	0
29	4	Kern	359-174-02	Barley	Fallow	Carrot	Fallow	Fallow	Carrot	60	60	0	0	36	0	83	70	0	83	70	0	83	0	0
30	4	Kern	359-174-03	Barley	Fallow	Carrot	Fallow	Fallow	Carrot	60	60	0	0	36	0	83	70	0	83	70	0	83	0	0
31	4	Kern	359-174-04	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	0	0	36	83	94	0	83	0	0	83	0	0	0
32	4	Kern	359-174-05	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	83	0	36	83	94	0	83	0	0	83	0	0	0

Land Use Data

				(indicates change from data)						Crop 1 Applied Water (AF)															
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
33	4	Kern	359-174-06	Sudangrass	Fallow	Carrot	Fallow	Fallow	Carrot	60	60	36	83	36	0	83	70	0	83	70	0	83	0	0
34	4	Kern	359-174-07	Potato	Fallow	Carrot	Fallow	Fallow	Carrot	58	58	34	79	34	0	79	58	0	79	67	0	79	0	0
35	4	Kern	359-174-08	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	79	34	79	0	34	79	90	0	79	0	0	79	0	0	0
36	4	Kern	359-174-09	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	83	0	60	83	94	0	83	0	0	83	0	0	0
37	4	Kern	359-174-10	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	60	60	36	83	60	0	83	60	0	0	0	83	0	0	0
38	4	Kern	359-174-11	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	60	60	36	83	60	0	83	60	0	0	0	83	0	0	0
39	4	Kern	359-174-12	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	85	32	75	0	54	75	85	0	75	0	0	75	0	0.83	0.83
40	4	Kern	359-174-14	Cultural	Cultural	Cultural	Cultural	Cultural	Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	4	Kern	359-240-04	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	339	339	339	144	192	385	339	0	339	0	385	678	0	0	147
42	8	Kern	359-331-17	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	8	Kern	359-331-19	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	8	Kern	359-331-25	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	4	Kern	359-011-01	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	29	29	18	40	0	0	40	0	0	0	0	40	0	0.83	0.83
56	7	Kern	359-041-30	Alfalfa	Alfalfa	Carrot	Alfalfa	Alfalfa	Alfalfa	272	272	272	272	272	272	272	272	272	164	272	272	272	0	0
67	2	Kern	261-196-10	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	571	571	571	571	571	571	571	571	571	571	571	0	0	110	110
68	15	Kern	359-041-29	Fallow	Alfalfa	Carrot	Alfalfa	Alfalfa	Alfalfa	272	231	272	272	272	272	272	0	272	164	272	272	272	0	0
69	15	Kern	359-041-31	Alfalfa	Alfalfa	Carrot	Alfalfa	Alfalfa	Alfalfa	272	272	272	272	272	272	272	272	272	164	272	272	272	0	0
70	15	Kern	359-041-32	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	245	245	245	245	245	245	245	0	245	147	245	245	245	0.83	0.83
71	5	Kern	359-175-01	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Barley	403	323	323	73	242	537	537	537	537	537	537	537	274	0	0
72	5	Kern	359-175-02	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Barley	18	11	11	12	18	18	18	18	18	18	18	18	9	0	0
73	5	Kern	359-175-03	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Barley	18	11	11	12	18	18	18	18	18	18	18	18	9	0	0
74	5	Kern	359-175-04	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0	0
75	5	Kern	359-321-01	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	0	234	71	296	296	593	593	593	593	593	593	593	593	0	0
76	5	Kern	359-321-02	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	0	195	71	296	296	593	593	593	593	593	593	593	593	0	0
77	5	Kern	359-324-18	Carrot	Carrot	Barley	Barley	Alfalfa	Alfalfa	147	147	147	147	147	147	147	88	88	75	75	147	147	0	0
78	5	Kern	359-324-20	Carrot	Carrot	Barley	Barley	Fallow	Barley	150	150	150	150	150	150	150	90	90	77	77	0	77	0	0
79	5	Kern	359-324-21	Carrot	Carrot	Barley	Barley	Fallow	Barley	120	151	151	151	151	151	151	91	91	77	77	0	77	0	0
80	9	Kern	359-331-24	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0	0
81	9	Kern	359-331-26	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	9	Kern	359-331-27	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	1	Kern	359-041-15	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	158	158	158	158	158	0	0	0	0	0	0	0	0	0	0
84	1	Kern	359-041-24	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0
85	1	Kern	359-041-25	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0
86	1	Kern	359-041-26	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0

Land Use Data

				(indicates change from data)						Crop 1 Applied Water (AF)															
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
87	1	Kern	359-041-27	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	30	30	30	30	30	0	0	0	0	0	0	0	0	0.83	0.83
88	3	Kern	261-193-02	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	3	Kern	261-193-03	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	3	Kern	261-193-06	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	3	Kern	261-193-07	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	3	Kern	261-193-08	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	3	Kern	261-193-09	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	3	Kern	261-193-10	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	3	Kern	261-193-15	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
96	3	Kern	261-193-17	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
97	3	Kern	261-193-18	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
98	3	Kern	261-193-20	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0
99	3	Kern	261-193-22	Fallow	Fallow	Carrot	Carrot	Fallow	Fallow	0	0	0	41	0	0	0	0	0	83	83	0	0	0	0
100	3	Kern	261-193-23	Barley	Carrot	Fallow	Carrot	Fallow	Fallow	0	0	0	166	0	166	0	140	166	0	166	0	0	0	0
101	3	Kern	261-193-24	Fallow	Fallow	Barley	Barley	Fallow	Fallow	0	0	0	162	0	162	0	0	0	137	137	0	0	0	0
102	3	Kern	261-193-25	Fallow	Fallow	Carrot	Carrot	Fallow	Fallow	0	0	0	0	0	0	0	0	0	81	81	0	0	0	0
103	3	Kern	261-193-26	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	81	0	0	0	0	0
104	3	Kern	261-194-28	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	363	363	320	320	320	0	0	0	0	0	0	0	0	0	0
105	3	Kern	261-194-29	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	363	363	320	320	320	0	0	0	0	0	0	0	0	0	0
106	3	Kern	261-194-30	Carrot	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	162	0	0	162	0	0	0	0	0	0	0
107	3	Kern	261-194-36	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	95	95	84	84	84	0	0	0	0	0	0	0	0	0	0
108	3	Kern	261-194-37	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	95	95	84	84	84	0	0	0	0	0	0	0	0	0	0
109	3	Kern	261-194-38	Cultural	Cultural	Cultural	Cultural	Cultural	Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	3	Kern	261-194-39	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0	0
111	3	Kern	261-194-45	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	3	Kern	261-194-46	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	3	Kern	261-194-47	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	3	Kern	261-196-08	Fallow	Fallow	Fallow	Barley	Fallow	Fallow	747	374	593	1,317	1,317	659	659	558	659	558	1,117	0	0	0	0
115	3	Kern	261-193-05	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	3	Kern	261-193-19	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0
117	3	Kern	261-194-35	Carrot	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	166	0	0	166	0	0	0	0	0	0	0
118	11	LA	3258-001-038	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Fallow	Fallow	542	542	0	0	0	0	0	542	542	542	542	0	0	0	0

Land Use Data

				(* indicates change from data)						Crop 1 Applied Water (AF)														
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
119	13	LA	3258-001-040	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	559	559	559	559	0	559	559	559	559	559	559	559	559	0	0
120	14	LA	3261-001-004	Alfalfa	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	1,081	0	0	0	0	0	0	0
121	10	LA	3261-001-007	Alfalfa	Fallow	Fallow	Fallow	Fallow	Fallow	247	247	247	247	0	494	494	494	0	0	0	0	0	0	247
122	11	LA	3261-001-003	Alfalfa	Fallow	Fallow	Fallow	Fallow	Fallow	547	547	547	547	0	547	547	547	0	0	0	0	0	0	0
123	11	LA	3258-001-001	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	245	490	245	245	0	0	0	0	0	0	0	0	0	0	0
124	12	LA	3258-001-024	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	275	275	275	275	0	275	275	275	275	275	275	275	275	0	0
126	15	LA	3258-001-031	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	3,211	2,408	3,211	3,211	3,211	2,151	3,211	3,211	3,211	3,211	3,211	3,211	3,211	0	0
127	15	LA	3258-001-030	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	1,084	1,084	1,084	1,084	1,084	1,084	542	1,084	1,084	1,084	1,084	1,084	1,084	0	0
128	11	LA	3258-001-025	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)												
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	4	Kern	359-011-02	0	0	0	0	0	0	0	0	0	0	0	59	59	35	81	0	0	81	0	0	0	0	81	0
1	4	Kern	359-011-03	0	0	0	0	0	0	0	0	0	0	0	59	59	35	81	0	0	81	0	0	0	0	81	0
2	4	Kern	359-011-04	0	0	0	0	0	0	0	0	0	0	0	59	59	35	81	0	0	81	0	0	0	0	81	0
3	4	Kern	359-011-05	0	0	0	0	0	0	0	0	0	0	0	82	82	36	0	82	0	82	82	93	0	0	82	0
4	4	Kern	359-011-06	0	0	0	0	0	0	0	0	0	0	0	82	82	36	0	82	0	0	82	93	0	0	82	0
5	4	Kern	359-011-07	0	0	0	0	0	0	0	0	0	0	0	82	82	36	0	82	0	0	82	93	0	0	82	0
6	4	Kern	359-011-08	0	0	0	0	0	0	0	0	0	0	0	78	78	34	44	78	0	0	78	0	0	0	78	0
7	4	Kern	359-011-09	0	0	0	0	0	0	0	0	0	0	0	34	34	79	0	0	0	0	0	0	0	0	0	0
8	4	Kern	359-011-10	0	0	0	0	0	0	0	0	0	0	0	36	36	83	0	0	0	0	0	0	0	0	0	0
9	4	Kern	359-011-11	0	0	0	0	0	0	0	0	0	0	0	36	36	83	0	0	61	83	0	0	0	0	0	0
10	4	Kern	359-011-12	0	0	0	0	0	0	0	0	0	0	0	36	36	83	0	0	94	83	0	0	0	0	0	83
11	4	Kern	359-011-13	0	0	0	0	0	0	0	0	0	0	0	84	36	61	84	0	95	84	0	0	84	71	0	84
12	4	Kern	359-011-14	0	0	0	0	0	0	0	0	0	0	0	84	36	61	84	0	0	84	84	0	0	84	84	0
13	4	Kern	359-011-15	0	0	0	0	0	0	0	0	0	0	0	95	36	61	0	84	84	0	84	0	0	71	0	0
14	4	Kern	359-011-16	0	0	0	0	0	0	0	0	0	0	0	91	35	58	0	0	80	0	0	80	0	68	0	80
15	4	Kern	359-011-17	0	0	0	0	0	0	0	0	0	0	0	58	58	34	79	0	0	0	0	0	0	0	0	0
16	4	Kern	359-011-18	0	0	0	0	0	0	0	0	0	0	0	61	61	36	83	0	0	0	0	0	0	0	0	0
17	4	Kern	359-011-19	0	0	0	0	0	0	0	0	0	0	0	61	61	36	83	0	0	0	0	0	0	0	0	0
18	4	Kern	359-011-20	0	0	0	0	0	0	0	0	0	0	0	61	61	36	83	0	0	0	0	0	0	0	0	0
19	4	Kern	359-011-21	0	0	0	0	0	0	0	0	0	0	0	79	34	34	0	90	0	79	58	0	0	0	79	0
20	4	Kern	359-011-22	0	0	0	0	0	0	0	0	0	0	0	83	36	36	0	94	0	83	60	0	0	0	83	0
21	4	Kern	359-011-23	0	0	0	0	0	0	0	0	0	0	0	89	36	36	0	83	0	0	83	0	0	0	83	0
22	4	Kern	359-011-24	0	0	0	0	0	0	0	0	0	0	0	94	36	36	0	83	0	0	83	0	0	0	83	0
23	4	Kern	359-011-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	4	Kern	359-020-50	145	189	242	0	0	0	0	0	0	0	0	710	387	522	189	575	166	0	499	754	0	532	564	665
25	6	Kern	359-041-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	6	Kern	359-041-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	6	Kern	359-041-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	4	Kern	359-174-01	0	0	0	0	0	0	0	0	0	0	0	94	36	0	0	36	83	0	0	83	0	0	83	0
29	4	Kern	359-174-02	0	0	0	0	0	0	0	0	0	0	0	60	60	0	0	36	0	83	70	0	83	70	0	83
30	4	Kern	359-174-03	0	0	0	0	0	0	0	0	0	0	0	60	60	0	0	36	0	83	70	0	83	70	0	83
31	4	Kern	359-174-04	0	0	0	0	0	0	0	0	0	0	0	94	36	0	0	36	83	94	0	83	0	0	83	0
32	4	Kern	359-174-05	0	0	0	0	0	0	0	0	0	0	0	94	36	83	0	36	83	94	0	83	0	0	83	0

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Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)											
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
33	4	Kern	359-174-06	0	0	0	0	0	0	0	0	0	0	0	60	60	36	83	36	0	83	70	0	83	70	0	83
34	4	Kern	359-174-07	0	0	0	0	0	0	0	0	0	0	0	58	58	34	79	34	0	79	58	0	79	67	0	79
35	4	Kern	359-174-08	0	0	0	0	0	0	0	0	0	0	0	79	34	79	0	34	79	90	0	79	0	0	79	0
36	4	Kern	359-174-09	0	0	0	0	0	0	0	0	0	0	0	94	36	83	0	60	83	94	0	83	0	0	83	0
37	4	Kern	359-174-10	0	0	0	0	0	0	0	0	0	0	0	60	60	36	83	60	0	83	60	0	0	0	83	0
38	4	Kern	359-174-11	0	0	0	0	0	0	0	0	0	0	0	60	60	36	83	60	0	83	60	0	0	0	83	0
39	4	Kern	359-174-12	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	86	33	76	1	55	76	86	1	76	1	1	76	1
40	4	Kern	359-174-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	4	Kern	359-240-04	247	0	0	339	247	0	0	0	0	0	0	339	486	586	144	192	723	586	0	339	0	385	678	0
42	8	Kern	359-331-17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	8	Kern	359-331-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	8	Kern	359-331-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	4	Kern	359-011-01	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	30	30	18	41	1	1	41	1	1	1	1	41	1
56	7	Kern	359-041-30	0	0	0	0	0	0	0	0	0	0	0	272	272	272	272	272	272	272	272	272	164	272	272	272
67	2	Kern	261-196-10	0	0	0	0	0	0	0	0	0	0	0	681	681	571	571	571	571	571	571	571	571	571	0	0
68	15	Kern	359-041-29	0	0	0	0	0	0	0	0	0	0	0	272	281	272	272	272	272	272	0	272	164	272	272	272
69	15	Kern	359-041-31	0	0	0	0	0	0	0	0	0	0	0	272	272	272	272	272	272	272	272	272	164	272	272	272
70	15	Kern	359-041-32	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	246	246	246	246	246	246	246	1	246	148	246	246	246
71	5	Kern	359-175-01	0	0	0	0	0	0	0	0	0	0	0	403	323	323	73	242	537	537	537	537	537	537	537	274
72	5	Kern	359-175-02	0	0	0	0	0	0	0	0	0	0	0	18	11	11	12	18	18	18	18	18	18	18	18	9
73	5	Kern	359-175-03	0	0	0	0	0	0	0	0	0	0	0	18	11	11	12	18	18	18	18	18	18	18	18	9
74	5	Kern	359-175-04	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
75	5	Kern	359-321-01	474	202	178	0	0	0	0	0	0	0	0	0	234	546	499	475	593	593	593	593	593	593	593	593
76	5	Kern	359-321-02	474	202	178	0	0	0	0	0	0	0	0	0	195	546	499	475	593	593	593	593	593	593	593	593
77	5	Kern	359-324-18	0	0	0	0	0	0	0	0	0	0	0	147	147	147	147	147	147	147	88	88	75	75	147	147
78	5	Kern	359-324-20	0	0	0	0	0	0	0	0	0	0	0	150	150	150	150	150	150	150	90	90	77	77	0	77
79	5	Kern	359-324-21	0	0	0	0	0	0	0	0	0	0	0	120	151	151	151	151	151	151	91	91	77	77	0	77
80	9	Kern	359-331-24	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
81	9	Kern	359-331-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	9	Kern	359-331-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	1	Kern	359-041-15	0	0	0	0	0	0	0	0	0	0	0	158	158	158	158	158	0	0	0	0	0	0	0	0
84	1	Kern	359-041-24	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	0	0	0	0	0	0	0	0
85	1	Kern	359-041-25	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	0	0	0	0	0	0	0	0
86	1	Kern	359-041-26	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	0	0	0	0	0	0	0	0

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Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)											
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
87	1	Kern	359-041-27	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	31	31	31	31	31	1	1	1	1	1	1	1	1
88	3	Kern	261-193-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	3	Kern	261-193-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	3	Kern	261-193-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	3	Kern	261-193-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	3	Kern	261-193-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	3	Kern	261-193-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	3	Kern	261-193-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	3	Kern	261-193-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
96	3	Kern	261-193-17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
97	3	Kern	261-193-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
98	3	Kern	261-193-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0
99	3	Kern	261-193-22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	0	0	0	0	83	83	0	0
100	3	Kern	261-193-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166	0	166	0	140	166	0	166	0	0
101	3	Kern	261-193-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	0	162	0	0	0	137	137	0	0
102	3	Kern	261-193-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	81	0	0
103	3	Kern	261-193-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	0	0	0
104	3	Kern	261-194-28	0	0	0	0	0	0	0	0	0	0	0	363	363	320	320	320	0	0	0	0	0	0	0	0
105	3	Kern	261-194-29	0	0	0	0	0	0	0	0	0	0	0	363	363	320	320	320	0	0	0	0	0	0	0	0
106	3	Kern	261-194-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	0	0	162	0	0	0	0	0
107	3	Kern	261-194-36	0	0	0	0	0	0	0	0	0	0	0	95	95	84	84	84	0	0	0	0	0	0	0	0
108	3	Kern	261-194-37	0	0	0	0	0	0	0	0	0	0	0	95	95	84	84	84	0	0	0	0	0	0	0	0
109	3	Kern	261-194-38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	3	Kern	261-194-39	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
111	3	Kern	261-194-45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	3	Kern	261-194-46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	3	Kern	261-194-47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	3	Kern	261-196-08	0	0	0	0	0	0	0	0	0	0	0	747	374	593	1,317	1,317	659	659	558	659	558	1,117	0	0
115	3	Kern	261-193-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	3	Kern	261-193-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0
117	3	Kern	261-194-35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166	0	0	166	0	0	0	0	0
118	11	LA	3258-001-038	0	0	0	0	0	0	0	0	0	0	0	542	542	0	0	0	0	0	542	542	542	542	0	0

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Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)											
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
119	13	LA	3258-001-040	0	0	0	0	0	0	0	0	0	0	0	559	559	559	559	0	559	559	559	559	559	559	559	559
120	14	LA	3261-001-004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,081	0	0	0	0	0
121	10	LA	3261-001-002	0	0	0	0	0	0	0	0	0	0	0	247	494	247	247	0	494	494	494	0	0	0	0	0
122	11	LA	3261-001-003	0	0	0	0	0	0	0	0	0	0	0	547	547	547	547	0	547	547	547	0	0	0	0	0
123	11	LA	3258-001-001	0	0	0	0	0	0	0	0	0	0	0	245	490	245	245	0	0	0	0	0	0	0	0	0
124	12	LA	3258-001-024	0	0	0	0	0	0	0	0	0	0	0	275	275	275	275	0	275	275	275	275	275	275	275	275
126	15	LA	3258-001-031	0	0	0	0	0	0	0	0	0	0	0	3,211	2,408	3,211	3,211	3,211	2,151	3,211	3,211	3,211	3,211	3,211	3,211	3,211
127	15	LA	3258-001-030	0	0	0	0	0	0	0	0	0	0	0	1,084	1,084	1,084	1,084	1,084	1,084	542	1,084	1,084	1,084	1,084	1,084	1,084
128	11	LA	3258-001-025	0	0	0	0	0	0	0	0	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0	0

Crop	AW (AF/yr)	Source
Alfalfa	7.65	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Barley	3.9	Irrigation Technology Reasearch Center, Fresno State (2008) indicates same as sudangrass
Carrot	4.6	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Cultural	0	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Domestic	0.83	Palmdale single family home water usage (2005)
Fallow	0	
Garlic	5.22	Irrigation Technology Reasearch Center, Fresno State (2008) indicates same as Onion
Oat	2.0	Actual reported AW requirement on that farm by Grimmway (9/28/12) due t Aug-Nov growing season
Onion	5.22	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Parsnip	4.6	Assumed to be equal to carrot
Pasture	7.45	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Peach	5.36	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Potato	3.35	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Rye	2.0	Actual reported AW requirement on that farm by Grimmway (9/28/12) due t Aug-Nov growing season
Sugar beet	4.96	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Sudangrass	3.9	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Watermelon	3.11	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Wheat	2.0	Actual reported AW requirement on that farm by Grimmway (9/28/12) due t Aug-Nov growing season

APN's 261-193-22; 261-193-23

	Used in Adjudication		Actual Precip at Rosamond, CA				
Month	Assumed Total Precip (in)	Assumed Effective Precip (in)	2000 (in)	2001 (in)	2002 (in)	2003 (in)	2004 (in)
J	1.05	0.53	0.05	1.18	0.2	0.01	0.01
F	1.95	0.98	0.8	3.74	0.06	3.55	1.86
M	0.8	0	0.96	0.66	0.3	0.72	0.24
A	0.48	0	0.1	0.58	0	0.96	0.05
M	0.12	0	0	0	0.02	0.27	0
J	0.05	0	0	0	0	0	0
J	0.12	0	0.01	0.02	0	0.11	0
A	0.04	0	0	0	0	0	0
S	0.16	0	0	0	0.01	0	0
O	0.16	0	0.01	0.24	0.01	0.23	1.93
N	0.37	0	0	0.6	0.66	0.32	0.16
D	0.54	0.27	0	0.64	1.04	0.22	3.63
Total	**5.84**		**1.93**	**7.66**	**2.3**	**6.39**	**7.88**
% above normal			-67%	31%	-61%	9%	35%

Land Use Data

Map ID	Parcel Group	County	Parcel #	PERCENT OF TOTAL WELL PUMPAGE FOR GROUP													AMOUNT OF GROUNDWATER APPLI							
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
0	4	Kern	359-011-02	2%	2%	1%	5%	0%	0%	3%	0%	0%	0%	0%	3%	0%	28	16	9	25	0	0	27	0
1	4	Kern	359-011-03	2%	2%	1%	5%	0%	0%	3%	0%	0%	0%	0%	3%	0%	28	16	9	25	0	0	27	0
2	4	Kern	359-011-04	2%	2%	1%	5%	0%	0%	3%	0%	0%	0%	0%	3%	0%	28	16	9	25	0	0	27	0
3	4	Kern	359-011-05	2%	3%	1%	0%	4%	0%	3%	5%	5%	0%	0%	3%	0%	39	22	9	0	41	0	27	19
4	4	Kern	359-011-06	2%	3%	1%	0%	4%	0%	0%	5%	5%	0%	0%	3%	0%	39	22	9	0	41	0	0	19
5	4	Kern	359-011-07	2%	3%	1%	0%	4%	0%	0%	5%	5%	0%	0%	3%	0%	39	22	9	0	41	0	0	19
6	4	Kern	359-011-08	2%	3%	1%	3%	4%	0%	0%	5%	0%	0%	0%	3%	0%	37	21	8	14	39	0	0	18
7	4	Kern	359-011-09	1%	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	16	9	19	0	0	0	0	0
8	4	Kern	359-011-10	1%	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17	10	20	0	0	0	0	0
9	4	Kern	359-011-11	1%	1%	3%	0%	0%	3%	3%	0%	0%	0%	0%	0%	0%	17	10	20	0	0	31	27	0
10	4	Kern	359-011-12	1%	1%	3%	0%	0%	5%	3%	0%	0%	0%	0%	0%	7%	17	10	20	0	0	49	27	0
11	4	Kern	359-011-13	2%	1%	2%	6%	0%	5%	3%	0%	0%	20%	5%	0%	7%	40	10	15	26	0	49	28	0
12	4	Kern	359-011-14	2%	1%	2%	6%	0%	0%	3%	5%	0%	0%	6%	3%	0%	40	10	15	26	0	0	28	19
13	4	Kern	359-011-15	3%	1%	2%	0%	4%	5%	0%	5%	0%	0%	5%	0%	0%	45	10	15	0	42	43	0	19
14	4	Kern	359-011-16	3%	1%	2%	0%	0%	4%	0%	0%	4%	0%	5%	0%	6%	43	9	14	0	0	41	0	0
15	4	Kern	359-011-17	2%	2%	1%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	28	16	8	24	0	0	0	0
16	4	Kern	359-011-18	2%	2%	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	29	16	9	26	0	0	0	0
17	4	Kern	359-011-19	2%	2%	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	29	16	9	26	0	0	0	0
18	4	Kern	359-011-20	2%	2%	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	29	16	9	26	0	0	0	0
19	4	Kern	359-011-21	2%	1%	1%	0%	4%	0%	3%	3%	0%	0%	0%	3%	0%	38	9	8	0	45	0	26	13
20	4	Kern	359-011-22	2%	1%	1%	0%	5%	0%	3%	4%	0%	0%	0%	3%	0%	40	10	9	0	47	0	27	14
21	4	Kern	359-011-23	2%	1%	1%	0%	4%	0%	0%	5%	0%	0%	0%	3%	0%	42	10	9	0	42	0	0	19
22	4	Kern	359-011-24	3%	1%	1%	0%	4%	0%	0%	5%	0%	0%	0%	3%	0%	45	10	9	0	42	0	0	19
23	4	Kern	359-011-27	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
24	4	Kern	359-020-50	20%	15%	19%	13%	28%	9%	0%	30%	39%	0%	36%	19%	54%	339	105	126	58	288	85	0	114
25	6	Kern	359-041-05	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
26	6	Kern	359-041-07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
27	6	Kern	359-041-08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
28	4	Kern	359-174-01	3%	1%	0%	0%	2%	5%	0%	0%	4%	0%	0%	3%	0%	45	10	0	0	18	43	0	0
29	4	Kern	359-174-02	2%	2%	0%	0%	2%	0%	3%	4%	0%	20%	5%	0%	7%	29	16	0	0	18	0	27	16
30	4	Kern	359-174-03	2%	2%	0%	0%	2%	0%	3%	4%	0%	20%	5%	0%	7%	29	16	0	0	18	0	27	16
31	4	Kern	359-174-04	3%	1%	0%	0%	2%	5%	4%	0%	4%	0%	0%	3%	0%	45	10	0	0	18	43	31	0
32	4	Kern	359-174-05	3%	1%	3%	0%	2%	5%	4%	0%	4%	0%	0%	3%	0%	45	10	20	0	18	43	31	0

Land Use Data

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				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
33	4	Kern	359-174-06	2%	2%	1%	6%	2%	0%	3%	4%	0%	20%	5%	0%	7%	29	16	9	25	18	0	27	16
34	4	Kern	359-174-07	2%	2%	1%	5%	2%	0%	3%	3%	0%	19%	5%	0%	6%	28	16	8	24	17	0	26	13
35	4	Kern	359-174-08	2%	1%	3%	0%	2%	4%	4%	0%	4%	0%	0%	3%	0%	38	9	19	0	17	41	30	0
36	4	Kern	359-174-09	3%	1%	3%	0%	3%	5%	4%	0%	4%	0%	0%	3%	0%	45	10	20	0	30	43	31	0
37	4	Kern	359-174-10	2%	2%	1%	6%	3%	0%	3%	4%	0%	0%	0%	3%	0%	29	16	9	25	30	0	27	14
38	4	Kern	359-174-11	2%	2%	1%	6%	3%	0%	3%	4%	0%	0%	0%	3%	0%	29	16	9	25	30	0	27	14
39	4	Kern	359-174-12	2%	1%	3%	0%	3%	4%	4%	0%	4%	0%	0%	3%	0%	41	9	18	0	28	39	28	0
40	4	Kern	359-174-14	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
41	4	Kern	359-240-04	10%	18%	22%	10%	9%	40%	24%	0%	17%	0%	26%	23%	0%	162	132	141	44	96	372	193	0
42	8	Kern	359-331-17	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
43	8	Kern	359-331-19	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
44	8	Kern	359-331-25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
45	4	Kern	359-011-01	1%	1%	1%	3%	0%	0%	2%	0%	0%	0%	0%	1%	0%	14	8	4	13	0	0	14	0
56	7	Kern	359-041-30	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	272	272	272	272	272	272	272	272
67	2	Kern	261-196-10	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	#DIV/0!	#DIV/0!	681	681	571	571	571	571	571	571
68	15	Kern	359-041-29	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	0
69	15	Kern	359-041-31	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	25%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	272
70	15	Kern	359-041-32	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	1
71	5	Kern	359-175-01	47%	26%	17%	5%	14%	24%	24%	26%	26%	27%	27%	28%	15%	10	118	171	53	177	254	254	266
72	5	Kern	359-175-02	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0	4	6	9	13	8	8	9
73	5	Kern	359-175-03	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0	4	6	9	13	8	8	9
74	5	Kern	359-175-04	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	1	1	0	0	0
75	5	Kern	359-321-01	0%	19%	29%	32%	28%	27%	27%	29%	29%	30%	30%	31%	33%	0	85	289	361	348	281	281	293
76	5	Kern	359-321-02	0%	16%	29%	32%	28%	27%	27%	29%	29%	30%	30%	31%	33%	0	71	289	361	348	281	281	293
77	5	Kern	359-324-18	17%	12%	8%	10%	9%	7%	7%	4%	4%	4%	4%	8%	8%	3	54	78	106	108	70	70	44
78	5	Kern	359-324-20	18%	12%	8%	10%	9%	7%	7%	4%	4%	4%	4%	0%	4%	4	55	80	109	110	71	71	45
79	5	Kern	359-324-21	14%	12%	8%	10%	9%	7%	7%	4%	4%	4%	4%	0%	4%	3	55	80	109	110	71	71	45
80	9	Kern	359-331-24	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	1	1	1	1	1	1	1	1
81	9	Kern	359-331-26	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
82	9	Kern	359-331-27	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
83	1	Kern	359-041-15	51%	51%	51%	51%	51%	0%	0%	0%	0%	0%	0%	0%	0%	158	158	158	158	158	0	0	0
84	1	Kern	359-041-24	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	40	40	40	40	40	0	0	0
85	1	Kern	359-041-25	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	40	40	40	40	40	0	0	0
86	1	Kern	359-041-26	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	40	40	40	40	40	0	0	0

Land Use Data

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				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
87	1	Kern	359-041-27	10%	10%	10%	10%	10%	100%	100%	100%	100%	100%	100%	100%	100%	31	31	31	31	31	1	1	1
88	3	Kern	261-193-02	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
89	3	Kern	261-193-03	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
90	3	Kern	261-193-06	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
91	3	Kern	261-193-07	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
92	3	Kern	261-193-08	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
93	3	Kern	261-193-09	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
94	3	Kern	261-193-10	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
95	3	Kern	261-193-15	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0	0	0	0	0	0	0	0
96	3	Kern	261-193-17	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0	0	0	0	0	0	0	0
97	3	Kern	261-193-18	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0	0	0	0	0	0	0	0
98	3	Kern	261-193-20	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0	0	0	0	0	0	0	0
99	3	Kern	261-193-22	0%	0%	0%	2%	0%	0%	0%	0%	0%	8%	5%	0%	0%	0	0	0	41	0	0	0	0
100	3	Kern	261-193-23	0%	0%	0%	7%	0%	17%	0%	14%	20%	0%	10%	0%	0%	0	0	0	166	0	206	0	183
101	3	Kern	261-193-24	0%	0%	0%	6%	0%	16%	0%	0%	0%	14%	9%	0%	0%	0	0	0	162	0	201	0	0
102	3	Kern	261-193-25	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%	5%	0%	0%	0	0	0	0	0	0	0	0
103	3	Kern	261-193-26	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0	0	0	0	0	0	0	0
104	3	Kern	261-194-28	22%	28%	23%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	363	363	320	320	320	0	0	0
105	3	Kern	261-194-29	22%	28%	23%	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	363	363	320	320	320	0	0	0
106	3	Kern	261-194-30	0%	0%	0%	0%	7%	0%	0%	16%	0%	0%	0%	0%	0%	0	0	0	0	162	0	0	211
107	3	Kern	261-194-36	6%	7%	6%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	95	95	84	84	84	0	0	0
108	3	Kern	261-194-37	6%	7%	6%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	95	95	84	84	84	0	0	0
109	3	Kern	261-194-38	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
110	3	Kern	261-194-39	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	100%	1	1	1	1	1	1	2	1
111	3	Kern	261-194-45	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
112	3	Kern	261-194-46	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
113	3	Kern	261-194-47	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
114	3	Kern	261-196-08	45%	29%	42%	53%	54%	67%	100%	54%	80%	55%	70%	0%	0%	747	374	593	1,317	1,317	820	1,754	728
115	3	Kern	261-193-05	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0	0	0
116	3	Kern	261-193-19	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0	0	0	0	0	0	0	0
117	3	Kern	261-194-35	0%	0%	0%	0%	7%	0%	0%	16%	0%	0%	0%	0%	0%	0	0	0	0	166	0	0	216
118	11	LA	3258-001-038	40%	34%	0%	0%	#DIV/0!	0%	0%	50%	100%	100%	100%	#DIV/0!	#DIV/0!	542	542	0	0	0	0	0	542

Land Use Data

Map ID	Parcel Group	County	Parcel #	PERCENT OF TOTAL WELL PUMPAGE FOR GROUP													AMOUNT OF GROUNDWATER APPLI							
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007
119	13	LA	3258-001-040	100%	100%	100%	100%	#DIV/0!	100%	100%	100%	100%	100%	100%	100%	100%	559	559	559	559	0	559	559	559
120	14	LA	3261-001-004	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	1,081
121	10	LA	3261-001-002	100%	100%	100%	100%	#DIV/0!	100%	100%	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	247	494	247	247	0	494	494	494
122	11	LA	3261-001-003	41%	35%	69%	69%	#DIV/0!	100%	100%	50%	0%	0%	0%	#DIV/0!	#DIV/0!	547	547	547	547	0	547	547	547
123	11	LA	3258-001-001	18%	31%	31%	31%	#DIV/0!	0%	0%	0%	0%	0%	0%	#DIV/0!	#DIV/0!	245	490	245	245	0	0	0	0
124	12	LA	3258-001-024	100%	100%	100%	100%	#DIV/0!	100%	100%	100%	100%	100%	100%	100%	100%	275	275	275	275	0	275	275	275
126	15	LA	3258-001-031	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	297%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	3,211
127	15	LA	3258-001-030	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	0	0	0	0	1,084
128	11	LA	3258-001-025	0%	0%	1%	0%	#DIV/0!	0%	0%	0%	0%	0%	0%	#DIV/0!	#DIV/0!	5	5	5	0	0	0	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
0	4	Kern	359-011-02	0	0	0	20	0
1	4	Kern	359-011-03	0	0	0	20	0
2	4	Kern	359-011-04	0	0	0	20	0
3	4	Kern	359-011-05	28	0	0	20	0
4	4	Kern	359-011-06	28	0	0	20	0
5	4	Kern	359-011-07	28	0	0	20	0
6	4	Kern	359-011-08	0	0	0	19	0
7	4	Kern	359-011-09	0	0	0	0	0
8	4	Kern	359-011-10	0	0	0	0	0
9	4	Kern	359-011-11	0	0	0	0	0
10	4	Kern	359-011-12	0	0	0	0	33
11	4	Kern	359-011-13	0	151	47	0	33
12	4	Kern	359-011-14	0	0	55	20	0
13	4	Kern	359-011-15	0	0	47	0	0
14	4	Kern	359-011-16	24	0	45	0	32
15	4	Kern	359-011-17	0	0	0	0	0
16	4	Kern	359-011-18	0	0	0	0	0
17	4	Kern	359-011-19	0	0	0	0	0
18	4	Kern	359-011-20	0	0	0	0	0
19	4	Kern	359-011-21	0	0	0	19	0
20	4	Kern	359-011-22	0	0	0	20	0
21	4	Kern	359-011-23	0	0	0	20	0
22	4	Kern	359-011-24	0	0	0	20	0
23	4	Kern	359-011-27	0	0	0	0	0
24	4	Kern	359-020-50	228	0	352	137	266
25	6	Kern	359-041-05	0	0	0	0	0
26	6	Kern	359-041-07	0	0	0	0	0
27	6	Kern	359-041-08	0	0	0	0	0
28	4	Kern	359-174-01	25	0	0	20	0
29	4	Kern	359-174-02	0	150	47	0	33
30	4	Kern	359-174-03	0	150	47	0	33
31	4	Kern	359-174-04	25	0	0	20	0
32	4	Kern	359-174-05	25	0	0	20	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
33	4	Kern	359-174-06	0	150	47	0	33
34	4	Kern	359-174-07	0	143	44	0	32
35	4	Kern	359-174-08	24	0	0	19	0
36	4	Kern	359-174-09	25	0	0	20	0
37	4	Kern	359-174-10	0	0	0	20	0
38	4	Kern	359-174-11	0	0	0	20	0
39	4	Kern	359-174-12	23	1	1	18	0
40	4	Kern	359-174-14	0	0	0	0	0
41	4	Kern	359-240-04	102	0	254	165	0
42	8	Kern	359-331-17	0	0	0	0	0
43	8	Kern	359-331-19	0	0	0	0	0
44	8	Kern	359-331-25	0	0	0	0	0
45	4	Kern	359-011-01	0	1	1	10	0
56	7	Kern	359-041-30	272	164	272	272	272
67	2	Kern	261-196-10	571	571	571	0	0
68	15	Kern	359-041-29	0	0	0	0	0
69	15	Kern	359-041-31	0	0	0	0	0
70	15	Kern	359-041-32	0	0	0	0	0
71	5	Kern	359-175-01	300	423	351	355	274
72	5	Kern	359-175-02	10	14	12	12	9
73	5	Kern	359-175-03	10	14	12	12	9
74	5	Kern	359-175-04	0	1	1	1	1
75	5	Kern	359-321-01	331	468	388	392	593
76	5	Kern	359-321-02	331	468	388	392	593
77	5	Kern	359-324-18	49	59	49	97	147
78	5	Kern	359-324-20	51	61	50	0	77
79	5	Kern	359-324-21	51	61	50	0	77
80	9	Kern	359-331-24	1	1	1	1	1
81	9	Kern	359-331-26	0	0	0	0	0
82	9	Kern	359-331-27	0	0	0	0	0
83	1	Kern	359-041-15	0	0	0	0	0
84	1	Kern	359-041-24	0	0	0	0	0
85	1	Kern	359-041-25	0	0	0	0	0
86	1	Kern	359-041-26	0	0	0	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
87	1	Kern	359-041-27	1	1	1	1	1
88	3	Kern	261-193-02	0	0	0	0	0
89	3	Kern	261-193-03	0	0	0	0	0
90	3	Kern	261-193-06	0	0	0	0	0
91	3	Kern	261-193-07	0	0	0	0	0
92	3	Kern	261-193-08	0	0	0	0	0
93	3	Kern	261-193-09	0	0	0	0	0
94	3	Kern	261-193-10	0	0	0	0	0
95	3	Kern	261-193-15	0	28	0	0	0
96	3	Kern	261-193-17	0	28	0	0	0
97	3	Kern	261-193-18	0	28	0	0	0
98	3	Kern	261-193-20	0	56	0	0	0
99	3	Kern	261-193-22	0	225	83	0	0
100	3	Kern	261-193-23	504	0	166	0	0
101	3	Kern	261-193-24	0	372	137	0	0
102	3	Kern	261-193-25	0	220	81	0	0
103	3	Kern	261-193-26	0	220	0	0	0
104	3	Kern	261-194-28	0	0	0	0	0
105	3	Kern	261-194-29	0	0	0	0	0
106	3	Kern	261-194-30	0	0	0	0	0
107	3	Kern	261-194-36	0	0	0	0	0
108	3	Kern	261-194-37	0	0	0	0	0
109	3	Kern	261-194-38	0	0	0	0	0
110	3	Kern	261-194-39	3	2	1	1	1
111	3	Kern	261-194-45	0	0	0	0	0
112	3	Kern	261-194-46	0	0	0	0	0
113	3	Kern	261-194-47	0	0	0	0	0
114	3	Kern	261-196-08	2,006	1,516	1,117	0	0
115	3	Kern	261-193-05	0	0	0	0	0
116	3	Kern	261-193-19	0	56	0	0	0
117	3	Kern	261-194-35	0	0	0	0	0
118	11	LA	3258-001-038	542	542	542	0	0

Land Use Data

Map ID	Parcel Group	County	Parcel #	ED (AF) 2008	2009	2010	2011	2012
119	13	LA	3258-001-040	559	559	559	559	559
120	14	LA	3261-001-004	0	0	0	0	0
121	10	LA	3261-001-002	0	0	0	0	0
122	11	LA	3261-001-003	0	0	0	0	0
123	11	LA	3258-001-001	0	0	0	0	0
124	12	LA	3258-001-024	275	275	275	275	275
126	15	LA	3258-001-031	0	0	0	0	0
127	15	LA	3258-001-030	0	0	0	0	0
128	11	LA	3258-001-025	0	0	0	0	0

April 21, 2008

CMF Land Development
9750 Hayvenhurst Avenue
Northridge, CA 91343

Lab ID : SP 0804068
Customer : 2-22643

Laboratory Report

Introduction: This report package contains total of 7 pages divided into 3 sections:

Case Narrative	(2 Pages)	: An overview of the work performed at FGL.
Sample Results	(2 pages)	: Results for each sample submitted.
Quality Control	(3 pages)	: Supporting Quality Control (QC) results.

Case Narrative

This Case Narrative pertains to the following samples:

Sample Description	Date Sampled	Date Received	FGL Lab ID #	Matrix
210th Ave West Ave C	04/15/2008	04/15/2008	SP 0804068-001	PW
180th St West & Gaskell Rd	04/15/2008	04/15/2008	SP 0804068-002	PW

Sampling and Receipt Information: All samples were performed by FGL using the following methods (where applicable):

Bacteriological Sampling	- SOP:S0FS005
Grab sampling for liquids	- SOP:S0FS010
Composite sampling for liquids	- SOP:S0FS015
Grab sampling for solids	- SOP:S0FS020
Composite sampling for solids	- SOP:S0FS025

All samples were received, prepared and analyzed within the method specified holding times. All samples arrived on ice. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

Quality Control: All samples were prepared and analyzed according to the following tables:

Inorganic - Metals QC

200.7	04/16/2008:203966 All analysis quality controls are within established criteria.
	04/16/2008:203656 All preparation quality controls are within established criteria.

April 21, 2008

Lab ID : SP 0804068-001
Customer ID : 2-22643

CMF Land Development
9750 Hayvenhurst Avenue
Northridge, CA 91343

Sampled On : April 15, 2008-10:40
Sampled By : Tom Mobley
Received On : April 15, 2008-15:45
Matrix : Potable Water

Description : 210th Ave West Ave C
Project : Water Monitoring

Sample Results - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral P,TS								
Total Hardness	98	2.5	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Calcium	31	1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Magnesium	5	1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Potassium	1	1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Sodium	31	1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Total Cations	3.3	0.1	meq/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Boron	ND	0.1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Copper	ND	10	ug/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Iron	80	50	ug/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Manganese	ND	10	ug/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Zinc	ND	20	ug/L		200.7	04/16/08:203656	200.7	04/16/08:203966
SAR	1.4	0.1	meq/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Total Alkalinity (as CaCO3)	110	10	mg/L		2320B	04/17/08:203735	2320B	04/17/08:204041
Hydroxide	ND	10	mg/L		2320B	04/17/08:203735	2320B	04/17/08:204041
Carbonate	ND	10	mg/L		2320B	04/17/08:203735	2320B	04/17/08:204041
Bicarbonate	130	10	mg/L		2320B	04/17/08:203735	2320B	04/17/08:204041
Sulfate	19	2	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Chloride	15	1	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Nitrate	29.1	0.4	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Nitrite as N	ND	0.1	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Fluoride	0.5	0.1	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Total Anions	3.4	0.1	meq/L		2320B	04/17/08:203735	2320B	04/17/08:204041
pH	7.8	--	units		4500-H B	04/15/08:203801	4500HB	04/15/08:204121
Specific Conductance	377	1	umhos/cm		2510B	04/16/08:203657	2510B	04/16/08:203962
Total Dissolved Solids	220	20	mg/L		2540 C,E	04/16/08:203672	2540C	04/17/08:204018
MBAS (foaming agents)	ND	0.1	mg/L		5540C	04/15/08:203652	5540C	04/15/08:203951
Aggressiveness Index	11.7	1	--		4500-H B	04/15/08:203801	4500HB	04/15/08:204121
Langlier Index	-0.09	1	--		4500-H B	04/15/08:203801	4500HB	04/15/08:204121

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: H2SO4 pH < 2, HNO3 pH < 2

April 21, 2008

Lab ID : SP 0804068-002
Customer ID : 2-22643

CMF Land Development
9750 Hayvenhurst Avenue
Northridge, CA 91343

Sampled On : April 15, 2008-11:05
Sampled By : Tom Mobley
Received On : April 15, 2008-15:45
Matrix : Potable Water

Description : 180th St West & Gaskell Rd
Project : Water Monitoring

Sample Results - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral P,I*S								
Total Hardness	124	2.5	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Calcium	43	1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Magnesium	4	1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Potassium	2	1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Sodium	28	1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Total Cations	3.7	0.1	meq/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Boron	ND	0.1	mg/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Copper	ND	10	ug/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Iron	ND	50	ug/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Manganese	ND	10	ug/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Zinc	ND	20	ug/L		200.7	04/16/08:203656	200.7	04/16/08:203966
SAR	1.1	0.1	meq/L		200.7	04/16/08:203656	200.7	04/16/08:203966
Total Alkalinity (as CaCO3)	150	10	mg/L		2320B	04/17/08:203735	2320B	04/17/08:204041
Hydroxide	ND	10	mg/L		2320B	04/17/08:203735	2320B	04/17/08:204041
Carbonate	ND	10	mg/L		2320B	04/17/08:203735	2320B	04/17/08:204041
Bicarbonate	190	10	mg/L		2320B	04/17/08:203735	2320B	04/17/08:204041
Sulfate	16	2	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Chloride	9	1	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Nitrate	9.4	0.4	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Nitrite as N	ND	0.1	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Fluoride	0.4	0.1	mg/L		300.0	04/16/08:203681	300.0	04/16/08:204172
Total Anions	3.9	0.1	meq/L		2320B	04/17/08:203735	2320B	04/17/08:204041
pH	8.1	--	units		4500-H B	04/15/08:203801	4500HB	04/15/08:204121
Specific Conductance	391	1	umhos/cm		2510B	04/16/08:203657	2510B	04/16/08:203962
Total Dissolved Solids	200	20	mg/L		2540 C,E	04/16/08:203672	2540C	04/17/08:204018
MBAS (foaming agents)	ND	0.1	mg/L		5540C	04/15/08:203652	5540C	04/15/08:203951
Aggressiveness Index	12.3	1	--		4500-H B	04/15/08:203801	4500HB	04/15/08:204121
Langlier Index	0.5	1	--		4500-H B	04/15/08:203801	4500HB	04/15/08:204121

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: H2SO4 pH < 2, HNO3 pH < 2

April 21, 2008
CMF Land Development

Lab ID : SP 0804068
Customer : 2-22643

Quality Control - Inorganic

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Metals								
Boron	200.7	04/16/2008:203656	MS	mg/L	4.000	101 %	75-125	
			MSD	mg/L	4.000	102 %	75-125	
			MSRPD	mg/L	800.0	0.9%	≤20.0	
	200.7	04/16/2008:203966	CCV	ppm	5.000	96.8 %	90-110	
			CCB	ppm		0.046	0.10	
			CCV	ppm	5.000	96.9 %	90-110	
			CCB	ppm		0.057	0.10	
Calcium	200.7	04/16/2008:203656	MS	mg/L	12.50	73.2 %	<¼	
			MSD	mg/L	12.50	69.7 %	<¼	
			MSRPD	mg/L	800.0	0.6%	≤20.0	
	200.7	04/16/2008:203966	CCV	ppm	25.00	105 %	90-110	
			CCB	ppm		-0.01	1.0	
			CCV	ppm	25.00	103 %	90-110	
			CCB	ppm		-0.02	1.0	
Copper	200.7	04/16/2008:203656	MS	ug/L	800.0	101 %	75-125	
			MSD	ug/L	800.0	101 %	75-125	
			MSRPD	ug/L	800.0	0.4%	≤20.0	
	200.7	04/16/2008:203966	CCV	ppm	1.000	99.5 %	90-110	
			CCB	ppm		0.0003	0.01	
			CCV	ppm	1.000	97.8 %	90-110	
			CCB	ppm		-0.00002	0.01	
Iron	200.7	04/16/2008:203656	MS	ug/L	4000	101 %	75-125	
			MSD	ug/L	4000	102 %	75-125	
			MSRPD	ug/L	800.0	0.3%	≤20.0	
	200.7	04/16/2008:203966	CCV	ppm	5.000	101 %	90-110	
			CCB	ppm		-0.0064	0.05	
			CCV	ppm	5.000	99.3 %	90-110	
			CCB	ppm		-0.0104	0.05	
Magnesium	200.7	04/16/2008:203656	MS	mg/L	12.50	90.1 %	75-125	
			MSD	mg/L	12.50	89.0 %	75-125	
			MSRPD	mg/L	800.0	0.4%	≤20.0	
	200.7	04/16/2008:203966	CCV	ppm	25.00	105 %	90-110	
			CCB	ppm		-0.02	1.0	
			CCV	ppm	25.00	104 %	90-110	
			CCB	ppm		-0.02	1.0	
Manganese	200.7	04/16/2008:203656	MS	ug/L	800.0	103 %	75-125	
			MSD	ug/L	800.0	103 %	75-125	
			MSRPD	ug/L	800.0	0.3%	≤20.0	
	200.7	04/16/2008:203966	CCV	ppm	1.000	101 %	90-110	
			CCB	ppm		0.00007	0.01	
			CCV	ppm	1.000	98.7 %	90-110	
			CCB	ppm		0.00004	0.01	
Potassium	200.7	04/16/2008:203656	MS	mg/L	12.50	107 %	75-125	
			MSD	mg/L	12.50	106 %	75-125	
			MSRPD	mg/L	800.0	0.7%	≤20.0	
	200.7	04/16/2008:203966	CCV	ppm	25.00	100 %	90-110	
			CCB	ppm		0.02	1.0	
			CCV	ppm	25.00	99.7 %	90-110	
			CCB	ppm		-0.003	1.0	
Sodium	200.7	04/16/2008:203656	MS	mg/L	12.50	100 %	75-125	
			MSD	mg/L	12.50	98.9 %	75-125	
			MSRPD	mg/L	800.0	0.5%	≤20.0	
	200.7	04/16/2008:203966	CCV	ppm	25.00	99.7 %	90-110	
			CCB	ppm		-0.11	1.0	
			CCV	ppm	25.00	98.8 %	90-110	

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Lab ID : SP 0804068
Customer : 2-22643

Quality Control - Inorganic

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Metals			CCB	ppm		0.006	1.0	
Zinc	200.7	04/16/2008:203656	MS	ug/L	2000	107 %	75-125	
			MSD	ug/L	2000	107 %	75-125	
			MSRPD	ug/L	800.0	0.1%	≤20.0	
	200.7	04/16/2008:203966	CCV	ppm	1.000	102 %	90-110	
			CCB	ppm		-0.0011	0.02	
			CCV	ppm	1.000	99.8 %	90-110	
			CCB	ppm		-0.0021	0.02	
Wet Chem								
Alkalinity (as CaCO3)	2320B	04/17/2008:204041	CCV	mg/l	234.9	98.5 %	90-110	
			CCV	mg/l	234.9	97.3 %	90-110	
Chloride	300.0	04/16/2008:203681	LCS	mg/L	25.00	95.0 %	90-110	
			MS	mg/L	500.0	99.5 %	86-128	
			MSD	mg/L	500.0	98.2 %	86-128	
			MSRPD	mg/L	100.0	1.3%	≤23.0	
	300.0	04/16/2008:204172	ICV	ppm	50.00	101 %	90-110	
			ICB	ppm		0.00	1	
			CCB	ppm		0.00	1	
			CCV	ppm	25.00	105 %	90-110	
Conductivity	2510B	04/16/2008:203962	ICB	umhos/cm		0.1	1	
			ICV	umhos/cm	1000	99.4 %	95-105	
			CCV	umhos/cm	1000	99.6 %	95-105	
E. C.	2510B	04/16/2008:203657	Blank	umhos/cm		ND	<1	
			Dup	umhos/cm		0.1%	0.372	
Fluoride	300.0	04/16/2008:203681	LCS	mg/L	2.500	99.5 %	90-110	
			MS	mg/L	50.00	103 %	81-126	
			MSD	mg/L	50.00	101 %	81-126	
			MSRPD	mg/L	100.0	1.1%	≤12.1	
	300.0	04/16/2008:204172	ICV	ppm	5.000	103 %	90-110	
			ICB	ppm		0.000	0.1	
			CCB	ppm		0.000	0.1	
			CCV	ppm	2.500	106 %	90-110	
MBAS	5540C	04/15/2008:203652	MS	mg/L	1.000	100 %	90-110	
			MSD	mg/L	1.000	100 %	90-110	
			MSRPD	mg/L	1.000	0.0	≤0.1	
	5540C	04/15/2008:203951	CCB	mg/L		0.000	0.1	
			CCV	mg/L	1.000	100 %	99-101	
Nitrate	300.0	04/16/2008:203681	LCS	mg/L	20.00	90.5 %	90-110	
			MS	mg/L	400.0	96.9 %	88-124	
			MSD	mg/L	400.0	95.6 %	88-124	
			MSRPD	mg/L	100.0	1.3%	≤29.1	
	300.0	04/16/2008:204172	ICV	ppm	40.00	96.6 %	90-110	
			ICB	ppm		0.000	0.4	
			CCB	ppm		0.000	0.4	
			CCV	ppm	20.00	100 %	90-110	
Nitrite	300.0	04/16/2008:203681	LCS	mg/L	15.00	95.1 %	90-110	
			MS	mg/L	300.0	95.9 %	91-121	
			MSD	mg/L	300.0	90.1 %	91-121	435
			MSRPD	mg/L	100.0	6.2%	≤23.8	
	300.0	04/16/2008:204172	ICV	ppm	30.00	98.9 %	90-110	
			ICB	ppm		0.000	0.3	
			CCB	ppm		0.000	0.3	
			CCV	ppm	15.00	104 %	90-110	
Solids, Total Dissolved	2540 C,E	04/16/2008:203672	Blank	mg/L		ND	<20	
			LCS	mg/L	1000	97.5 %	90-110	
			LCS	mg/L	1000	98.1 %	90-110	
			Dup	mg/L		0.7%	10.0	
Sulfate	300.0	04/16/2008:203681	LCS	mg/L	50.00	92.5 %	90-110	

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Quality Control - Inorganic

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Wet Chem								
Sulfate	300.0	04/16/2008:203681	MS	mg/L	1000	98.6 %	78-137	
			MSD	mg/L	1000	97.7 %	78-137	
			MSRPD	mg/L	100.0	0.9%	≤12.3	
	300.0	04/16/2008:204172	ICV	ppm	100.0	97.9 %	90-110	
			ICB	ppm		0.00	2	
			CCB	ppm		0.00	2	
			CCV	ppm	50.00	102 %	90-110	

Definition

ICV	: Initial Calibration Verification - Analyzed to verify the instrument calibration is within criteria.
ICB	: Initial Calibration Blank - Analyzed to verify the instrument baseline is within criteria.
CCV	: Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria.
CCB	: Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria.
Blank	: Method Blank - Prepared to verify that the preparation process is not contributing contamination to the samples.
LCS	: Laboratory Control Standard/Sample - Prepared to verify that the preparation process is not affecting analyte recovery.
MS	: Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery.
MSD	: Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery.
Dup	: Duplicate Sample - A random sample with each batch is prepared and analyzed in duplicate. The relative percent difference is an indication of precision for the preparation and analysis.
MSRPD	: MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis.
ND	: Non-detect - Result was below the DQO listed for the analyte.
<¼	: High Sample Background - Spike concentration was less than one forth of the sample concentration.
DQO	: Data Quality Objective - This is the criteria against which the quality control data is compared.

Explaination

435	: Sample matrix may be affecting this analyte. Data was accepted based on the LCS or CCV recovery.

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Inorganic - Wet Chemistry QC

2320B	04/17/2008:204041 All analysis quality controls are within established criteria.
2510B	04/16/2008:203962 All analysis quality controls are within established criteria.
	04/16/2008:203657 All preparation quality controls are within established criteria.
2540 C,E	04/16/2008:203672 All preparation quality controls are within established criteria.
300.0	04/16/2008:204172 All analysis quality controls are within established criteria.
	04/16/2008:203681 All preparation quality controls are within established criteria, except: The following note applies to Nitrite: 435 Sample matrix may be affecting this analyte. Data was accepted based on the LCS or CCV recovery.
5540C	04/15/2008:203951 All analysis quality controls are within established criteria.
	04/15/2008:203652 All preparation quality controls are within established criteria.

Certification: I certify that this data package is in compliance with NELAC standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S.
Title: Laboratory Director
Date: 2008-04-21

INTRODUCTION

At the Antelope Valley Groundwater Adjudication Settlement Meeting facilitated by Randy Williams on October 7, 2009, the group selected Steve Dassler, Andrew Werner and Gene Nebeker to recalculate the total groundwater pumping in the Antelope Valley based on 1) crop water requirements prepared by experts in Antelope Valley crop water use primarily from the University of California and 2) recommendations from mutual water companies regarding the mutuals' groundwater pumping.

The historical water use by agriculture was calculated by multiplying these crop water requirements by the acres of the various crops reported in the "Problem Statement" prepared by a Technical Committee. To be consistent with the procedure in the "Problem Statement," an extra 5% was added to take into account water use that may have been unreported. In these crop water use calculations, nothing was changed from the "Problem Statement" except the crop water requirements. Any other data taken from the "Problem Statement" has not been confirmed or vetted. A relatively arbitrary twelve year time period was examined because the "Problem Statement" separates data into five-year periods and the data ended with 2006. The overall result indicating under-valuing of the groundwater pumping in the "Problem Statement" is insensitive to the period that was chosen.

When the groundwater adjudication began, no reliable crop water requirements for the Antelope Valley, prepared by rigorous peer-reviewed analysis, existed. As a result, in April 19, 2007, the "Estimate of Crop Water Requirements in the Antelope Valley" was prepared by Grant Poole, former Los Angeles County Farm Advisor in Antelope Valley, Steve Orloff, Los Angeles County Farm Advisor in Antelope Valley just prior to Mr. Poole and current Farm Advisor in Siskiyou County, Blake Sanden, Kern County Farm Advisor in Antelope Valley, Tim Hays, Agricultural Consultant and California Licensed Pest Control Advisor in Antelope Valley, Blaine Hansen, Ph.D., Irrigation and Drainage Specialist at University of California at Davis, and Eugene B. Nebeker, Ph.D., grower in Antelope Valley and licensed Professional Engineer in Chemical and Agricultural Engineering. The resulting crop water requirements compare closely to the experiences of growers in Antelope Valley.

Crop water requirements for grapes do not appear in these University of California crop water requirements because grapes represent a very small consumption of water because the acreages of grapes are small. In these calculations, the crop water requirements for grapes used in the "Problem Statement" were retained because any inaccuracies do not significantly affect the results.

The information for mutual water company groundwater use was furnished by Mr. John Ukkestad of the Antelope Valley United Water Purveyors.

The results of these analyses show the "Problem Statement" under-valued groundwater pumping in the Antelope Valley by 13,471 to 22,440 acre-feet per year or an average of 18,957 acre-feet per year. Total groundwater pumping varied between 132,091 to 196,738 acre-feet per year for an average of 165,213 per year.

Crop Water Requirements and Applied Water

Crop	Problem Statement (AF) (1)	U of C (AF) (2)
Alfalfa	6.5	7.65
Carrots	3.9	4.60
Grain	2.6	3.05
Melons and Squash	2.8	3.11
Onions	4.5	5.22
Orchard	4.9	5.36
Pasture	6.7	7.45
Potatoes	2.8	3.35
Sugar Beets	4.6	4.96
Vinyard	3.7	

(1) Problem Statement Appendix D-3, Table 4
(2) University of CA, Table 4 (2007)

Appendix D-3

Applied Crop Water Duties, Irrigation Efficiencies, and Agricultural Return Flows

In order to estimate water requirements for agricultural irrigation in some detail over recent time (since 1970), and as a basis for assessing historical as well as current agricultural water requirements, applied water duties for individual crops were developed and utilized as follows. As part of the development and utilization of crop water duties, it was recognized that irrigation practices and other farming practices require the application of more water than is simply required for plant growth. Of the additional applied water, some of it deep percolates and thus contributes to groundwater recharge as so-called return flow, while some of it is lost to evaporation and does not contribute to recharge. The fate of water applied in excess of plant water requirements was tracked as part of the overall development of crop water duties, primarily to estimate the amounts of applied water that contribute to groundwater recharge.

Applied Crop Water Duties

Included within the Los Angeles County annual crop reports and the Kern County annual pesticide use reports are crop acreage subdivisions applicable to the Antelope Valley for vegetable crops (notably onions and root vegetables), field crops (notably alfalfa), and fruit and nut crops. Those annual land use and crop acreage data were converted to water requirements using a CIMIS-based (California Irrigation Management Information System) approach where reference evapotranspiration data were coupled with various crop coefficients to first estimate the total annual evapotranspirative water requirements of the various crops grown in the Valley. Those requirements were then factored to consider any effective precipitation that would have reduced the need for applied water to meet the respective evapotranspirative water requirements. The resultant crop evapotranspirative water requirements were then converted to applied crop water requirements by considering irrigation system distribution uniformity values. Finally, applied water for cultural practices that involve the application of water for field preparation, pre-irrigation, and erosion control was added to the applied water for consumption of the crops to develop applied crop water duties (AW_T).

In sequential equation form, the preceding approach to estimating applied crop water requirements can be expressed as follows. The results are summarized in Appendix D-3: Tables 1 through 5.

Crop Water Requirement

$$ET_C = K_C * ET_O$$

where

ET_C = crop evapotranspirative requirement

K_C = crop coefficient

ET_O = reference evapotranspiration

Crop Evapotranspiration of Applied Water

$$ET_{AW} = ET_C - P_e$$

where

ET_{AW} = evapotranspiration of applied water

P_e = effective precipitation

Total Applied Water

$$AW_T = \frac{ET_{AW}}{DU} + AW_{er} + AW_{pr}$$

where

AW_T = total applied crop water duty

DU = distribution uniformity of irrigation system[1]

AW_{er} = applied water for erosion control

AW_{pr} = applied water for field preparation and pre-irrigation

The crops grown in the Antelope Valley, as reported by the Los Angeles and Kern County Agricultural Commissioners, were grouped into the following crop categories for purposes of estimating annual applied water requirements: alfalfa and irrigated pasture, carrots, deciduous orchard, grain (barley, wheat, hay, sorghum, sudan), melons and squash, onions, potatoes, sugar beets, and grapes. The daily reference evapotranspiration (ET_o) data reported for the nearest CIMIS station, at Victorville, shows only small fluctuation from year to year, so they were utilized to develop average ET_o values for each bimonthly and monthly period of the growth stages for each crop grown in the Antelope Valley. These values were calculated as the average of the daily data within each of the growth stage periods from each year of available data at the Victorville CIMIS station. The resultant bimonthly (and monthly) average ET_o values are tabulated in Appendix D-3: Table 1.

Crop coefficients (K_c) specific to the high desert of California for each of the growth stage periods of each crop category were derived from the University of California Cooperative Extension as listed in Appendix D-3: Table 5. Those crop coefficients were then combined with

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[1] *DU is a term relating to the evenness of water application to plants throughout a field and is defined as:*

$$\frac{\text{Minimum depth of water applied to plants in a field}}{\text{Average amount of water applied to plants}} \times 100$$

where the minimum equals the average of the lowest quarter of the values. (ITRC, California Polytechnic State University, 1994).

the corresponding average ET_o values to estimate crop water requirements in the Antelope Valley. Specifically, the products of the K_c value and average ET_o for each bimonthly growth stage period were summed to estimate the total annual evapotranspirative water requirements (ET_c) of the various crops grown in the Valley (Appendix D-3: Table 2). Crop coefficients and growth stage periods for vineyard (grape crops) grown in California's high desert were not available; available monthly coefficients and growth stage periods specific to Yolo and Solano Counties were utilized with the Victorville ET_o values to estimate the annual crop water requirement ET_c for grapes grown in the Valley.

Interpretation of the seasonal variation in the relative amounts of precipitation and evaporation in the Valley indicated that, typically, evaporative losses exceed the amount of precipitation in all months from March through November so rainfall during those months was considered to be lost to evaporation and thus not available for uptake by the crops. Consequently, only the precipitation occurring in December through February would be available for the crops and approximately one-half of that was considered to be "effective precipitation" (P_e) that contributed to meeting ET_c of the various crops, and thus reduce applied water requirements. After allowing for effective precipitation (P_e) (up to the ET_c value), the remainder is the average amount of applied water required to directly meet crop evapotranspirative requirements (ET_{AW}), as summarized in Appendix D-3: Table 3.

The amount of total applied water needed to meet crop water requirements (ET_{AW}), specifically to accommodate irrigation distribution uniformities (DU) and cultural practices in the Valley, was then calculated. For all crops, there are no known data on DU values; anecdotal information suggests that there have been widespread efforts to utilize irrigation equipment and practices to increase DU values into the range of 80 percent. For purposes of converting the applied water needed to meet crop water requirements (ET_{AW}) to applied crop water requirements (AW_c), irrigation system DU was assumed to be 80 percent for all crops. Ultimately, that value was checked by computing overall irrigation efficiencies as described below, and then assessing the resultant values in the context of generally reported values in the Valley. For those crops where water is used for field preparation and pre-irrigation (all except pasture, orchard, and grapes) and/or are subject to damage from soil erosion in the Valley (carrots and onions), respective amounts of water were added to that applied at the estimated distribution uniformity for irrigation systems in the Valley. Anecdotal information suggests that, for alfalfa, carrot, grain, melon/squash, onion, potato, and sugar beet crops grown in the Antelope Valley, an additional 2 to 6.5 inches of water are applied for field preparation and pre-irrigation purposes (AW_{pr}); and for carrot and onion crops, an additional 3 to 6 inches of water are applied for erosion control (AW_{er}). Accordingly, the applied water requirements for those crops were increased by these amounts to arrive at estimates of total applied water (applied crop water duties, AW_T) as summarized in Appendix D-3: Table 4. Overall, the resultant values of total applied water in Appendix D-3: Table 4 are within ranges typically reported for crops and irrigation practices in the Antelope Valley.

Irrigation Efficiency

Historically, the term "irrigation efficiency" has been used to describe the fraction of total applied water that was consumptively used by a crop. With time, the definition of the term has been broadened to recognize that other uses of water associated with the growing and harvesting of crops are also beneficial. Thus, a modern definition of "irrigation efficiency" can be considered to be the ratio of that portion of applied water that is beneficially used for farming operations divided by total applied water, expressed as a percentage. In the Antelope Valley setting, the application of water for cultural practices that include field preparation, pre-irrigation, and erosion control can be considered a beneficial use of water. Thus, in this analysis, irrigation efficiency is defined as the fraction of total applied water that is consumptively used by a crop plus water used for field preparation, pre-irrigation, and erosion control.

In equation form, the preceding can be expressed as follows, where ET_{AW}, ET_{cr} and ET_{pr} are as defined above.

Overall Irrigation Efficiency

$$E_{irr} = \frac{ET_{AW} + AW_{cr} + AW_{pr}}{AW_T}$$

where

E_{irr} = overall efficiency of irrigation

Utilizing the preceding definition, the total beneficial use of water results in irrigation efficiency values in the range of 80 to 85 percent for the crops grown and the associated farming practices in the Antelope Valley, as delineated in Appendix D-3: Table 4.

Return Flows

As introduced above, most of the applied water in crop irrigation is consumptively used in plant growth. Additional water is applied for beneficial purposes such as field preparation, pre-irrigation, and erosion control. Some of the applied water not consumptively used by crops deep percolates and ultimately becomes groundwater recharge, while other of the additional applied water evaporates. Since the main focus of tracking the fate of applied water in excess of plant consumptive use was to estimate return flow contributions to groundwater recharge, the return flow component was estimated by first recognizing that applied irrigation in excess of plant water requirements contributes to return flow, and then separately considering the individual components of additional water applied to irrigated areas. Respectively, in the Antelope Valley, those components are for the purposes of erosion control, field preparation, and pre-irrigation.

Erosion Control – As delineated in Appendix D-3: Table 4, about 3 to 6 inches of water are applied during certain stages of plant growth for carrots and onions to resist the sand-blasting

effects of wind and the granular soils in the area. Over the course of overall plant growth cycles, those amounts of water are quite small since they are for the purpose of wetting only the uppermost soil profile to keep seedlings from being damaged by wind. Thus, that applied water is not expected to infiltrate to a sufficient depth to contribute to soil moisture that ultimately deep percolates. Consequently, water applied for erosion control is considered to be lost to evaporation from the uppermost soil profile, and not part of return flow.

Field Preparation and Pre-Irrigation – As delineated in Appendix D-3: Table 4, for certain crops, between 2 and 6.5 inches of additional water are applied for some combination of field preparation and pre-irrigation. In the one case of alfalfa, where soil moisture is maintained near field capacity throughout the year, the application of any water above crop water requirements is considered to contribute to an increase in soil moisture that, in turn, precipitates deep percolation past the crop root zone. Thus, all additional applied water is considered to be part of return flows that ultimately become groundwater recharge. For all other crops where additional water is applied for field preparation or pre-irrigation outside the period of active plant growth, all water is considered to contribute to soil moisture which can be later captured by the plants, or can be deep percolated as a result of subsequent application of water during the plant growing season. However, recognizing that the application of water outside the plant growing season results in shallow soil moisture being susceptible to evaporation, water in the uppermost 6 inches of soil is considered to be lost to evaporation and thus not part of the return flows that ultimately become groundwater recharge. For average Antelope Valley soil conditions, field capacity is about one inch per foot of depth. Thus, the application of 4 to 6 inches of water for field preparation and pre-irrigation of certain crops will tend to wet several feet of soil; of that, evaporation will consume water stored in the uppermost half-foot of soil profile (about one-half inch of water) and the balance is in the soil profile from which it can ultimately deep percolate as return flow to groundwater recharge.

Derivations of individual quantities of return flows on a per-crop basis, following the methodology described above, are delineated in Appendix D-3: Table 6. Total amounts of agricultural return flows, for selected years prior to 1970 (when the preceding level of detail was not available, and for which return flows were estimated to be 30 percent of total applied water) and for each year since 1970, are summarized in Appendix D-3: Table 7 and illustrated in Appendix D-3: Figure 1.

References

California Department of Water Resources, CIMIS Program, 1994-2003. Records of Reference Evapotranspiration, Victorville Station, California.

California Polytechnic State University, Irrigation Training and Research Center, 1994. *Drip and Microirrigation for Trees, Vines, and Row Crops*, 261 pp.

Kern County Agricultural Commissioner, 1994-2003. Annual Pesticide Use Reports (available online).

Los Angeles County Agricultural Commissioner, 1970-2006. Annual Crop and Livestock Reports.

Univ. of California, Cooperative Extension Program, date not available. *Table 2: "Normal Year" grass potential evapotranspiration (ETo), forage crop coefficients and ET for the High Desert.*

Appendix D-3: Table 1
Reference Evapotranspiration and Crop Coefficients by Growth Stage
Antelope Valley Area of Adjudication

		Reference Evapotranspiration*		Crop Coefficients**											
Growth Stage Periods		Monthly	Bimonthly	Alfalfa	Pasture	Deciduous	Grain	Fall Silage	Sugar Beets	Melons	Onions	Spring Carrots	Summer Carrots	Potatoes	Grapes***
		ET_o (in)	ET_o (in)	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c	K_c
January	1	2.02	0.91	0.40	1.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.11	0.40	1.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	1	2.61	1.18	0.40	1.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.43	1.00	1.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
March	1	4.55	2.05	1.15	1.00	0.25	0.66	0.00	0.00	0.00	0.30	0.31	0.00	0.55	0.35
	2		2.50	1.15	1.00	0.54	0.92	0.00	0.15	0.18	0.30	0.55	0.00	0.61	
April	1	6.19	2.89	0.95	1.00	0.60	1.00	0.00	0.15	0.18	0.30	0.82	0.00	0.88	0.55
	2		3.30	0.95	1.00	0.66	1.00	0.00	0.37	0.34	0.53	1.03	0.00	1.16	
May	1	7.30	3.45	0.95	1.00	0.72	1.15	0.00	0.61	0.72	0.83	1.11	0.00	1.21	0.73
	2		3.85	0.95	1.00	0.79	1.10	0.00	0.88	1.11	1.14	1.13	0.31	1.19	
June	1	8.85	4.29	0.95	1.00	0.84	0.78	0.14	1.11	1.11	1.14	1.05	0.53	0.87	0.82
	2		4.56	0.95	1.00	0.86	0.00	0.25	1.11	1.11	1.14	1.00	0.82	0.55	
July	1	9.77	4.90	0.95	1.00	0.92	0.00	0.56	1.11	0.78	1.04	0.00	1.03	0.00	0.82
	2		4.87	0.95	1.00	0.94	0.00	1.00	1.07	0.29	0.92	0.00	1.11	0.00	
August	1	8.99	4.61	0.95	1.00	0.94	0.00	1.15	1.04	0.00	0.80	0.00	1.13	0.00	0.72
	2		4.38	0.95	1.00	0.94	0.00	1.20	1.00	0.00	0.68	0.00	1.05	0.00	
September	1	6.52	3.48	0.95	1.00	0.94	0.00	1.20	0.97	0.00	0.00	0.00	0.00	0.00	0.50
	2		3.04	0.95	1.00	0.91	0.00	1.06	0.00	0.00	0.00	0.00	0.00	0.00	
October	1	4.66	2.51	0.95	1.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		2.15	0.95	1.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
November	1	2.68	1.64	0.95	1.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.04	0.95	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	1	2.05	1.06	0.95	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.99	0.95	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (inches)		66.19	66.19												
Total (feet)		5.52	5.52												

* Avg ET_o for specified periods, based on available historical and daily data at the Victorville CIMIS Station, 1994 - 2003

** Crop growth stages and coefficients from Univ. California Cooperative Extension; values for the California High Desert.

*** Crop coefficients for grapes from Univ. California Cooperative Extension; monthly values for Yolo and Solano Counties (High Desert value not available)

Appendix D-3: Table 2
Evapotranspiration of Crops
Antelope Valley Area of Adjudication

		Evapotranspiration of Crops											
Growth Stage Periods		Alfalfa	Pasture	Deciduous	Grain	Fall Silage	Sugar Beets	Melons	Onions	Spring Carrots	Summer Carrots	Potatoes	Grapes
		ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)	ET_c (in)
January	1	0.36	0.91	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.44	1.11	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	1	0.47	1.18	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	1.43	1.43	0.00	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
March	1	2.36	2.05	0.51	1.35	0.00	0.00	0.00	0.62	0.64	0.00	1.13	1.59
	2	2.88	2.50	1.35	2.30	0.00	0.38	0.45	0.75	1.38	0.00	1.53	
April	1	2.75	2.89	1.73	2.89	0.00	0.43	0.52	0.87	2.37	0.00	2.54	3.40
	2	3.14	3.30	2.18	3.30	0.00	1.22	1.12	1.75	3.40	0.00	3.83	
May	1	3.28	3.45	2.48	3.97	0.00	2.10	2.48	2.86	3.83	0.00	4.17	5.33
	2	3.66	3.85	3.04	4.24	0.00	3.39	4.27	4.39	4.35	1.19	4.58	
June	1	4.08	4.29	3.60	3.35	0.60	4.76	4.76	4.89	4.50	2.27	3.73	7.26
	2	4.33	4.56	3.92	0.00	1.14	5.06	5.06	5.20	4.56	3.74	2.51	
July	1	4.66	4.90	4.51	0.00	2.74	5.44	3.82	5.10	0.00	5.05	0.00	8.01
	2	4.63	4.87	4.58	0.00	4.87	5.21	1.41	4.48	0.00	5.41	0.00	
August	1	4.38	4.61	4.33	0.00	5.30	4.79	0.00	3.69	0.00	5.21	0.00	6.47
	2	4.16	4.38	4.12	0.00	5.26	4.38	0.00	2.98	0.00	4.60	0.00	
September	1	3.31	3.48	3.27	0.00	4.18	3.38	0.00	0.00	0.00	0.00	0.00	3.26
	2	2.89	3.04	2.77	0.00	3.22	0.00	0.00	0.00	0.00	0.00	0.00	
October	1	2.38	2.51	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	2.04	2.15	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
November	1	1.56	1.64	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.99	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	1	1.01	1.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.94	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (inches)		62.10	66.19	47.38	22.94	27.31	40.55	23.91	37.57	25.02	27.47	24.02	35.33
Total (feet)		5.18	5.52	3.95	1.91	2.28	3.38	1.99	3.13	2.09	2.29	2.00	2.94

Appendix D-3: Table 3
Evapotranspiration of Applied Water
Antelope Valley Area of Adjudication

Growth Stage Periods		Monthly Precipitation (in)	Bimonthly Precipitation (in)	Effective Precipitation P_e (in)	Evapotranspiration of Applied Water											
					Alfalfa	Pasture	Deciduous	Grain	Fall Silage	Sugar Beets	Melons	Onions	Spring Carrots	Summer Carrots	Potatoes	Grapes
					ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)	ET_{AW} (in)
January	1	1.05	0.47	0.24	0.13	0.68	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.58	0.29	0.15	0.82	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	1	1.95	0.88	0.44	0.03	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		1.07	0.54	0.90	0.90	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
March	1	0.8	0.44	0.00	2.36	2.05	0.51	1.35	0.00	0.00	0.00	0.62	0.64	0.00	1.13	1.59
	2		0.36	0.00	2.88	2.50	1.35	2.30	0.00	0.38	0.45	0.75	1.38	0.00	1.53	
April	1	0.48	0.26	0.00	2.75	2.89	1.73	2.89	0.00	0.43	0.52	0.87	2.37	0.00	2.54	3.40
	2		0.22	0.00	3.14	3.30	2.18	3.30	0.00	1.22	1.12	1.75	3.40	0.00	3.83	
May	1	0.12	0.06	0.00	3.28	3.45	2.48	3.97	0.00	2.10	2.48	2.86	3.83	0.00	4.17	5.33
	2		0.06	0.00	3.66	3.85	3.04	4.24	0.00	3.39	4.27	4.39	4.35	1.19	4.58	
June	1	0.05	0.03	0.00	4.08	4.29	3.60	3.35	0.60	4.76	4.76	4.89	4.50	2.27	3.73	7.26
	2		0.02	0.00	4.33	4.56	3.92	0.00	1.14	5.06	5.06	5.20	4.56	3.74	2.51	
July	1	0.12	0.06	0.00	4.66	4.90	4.51	0.00	2.74	5.44	3.82	5.10	0.00	5.05	0.00	8.01
	2		0.06	0.00	4.63	4.87	4.58	0.00	4.87	5.21	1.41	4.48	0.00	5.41	0.00	
August	1	0.04	0.02	0.00	4.38	4.61	4.33	0.00	5.30	4.79	0.00	3.69	0.00	5.21	0.00	6.47
	2		0.02	0.00	4.16	4.38	4.12	0.00	5.26	4.38	0.00	2.98	0.00	4.60	0.00	
September	1	0.16	0.08	0.00	3.31	3.48	3.27	0.00	4.18	3.38	0.00	0.00	0.00	0.00	0.00	3.26
	2		0.08	0.00	2.89	3.04	2.77	0.00	3.22	0.00	0.00	0.00	0.00	0.00	0.00	
October	1	0.16	0.08	0.00	2.38	2.51	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.08	0.00	2.04	2.15	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
November	1	0.37	0.14	0.00	1.56	1.64	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.23	0.00	0.99	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	1	0.54	0.26	0.13	0.88	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		0.28	0.14	0.80	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (inches)		5.84	5.84	1.77	60.33	64.42	47.38	21.52	27.31	40.55	23.91	37.57	25.02	27.47	24.02	35.33
Total (feet)		0.49	0.49	0.15	5.03	5.37	3.95	1.79	2.28	3.38	1.99	3.13	2.09	2.29	2.00	2.94

Appendix D-3: Table 4
Applied Crop Water Duties and Irrigation Efficiency Values
(DU = 80%)
Antelope Valley Area of Adjudication

Crop	ET_c[1] (in)	P_e[2] (in)	ET_{AW}[3] (in)	DU[4] (%)	AW_c[5] (in)	AW_{er}[6] (in)	AW_{pr}[7] (in)	AW_T[8] (in)	(ft)	E_{irr}[9] (%)
Alfalfa	62.10	1.77	60.33	80	75.42	0	2.0	77.42	6.5	81
Carrots	27.47	0.00	27.47	80	34.33	6	6.5	46.83	3.9	85
Grain	22.94	1.42	21.52	80	26.90	0	4.0	30.90	2.6	83
Melons/Squash	23.91	0.00	23.91	80	29.88	0	4.0	33.88	2.8	82
Onions	37.57	0.00	37.57	80	46.96	3	4.0	53.96	4.5	83
Orchard (Deciduous)	47.38	0.00	47.38	80	59.22	0	0.0	59.22	4.9	80
Pasture	66.19	1.77	64.42	80	80.53	0	0.0	80.53	6.7	80
Potatoes	24.02	0.00	24.02	80	30.03	0	4.0	34.03	2.8	82
Silage	27.31	0.00	27.31	80	34.14	0	4.0	38.14	3.2	82
Sugar Beets	40.55	0.00	40.55	80	50.68	0	4.0	54.68	4.6	81
Vineyard (Grapes)	35.33	0.00	35.33	80	44.16	0	0.0	44.16	3.7	80

[1] $ET_c = K_c * ET_o$ where ET_o = average ET_o for specified periods, based on data from Victorville CIMIS Station, 1994-2003); K_c values from Univ. California Cooperative Extension

[2] P_e = effective precipitation offsetting ET_c, up to 1/2 of the average precipitation, in Dec. - Feb., inclusive

[3] ET_{AW} = evapotranspiration of applied water = $ET_c - P_e$

[4] DU = irrigation distribution uniformity

[5] AW_c = applied water for crop requirement = $ET_{AW} \div DU$

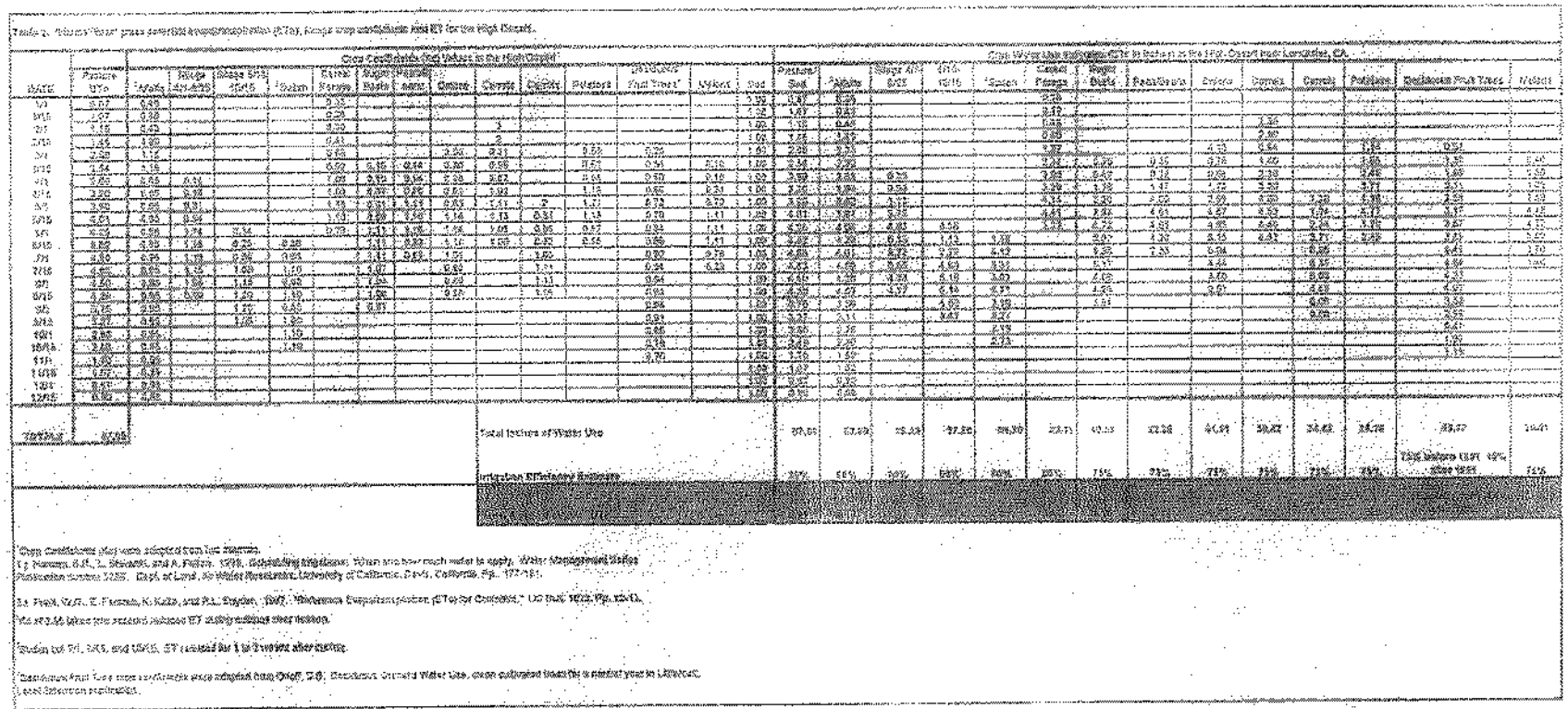
[6] AW_{er} = applied water for erosion control (after Nebeker, 4-19-07)

[7] AW_{pr} = applied water for field preparation and pre-irrigation (after Nebeker, 4-19-07)

[8] AW_T = applied crop water duty = $AW_c + AW_{er} + AW_{pr}$

[9] E_{irr} = overall irrigation efficiency for beneficial uses = $(ET_{AW} + AW_{er} + AW_{pr}) \div AW_T$

Appendix D-3: Table 5
Crop Coefficients and Growth Stages
California High Desert



4/19/07

AN ESTIMATE OF CROP WATER REQUIREMENTS IN THE ANTELOPE VALLEY

Eugene B. Nebeker, Ph.D., P.E.

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DISCUSSION

The irrigation challenges in Antelope Valley are perhaps unique to all of California because solid set irrigation is one of the most popular types, sandy soils are common, and heavy winds prevail.

The calculations below are the best estimates of average crop water usage assuming all irrigations perform as anticipated with no unexpected problems such as equipment failure, the irrigation sets finishing when expected, etc. and no severe weather events such as excessive heat, high winds, etc. Otherwise, more water is required than these estimates represent. These calculations account for planting dates, harvesting dates, and end-of-season dates.

Historical data from Palmdale and Littlerock were used to estimate the amount of reference or "normal year" potential evapotranspiration (ETo) for Antelope Valley as shown in Table 2. ETo data from the CIMIS weather station in Victorville, CA is very similar to the Palmdale and Littlerock data and the Victorville is shown in Table 1 for comparison.. Climatic conditions largely

determine evapotranspiration and observations over many years by local Farm Advisors have indicated that Victorville data closely represent the climatic conditions in Antelope Valley.

Once the reference evapotranspiration ETo is known, the evapotranspiration for each crop (ETc) can be determined by

$$ETc = Kc\ (ETo)$$

where Kc is the crop coefficient. The crop coefficient varies with the crop, its stage of development, and the frequency of irrigation at less than full crop cover. Since these coefficients are practically independent of location, they can be used over a wide area.

ETc is the amount of water that must be supplied to the plant for proper growth, sometimes called net water requirements. Unfortunately, irrigation systems are not perfect and some additional water losses occur in the form of deep percolation, ponding, runoff, etc. The total amount of water that must be applied to the crop, often called gross water requirements, is calculated by

$$\text{Gross Water Requirement} = \text{Net Water Requirement} / (\text{Irrigation System Efficiency})$$

These irrigation system efficiencies have been developed over the years from field studies by University of California researchers and the Natural Resources Conservation Service (NRCS). With rare exceptions, irrigation system efficiencies for each particular type of irrigation method have not varied significantly from 1970 to the present. However, because the cost of irrigation water was less during these earlier periods, the amount of water wasted during these periods was greater than today. Some growers in the Antelope Valley area estimate their total water usage per acre was 25% greater during these earlier periods.

The following tables represent the "normal year" potential evapotranspiration, ETo , Crop Coefficients, and Evapotranspiration Requirements for various crops currently and historically grown in the Lancaster, CA area. Note that a heavy rainfall winter, which produces "effective rainfall," that is, rainfall that soaks into the soil and is not dissipated by evaporation, runoff, etc. may slightly reduce these requirements.

Table 4 lists the water requirements to reduce wind erosion damage in onion and carrot crops and the water applied when no crop is growing to facilitate field preparation and other cultural practices. These water requirements are not included in the crop evaporation estimates. Table 4 also shows the total crop water requirements in Antelope Valley.

Table 1. Plant evapotranspiration data for Jan. to December 2003, collected from Victorville, CA CIMIS weather station number 117, to be used as an estimate for ET near Palmdale, CA.

January	ETo(in)	February	ETo(in)	March	ETo(in)	April	ETo(in)	May	ETo(in)	June	ETo(in)	July	ETo(in)	August	ETo(in)	September	ETo(in)	October	ETo(in)	November	ETo(in)	December	ETo	January	ETo
1/1	0.07	2/1	0.13	3/1	0.12	4/1	0.24	5/1	0.21	6/1	0.29	7/1	0.34	8/1	0.22	9/1	0.26	10/1	0.21	11/1	0.07	12/1	0.1	1/1	0.09
1/2	0.07	2/2	0.11	3/2	0.13	4/2	0.18	5/2	0.21	6/2	0.31	7/2	0.32	8/2	0.27	9/2	0.16	10/2	0.2	11/2	0.08	12/2	0.07	1/2	0.08
1/3	0.08	2/3	0.09	3/3	0.09	4/3	0.17	5/3	0.18	6/3	0.32	7/3	0.38	8/3	0.28	9/3	0.17	10/3	0.16	11/3	0.08	12/3	0.08	1/3	0.08
1/4	0.07	2/4	0.11	3/4	0.10	4/4	0.18	5/4	0.20	6/4	0.31	7/4	0.31	8/4	0.32	9/4	0.23	10/4	0.16	11/4	0.08	12/4	0.07	1/4	0.06
1/5	0.08	2/5	0.10	3/5	0.12	4/5	0.19	5/5	0.22	6/5	0.29	7/5	0.32	8/5	0.32	9/5	0.22	10/5	0.17	11/5	0.09	12/5	0.07	1/5	0.06
1/6	0.13	2/6	0.11	3/6	0.15	4/6	0.19	5/6	0.22	6/6	0.30	7/6	0.32	8/6	0.32	9/6	0.25	10/6	0.17	11/6	0.08	12/6	0.11	1/6	0.05
1/7	0.14	2/7	0.11	3/7	0.14	4/7	0.20	5/7	0.21	6/7	0.30	7/7	0.31	8/7	0.31	9/7	0.27	10/7	0.17	11/7	0.1	12/7	0.06	1/7	0.08
1/8	0.06	2/8	0.08	3/8	0.15	4/8	0.23	5/8	0.14	6/8	0.31	7/8	0.3	8/8	0.33	9/8	0.26	10/8	0.17	11/8	0.07	12/8	0.07	1/8	0.07
1/9	0.07	2/9	0.09	3/9	0.16	4/9	0.22	5/9	0.25	6/9	0.31	7/9	0.32	8/9	0.32	9/9	0.25	10/9	0.19	11/9	0.1	12/9	0.08	1/9	0.06
1/10	0.03	2/10	0.12	3/10	0.16	4/10	0.24	5/10	0.21	6/10	0.30	7/10	0.31	8/10	0.32	9/10	0.21	10/10	0.16	11/10	0.09	12/10	0.08	1/10	0.07
1/11	0.06	2/11	0.02	3/11	0.16	4/11	0.21	5/11	0.25	6/11	0.28	7/11	0.32	8/11	0.24	9/11	0.22	10/11	0.15	11/11	0.09	12/11	0.06	1/11	0.07
1/12	0.07	2/12	0.00	3/12	0.16	4/12	0.23	5/12	0.28	6/12	0.27	7/12	0.31	8/12	0.31	9/12	0.23	10/12	0.17	11/12	0	12/12	0.05	1/12	0.07
1/13	0.07	2/13	0.01	3/13	0.19	4/13	0.19	5/13	0.22	6/13	0.28	7/13	0.32	8/13	0.27	9/13	0.23	10/13	0.16	11/13	0.08	12/13	0.04	1/13	0.07
1/14	0.06	2/14	0.08	3/14	0.17	4/14	0.06	5/14	0.18	6/14	0.30	7/14	0.33	8/14	0.28	9/14	0.27	10/14	0.19	11/14	0.08	12/14	0.06	1/14	0.08
1/15	0.08	2/15	0.11	3/15	0.04	4/15	0.18	5/15	0.25	6/15	0.32	7/15	0.33	8/15	0.3	9/15	0.27	10/15	0.2	11/15	0.06	12/15	0.06	1/15	0.07
1/16	0.08	2/16	0.11	3/16	0.10	4/16	0.20	5/16	0.28	6/16	0.29	7/16	0.25	8/16	0.29	9/16	0.27	10/16	0.15	11/16	0.06	12/16	0.08	1/16	0.07
1/17	0.09	2/17	0.08	3/17	0.18	4/17	0.18	5/17	0.27	6/17	0.30	7/17	0.21	8/17	0.28	9/17	0.25	10/17	0.15	11/17	0.07	12/17	0.05	1/17	0.08

1/18	0.08	2/18	0.10	3/18	0.18	4/18	0.16	5/18	0.26	6/18	0.32	7/18	0.28	8/18	0.3	9/18	0.21	10/18	0.16	11/18	0.08	12/18	0.06	1/18	0.08
January	**ETo(in)**	**February**	**ETo(in)**	**March**	**ETo(in)**	**April**	**ETo(in)**	**May**	**ETo(in)**	**June**	**ETo(in)**	**July**	**ETo(in)**	**August**	**ETo(in)**	**September**	**ETo(in)**	**October**	**ETo(in)**	**November**	**ETo(in)**	**December**	**ETo**	**January**	**ETo**
1/19	0.08	2/19	0.12	3/19	0.15	4/19	0.19	5/19	0.25	6/19	0.29	7/19	0.29	8/19	0.32	9/19	0.21	10/19	0.15	11/19	0.07	12/19	0.06	1/19	0.07
1/20	0.10	2/20	0.11	3/20	0.18	4/20	0.20	5/20	0.27	6/20	0.25	7/20	0.3	8/20	0.24	9/20	0.22	10/20	0.15	11/20	0.12	12/20	0.07	1/20	0.07
1/21	0.10	2/21	0.13	3/21	0.16	4/21	0.18	5/21	0.28	6/21	0.26	7/21	0.31	8/21	0.22	9/21	0.22	10/21	0.15	11/21	0.11	12/21	0.07	1/21	0.09
1/22	0.07	2/22	0.15	3/22	0.19	4/22	0.15	5/22	0.31	6/22	0.27	7/22	0.26	8/22	0.29	9/22	0.21	10/22	0.17	11/22	0.09	12/22	0.07	1/22	0.1
1/23	0.06	2/23	0.09	3/23	0.19	4/23	0.20	5/23	0.31	6/23	0.27	7/23	0.29	8/23	0.28	9/23	0.23	10/23	0.14	11/23	0.07	12/23	0.03	1/23	0.08
1/24	0.09	2/24	0.11	3/24	0.16	4/24	0.22	5/24	0.30	6/24	0.26	7/24	0.32	8/24	0.23	9/24	0.17	10/24	0.14	11/24	0.04	12/24	0.06	1/24	0.07
1/25	0.10	2/25	0.02	3/25	0.18	4/25	0.21	5/25	0.29	6/25	0.31	7/25	0.31	8/25	0.25	9/25	0.2	10/25	0.16	11/25	0.11	12/25	0.06	1/25	0.08
1/26	0.10	2/26	0.07	3/26	0.23	4/26	0.23	5/26	0.27	6/26	0.28	7/26	0.22	8/26	0.2	9/26	0.2	10/26	0.16	11/26	0.07	12/26	0.09	1/26	0.08
1/27	0.10	2/27	0.11	3/27	0.19	4/27	0.26	5/27	0.30	6/27	0.30	7/27	0.28	8/27	0.22	9/27	0.2	10/27	0.14	11/27	0.09	12/27	0.05	1/27	0.1
1/28	0.08	2/28	0.12	3/28	0.23	4/28	0.23	5/28	0.31	6/28	0.32	7/28	0.28	8/28	0.24	9/28	0.23	10/28	0.13	11/28	0.05	12/28	0.05	1/28	0.08
1/29	0.09			3/29	0.23	4/29	0.22	5/29	0.32	6/29	0.34	7/29	0.19	8/29	0.27	9/29	0.22	10/29	0.17	11/29	0.06	12/29	0.06	1/29	0.08
1/30	0.10			3/30	0.22	4/30	0.21	5/30	0.31	6/30	0.35	7/30	0.24	8/30	0.24	9/30	0.22	10/30	0.14	11/30	0.07	12/30	0.07	1/30	0.13
1/31	0.11			3/31	0.23			5/31	0.30			7/31	0.24	8/31	0.29			10/31	0.11			12/31	0.06	1/31	0.09
January	2.55	February	2.59	March	5.04	April	5.95	May	7.84	June	8.90	July	9.11	August	8.57	September	6.76	October	5.00	November	2.31	December	2.05	January	2.41
Daily Ave.	0.08	Daily Ave.	0.09	Daily Ave.	0.16	Daily Ave.	0.20	Daily Ave.	0.25	Daily Ave.	0.30	Daily Ave.	0.29	Daily Ave.	0.28	Daily Ave.	0.23	Daily Ave.	0.16	Daily Ave.	0.08	Daily Ave.	0.07	Daily Ave.	0.08

TABLE 2. CROP COEFFICIENTS (Kc) IN THE HIGH DESERT[1,5]

Date	Pasture ETo	Alfalfa[2]	Silage 4/1-8/25	Silage 6/15-10/15	Sudan[3]	Cereal Forage	Sugar Beets	Peas/ Beans	Onions	Carrots	Carrots	Potatoes	Deciduous[4] Fruit Trees	Melons	Sod
1/1	0.87	0.40				0.30									1.00
1/15	1.07	0.40				0.30									1.00
2/1	1.19	0.40				0.30				0.31					1.00
2/15	1.45	1.00				0.41				0.31					1.00
3/1	2.08	1.15				0.66			0.30	0.31		0.55	0.25		1.00
3/15	2.54	1.15				0.92	0.15	0.14	0.30	0.55		0.61	0.54	0.18	1.00
4/1	2.80	1.05	0.14			1.00	0.15	0.14	0.30	0.82		0.88	0.60	0.18	1.00
4/15	3.20	1.05	0.18			1.00	0.37	0.46	0.53	1.03		1.16	0.66	0.34	1.00
5/1	3.60	1.05	0.31			1.15	0.61	1.11	0.83	1.11	0.31	1.21	0.72	0.72	1.00
5/15	4.01	1.05	0.94			1.10	0.88	1.15	1.14	1.13	0.31	1.19	0.79	1.11	1.00
6/1	4.25	1.05	1.14	0.14		0.78	1.11	1.15	1.14	1.05	0.55	0.87	0.84	1.11	1.00
6/15	4.52	1.05	1.18	0.25	0.30		1.11	0.93	1.14	1.00	0.82	0.55	0.86	1.11	1.00
7/1	4.85	1.05	1.18	0.56	0.85		1.11	0.49	1.04		1.03		0.92	0.78	1.00
7/15	4.83	1.05	1.15	1.00	1.10		1.07		0.92		1.11		0.94	0.29	1.00
8/1	4.50	1.05	1.06	1.15	0.85		1.04		0.80		1.13		0.94		1.00
8/15	4.28	1.05	0.98	1.20	1.10		1.00		0.68		1.05		0.94		1.00
9/1	3.75	1.05		1.20	0.85		0.97						0.94		1.00
9/15	3.27	1.05		1.06	1.00								0.91		1.00
10/1	2.90	1.05			1.10								0.85		1.00
10/15	2.48	1.05			1.10								0.79		1.00
11/1	1.70	1.05											0.70		1.00
11/15	1.07	0.40													1.00
12/1	0.97	0.40													1.00
12/15	0.90	0.40													1.00
Total	67.08														

TABLE 3. CROP EVAPOTRANSPIRATION (ET_C IN INCHES) IN ANTELOPE VALLEY

Date	Pasture/ Sod	Alfalfa	Silage 4/1-8/25	Silage 6/15-10/15	Sudan	Cereal Forage	Sugar Beets	Peas/ Beans	Onions	Carrots	Carrots	Potatoes	Deciduous Fruit Trees	Melons
1/1	0.87	0.35				0.26								
1/15	1.07	0.43				0.32								
2/1	1.19	0.48				0.36				0.37				
2/15	1.45	1.45				0.60				0.45				
3/1	2.08	2.39				1.37			0.62	0.64		1.14	0.52	
3/15	2.54	2.92				2.34	0.38	0.36	0.76	1.40		1.55	1.37	0.46
4/1	2.80	2.94	0.39			2.80	0.42	0.39	0.84	2.30		2.46	1.68	0.50
4/15	3.20	3.36	0.56			3.20	1.18	1.47	1.70	3.30		3.71	2.11	1.09
5/1	3.60	3.78	1.13			4.14	2.20	4.00	2.99	4.00	1.12	4.36	2.59	2.59
5/15	4.01	4.21	3.76			4.41	3.53	4.61	4.57	4.53	1.24	4.77	3.17	4.45
6/1	4.25	4.46	4.83	0.58		3.32	4.72	4.89	4.85	4.46	2.34	3.70	3.57	4.72
6/15	4.52	4.75	5.33	1.13	1.36		5.02	4.20	5.15	4.52	3.71	2.49	3.89	5.02
7/1	4.85	5.09	5.72	2.73	4.12		5.38	2.38	5.04		5.00		4.46	3.78
7/15	4.83	5.07	5.55	4.83	5.31		5.17		4.44		5.36		4.54	1.40
8/1	4.50	4.73	4.78	5.18	3.83		4.68		3.60		5.09		4.23	
8/15	4.28	4.49	4.17	5.14	4.71		4.28		2.91		4.49		4.02	
9/1	3.75	3.94		4.50	3.19		3.64				0.00		3.53	
9/15	3.27	3.43		3.47	3.27						0.00		2.98	
10/1	2.90	3.05			3.19								2.47	
10/15	2.48	2.60			2.73								1.96	
11/1	1.70	1.79											1.19	
11/15	1.07	0.43												
12/1	0.97	0.39												
12/15	0.90	0.36												
Total Inches Of Net Water Use	67.08	66.89	36.22	27.56	31.71	23.12	40.60	22.30	37.47	25.97	28.35	24.18	48.28	24.01

TABLE 4. GROSS AND NET CROP WATER REQUIREMENTS (IN INCHES) IN ANTELOPE VALLEY

	Pasture/ Sod	Alfalfa	Silage 4/1-8/25	Silage 6/15-10/15	Sudan	Cereal Forage	Sugar Beets	Peas/ Beans	Onions	Carrots	Carrots	Potatoes	Deciduous Fruit Trees	Melons
Net Evapo-transpiration Water Requirement	67.08	66.89	36.22	27.56	31.71	23.12	40.60	22.30	37.47	25.97	28.35	24.18	48.28	24.01
Net Soil Erosion Water Requirement									3.54	4.46	6.08			
Net Non-Growing Water Requirement[10]	0.00	2.00	4.00	4.00	4.00	4.00	4.00	4.00	6.00[7]	6.50[8]	6.50[8]	4.00	0.00	4.00
Total Net Water Requirement	67.08	68.89	40.22	31.56	35.71	27.12	44.60	26.30	47.01	36.93	40.93	30.18	48.28	28.01
Irrigation Efficiency	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%[9]	75%
Gross Water Requirement														
Inches	89.44	91.85	53.63	42.08	46.80	36.16	59.47	35.07	62.68	49.24	54.57	40.24	64.37	37.35
Acre Feet	7.45	7.65	4.47	3.51	3.90	3.01	4.96	2.92	5.22	4.10	4.55	3.35	5.36	3.11

References

1) Crop Coefficients were adapted from two references: Hansen, B.R., Shwannkl, L., and Fulton, A. "Scheduling Irrigations: When and How Much Water to Apply," Water Management Series Publication Number 3396, Dept. of Land, Air & Water Resources, University of California, Davis, California and Pruitt, W. O., Fereres, E., Kelta, K., and Snyder, R. L., "Reference Evapotransppiration (ETo) for California," UC Bull. 1922
2) Kc of 1.05 takes into account reduced ET during the cuttings throughout the season. Since some alfalfa varieties go dormant during major portions of December and January and some rainfall may occur during this period, perhaps about 3 inches of applied water need not be applied during this period.
3) Sudan was cut on 7/1, 8/16, and 10/16. ET was reduced for 1 to 2 weeks after cutting.
4) Deciduous Fruit Tree Crop Coefficients were adapted from Orloff, S. B. "Deciduous Orchard Water Use, clean cultivated trees for a normal year in Littlerock, Local Extension Publication
5) Pasture ETo and Forage Crop Coefficients were drafted by B. L. Sanden, Kern County Farm Advisor, 2002, and modified by G. J. Poole, Los Angeles County Farm Advisor, 2004
6) Assumes a 5-year life of an alfalfa stand and includes the water requirement for pre-irrigation before field preparation and planting.
7) Water is required for pre-irrigation before field preparation, fumigation and "water capping" after fumigation.
8) Water is required for pre-irrigation before field preparation, fumigation and "water capping" after fumigation.
9) From 1991 on, drip irrigation in orchards became popular and the irrigation efficiency increased to 90%.
10) These water requirements are not included elsewhere.

NEBEKER RANCH, INC.
LANCASTER, CALIFORNIA

MAIL ADDRESS:
400 N. Rockingham Avenue
Los Angeles, CA 90049
310-440-8862

March 25, 2008

Dr, Blaine Hanson
Extension Irrigation and Drainage Specialist
Department of Land, Air and Water Resources
113 Veihmeyer Hall
University of California, Davis

Dear Dr. Hanson:

I would appreciate it if you and your colleagues would comment on:

Crop Water Requirements for Antelope Valley

You and your colleagues helped me assemble the document "An Estimate of Crop Water Requirements in the Antelope Valley" dated April 19, 2007. Are these values accurate and reasonable estimates of crop water requirements for this area?

Relation Between Applied Water and Net Water Required for Irrigation

The relation between Applied Water and Net Water is:

Applied Water = Net Water/(Distribution Uniformity – Miscellaneous Unavoidable Losses)

where Distribution Uniformity is the "catch-can" distribution uniformity and Miscellaneous Unavoidable Losses include scheduling difficulties, maintenance, breaks, unexpected pressure losses, and other problems often encountered in the field. The denominator in the above equation is often referred to as the "Irrigation Efficiency." This denominator is only Distribution Uniformity for an ideal system in which Irrigation Management Practices are zero and not for a real system in the field.

Net Water

Net Water in the above equation is the sum of all beneficial uses of water not simply water for evapotranspiration. Other beneficial uses include water to control soil erosion when the plants are small and all water used during the non-growing time periods that include water preceding field preparation, fumigation and "water capping."

Fate of the Difference Between Applied Water and Net Water

All of the difference between Applied Water and Net Water is not return flow. This difference needs to be divided between at least four factors including losses between the sprinkler nozzles and the soil, pooling in the fields, runoff, and return flows. Quantifying these values is a challenge. After discussing this issue with University of California specialists, I estimated the following ranges of these values as a percent of Applied Water that may occur in the Antelope Valley:

Return Flow	4% to 25% [1]
Losses Between the Sprinkler Nozzles and the Soil	3% to 15% [2]
Pooling in the Fields	0% to 3%
Runoff	0% to 3%

1 Minimum Leaching Requirements are Estimated at 4%
2 These losses may be 2 to 5% greater during the hot, dry winds in Antelope Valley

Thank you for your assistance in this matter.

Eugene B. Nebeker, Ph.D., P.E.
President

cc: Mr. Steve Orloff, University of California Cooperative Extension Farm Advisor

UNIVERSITY OF CALIFORNIA, DAVIS

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DAVIS, CALIFORNIA 95616-8628

April 22, 2008

Dr. Gene Nebeker
400 N. Rockingham
Los Angeles, CA 90049

Dear Gene:

In response to your letter of March 25, 2008, the following are offered:

1. Crop Water Requirements for Antelope Valley

Crop evapotranspiration (ET) is by far the largest beneficial use. The potential ET is calculated as the product of crop coefficients and a reference crop ET, obtained from the CIMIS network. Crop coefficients are developed from field studies, either on an agricultural experiment station or in commercial fields, by making direct measurements of the crop ET using lysimeters or meteorological methods and then calculating the ratio of the crop ET to the reference crop ET.

You assembled the document "An Estimate of Crop Water Requirements in the Antelope Valley" dated April 19, 2007 with assistance from University of California farm advisors or former advisors and UC specialists working in crop ET. The document lists estimates of crop coefficients of crops grown in the area in question and historical reference crop ET. After reviewing these data, in our opinion, they are the best available information on this matter and are as accurate as possible for your area. For example, your estimate of the seasonal alfalfa ET is reasonable when compared to estimates for the Imperial Valley or Arizona, both of which have extremely hot summer climates.

2. Relation between Applied Water and Net Water Required for Irrigation

You have described a relation between Applied Water and Net Water as:

> Applied Water = Net Water/(Distribution Uniformity – Miscellaneous Unavoidable Losses)

You have defined Miscellaneous Unavoidable Losses to include scheduling difficulties, maintenance, breaks, unexpected pressure losses, and other problems often encountered in the field. In theory, we feel that including the Miscellaneous Unavoidable Losses in the efficiency equation is appropriate, but caution should be used in promoting these losses as necessary adjustments to the water supply. For example, one could argue that losses due to irrigation scheduling difficulties could be avoided if growers paid more attention to water management. Note that in your equation, these losses are expressed as a fraction of the total amount of applied water. Confusion can exist in the appropriate value to be used for distribution uniformity (DU) because of the different definitions of DU. One definition is the catch can uniformity which accounts for the nonuniform water applications due to the sprinkler spacings. However, the field-wide DU not only includes the catch can

uniformity (which is usually the dominate factor in the field-wide DU in the valley), but also nonuniformity due to pressure losses throughout the field, leaks, non-vertical risers, and mixed nozzle sizes (which should be avoided).

The field wide DU should be used in your equation. The article, "Practical Potential Irrigation Efficiencies", (B. Hanson, Proceedings of the First International Conference, American Society of Civil Engineers, August 14-18, 1995) lists estimates of practical maximum irrigation efficiencies based on the practical maximum attainable field-wide uniformities (sometimes called the global uniformity) for different irrigation methods. These estimates are based on irrigation system evaluations conducted by mobile irrigation evaluation laboratories throughout the state.

A reasonable estimate of the field-wide DU of portable solid set sprinkler systems is about 75% under low wind conditions. This means that about 25% of the water reaching the ground surface would be deep percolation assuming no other losses, which in your case, you feel that there are other losses that do not become deep percolation. However, as the wind speed increases above about 5 miles per hour, the catch can DU decreases rapidly, as does the field wide DU.

3. Net Water

We agree that the Net Water in the above equation is the sum of all beneficial uses of water not simply water for evapotranspiration. Other beneficial uses include water to control soil erosion when the plants are small and all water used during the non-growing time periods that include water preceding field preparation, fumigation and "water capping." These additional beneficial uses can reflect the site specific conditions of your area and grower experience. In our opinion, these additional beneficial uses are reasonable.

4. Fate of the Difference between Applied Water and Net Water

It is frequently assumed that the difference between Applied Water and Net Water is deep percolation. However, you feel that this difference needs to be divided between at least four sinks including losses between the sprinkler nozzles and the soil, pooling in the fields, runoff, and return flows or deep percolation. As you stated, quantifying these values is a challenge, and some cases can only be based on grower experience. Your estimates of these values for the Antelope Valley are:

Return Flow	4% to 25%[1]
Losses between the Sprinkler Nozzles and the Soil	3% to 15%[2]
Pooling in the Fields	0% to 3%
Runoff	0% to 3%

1 Minimum Leaching Requirements are estimated at 4%

2 These losses may be 2 to 5% greater during the hot, dry winds in Antelope Valley

We feel that these sinks are reasonable descriptions of the partitioning. However, the return flow minimum value (based on a leaching requirement of 4%) needs to be adjusted upward. No irrigation method can apply water such that 4% of the applied water is return flow unless the field is severely under irrigated. Basing irrigation water management on minimum leaching requirements is not very practical, in our opinion. A rough guess for the minimum return flow is 15 to 20%. The values for evaporation losses can be justified from research results. A commonly used value is 10% (based on research results); however, it could be more under the Antelope Valley conditions. No research data exists on the other sinks, and thus, grower experience is the only source of these estimates.

Sincerely,

Blaine Hanson
Extension Irrigation and Drainage Specialist
Dept. of Land, Air and Water Resources
University of California, Davis

Steve Orloff
Farm Advisor, Siskiyou County and former Farm Advisor, Los Angeles County
University of California Cooperative Extension

APPLIED AG WATER (Problem Statement)

ACREAGE TOTAL (1)

Year	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	TOTAL
1995	7,093	4,754	869	2,411	1,342	120	550	0	0	17,139
1996	7,088	4,441	3,370	2,755	1,386	180	374	0	0	19,593
1997	7,492	3,922	5,506	2,818	1,411	75	529	0	15	21,768
1998	7,300	1,905	8,139	2,982	1,607	75	324	320	24	22,677
1999	8,417	1,378	8,162	2,706	1,749	75	285	480	26	23,277
2000	8,720	1,452	10,787	3,304	2,124	408	244	797	33	27,868
2001	7,808	1,624	9,485	2,992	2,143	265	237	598	49	25,200
2002	7,958	1,702	14,128	2,223	1,447	40	323	459	54	28,335
2003	7,261	1,546	11,782	3,778	1,410	80	216	665	63	26,801
2004	7,703	1,783	10,954	3,288	1,426	40	216	394	140	25,944
2005	7,074	2,626	9,909	3,358	1,363	40	231	470	107	25,178
2006	6,741	2,865	8,126	3,242	1,802	0	77	562	113	23,528
2007										
2008										

WATER APPLICATION TOTAL (AF)

	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	SUB TOTAL	PLUS Unreported Farms (3)	MINUS Surface Water (4)	MINUS Reclaim Water (4)	TOTAL APPLIED GROUND-WATER
Applied Water Rqrmnt /acre (2)	6.5	2.6	3.9	4.5	4.9	4.6	2.8	2.8	3.7					
1995	46,105	12,360	3,389	10,850	6,576	552	1,540	0	0	81,371	4,068	(12,846)	(3,294)	**69,299**
1996	46,072	11,547	13,143	12,398	6,791	828	1,047	0	0	91,826	4,591	(18,245)	(3,602)	**74,570**
1997	48,698	10,197	21,473	12,681	6,914	345	1,481	0	56	101,845	5,092	(23,691)	(3,838)	**79,408**
1998	47,450	4,953	31,742	13,419	7,874	345	907	896	89	107,675	5,384	(17,110)	(3,414)	**92,535**
1999	54,711	3,583	31,832	12,177	8,570	345	798	1,344	96	113,455	5,673	(25,235)	(3,678)	**90,215**
2000	56,680	3,775	42,069	14,868	10,408	1,877	683	2,232	122	132,714	6,636	(28,221)	(4,381)	**106,748**
2001	50,752	4,222	36,992	13,464	10,501	1,219	664	1,674	181	119,669	5,983	(19,643)	(4,597)	**101,412**
2002	51,727	4,425	55,099	10,004	7,090	184	904	1,285	200	130,919	6,546	(10,138)	(6,628)	**120,699**
2003	47,197	4,020	45,950	17,001	6,909	368	605	1,862	233	124,144	6,207	(6,390)	(7,501)	**116,460**
2004	50,070	4,636	42,721	14,796	6,987	184	605	1,103	518	121,619	6,081	(7,682)	(8,142)	**111,876**
2005	45,981	6,828	38,645	15,111	6,679	184	647	1,316	396	115,786	5,789	(9,282)	(9,998)	**102,295**
2006	43,817	7,449	31,691	14,589	8,830	0	216	1,574	418	108,583	5,429	(12,731)	(11,797)	**89,484**
2007														
2008														

(1) Problem Statement Appendix D, Table D.2-1b
(2) Problem Statement Appendix D-3, Table 4
(3) 5% of Subtotal, Problem Statement Appendix D, Table D.3-1
(4) Problem Statement Appendix D, Table D.4-4

APPLIED AG WATER (U of C)

Year	ACREAGE TOTAL (1)									
	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	TOTAL
1995	7,093	4,754	869	2,411	1,342	120	550	0	0	17,139
1996	7,088	4,441	3,370	2,755	1,386	180	374	0	0	19,593
1997	7,492	3,922	5,506	2,818	1,411	75	529	0	15	21,768
1998	7,300	1,905	8,139	2,982	1,607	75	324	320	24	22,677
1999	8,417	1,378	8,162	2,706	1,749	75	285	480	26	23,277
2000	8,720	1,452	10,787	3,304	2,124	408	244	797	33	27,868
2001	7,808	1,624	9,485	2,992	2,143	265	237	598	49	25,200
2002	7,958	1,702	14,128	2,223	1,447	40	323	459	54	28,335
2003	7,261	1,546	11,782	3,778	1,410	80	216	665	63	26,801
2004	7,703	1,783	10,954	3,288	1,426	40	216	394	140	25,944
2005	7,074	2,626	9,909	3,358	1,363	40	231	470	107	25,178
2006	6,741	2,865	8,126	3,242	1,802	0	77	562	113	23,528
2007										
2008										

Year	WATER APPLICATION TOTAL (AF)														
	Alfalfa	Grain	Carrots	Onions	Orchards	Sugar Beets	Melons and Squash	Potatoes	Grapes	SUB TOTAL	PLUS Unreported Farms (3)	MINUS Surface Water (4)	MINUS Reclaim Water (4)	TOTAL APPLIED GROUND-WATER	Difference (U of C - Prob Stmt)
Applied Water Rqrmnt /acre (2)	7.65	3.05	4.6	5.22	5.36	4.96	3.11	3.35	3.7						
1995	54,261	14,500	3,997	12,585	7,193	595	1,711	0	0	94,843	4,068	(12,846)	(3,294)	**82,771**	**13,471**
1996	54,223	13,545	15,502	14,381	7,429	893	1,163	0	0	107,136	4,591	(18,245)	(3,602)	**89,880**	**15,311**
1997	57,314	11,962	25,328	14,710	7,563	372	1,645	0	56	118,949	5,092	(23,691)	(3,838)	**96,512**	**17,104**
1998	55,845	5,810	37,439	15,566	8,614	372	1,008	1,072	89	125,815	5,384	(17,110)	(3,414)	**110,675**	**18,139**
1999	64,390	4,203	37,545	14,125	9,375	372	886	1,608	96	132,601	5,673	(25,235)	(3,678)	**109,361**	**19,145**
2000	66,708	4,429	49,620	17,247	11,385	2,024	759	2,670	122	154,963	6,636	(28,221)	(4,381)	**128,997**	**22,249**
2001	59,731	4,953	43,631	15,618	11,486	1,314	737	2,003	181	139,656	5,983	(19,643)	(4,597)	**121,399**	**19,987**
2002	60,879	5,191	64,989	11,604	7,756	198	1,005	1,538	200	153,359	6,546	(10,138)	(6,628)	**143,139**	**22,440**
2003	55,547	4,715	54,197	19,721	7,558	397	672	2,228	233	145,267	6,207	(6,390)	(7,501)	**137,583**	**21,124**
2004	58,928	5,438	50,388	17,163	7,643	198	672	1,320	518	142,269	6,081	(7,682)	(8,142)	**132,526**	**20,650**
2005	54,116	8,009	45,581	17,529	7,306	198	718	1,575	396	135,428	5,789	(9,282)	(9,398)	**121,937**	**19,642**
2006	51,569	8,738	37,380	16,923	9,659	0	239	1,883	418	126,809	5,429	(12,731)	(11,797)	**107,710**	**18,226**
2007															
2008															

(1) Problem Statement Appendix D, Table D.2-1b
(2) University of CA, Table 4 (2007)
(3) 5% of Subtotal, Problem Statement Appendix D, Table D.3-1
(4) Problem Statement Appendix D, Table D.4-4

Table D.2-1b
Summary of Historical Crop Acreages Grouped by Applied Crop Water Requirements
Crop Acreages Shown by County and in Total for the Antelope Valley

		Los Angeles County Portion of Antelope Valley										Kern County Portion of Antelope Valley										Total Acreage for Antelope Valley									
Year	Source	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Total	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Total	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Total
1910	(1)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	4,629
1919	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7,155	----	----	----	----	----	----	----	----	11,960
1920	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7,400	----	----	----	----	----	----	----	----	----
1922	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7,000	----	----	----	----	----	----	----	----	----
1924	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	12,000	----	----	----	----	----	----	----	----	16,780
1925	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	14,000	----	----	----	----	----	----	----	----	----
1927	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	20,250	----	----	----	----	----	----	----	----	----
1929	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	25,000	----	----	----	----	----	----	----	----	31,420
1930	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	22,000	----	----	----	----	----	----	----	----	----
1931	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	21,700	----	----	----	----	----	----	----	----	----
1934	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15,317	----	----	----	----	----	----	----	----	23,800
1935	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	16,000	----	----	----	----	----	----	----	----	----
1938	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	23,000	----	----	----	----	----	----	----	----	----
1939	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	20,000	----	----	----	----	----	----	----	----	----
1945	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	29,600	----	----	----	----	----	----	----	----	37,795
1945	(3)	30,000	9,000	----	----	2,260	----	740	----	----	42,000	----	4,000	----	----	----	----	----	----	----	4,000	30,000	13,000	----	----	2,260	----	740	----	----	46,000
1946	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	31,500	----	----	----	----	----	----	----	----	40,027
1947	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	34,700	----	----	----	----	----	----	----	----	----
1948	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	37,700	----	----	----	----	----	----	----	----	----
1949	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	38,900	----	----	----	----	----	----	----	----	52,497
1950	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	38,526	----	----	----	----	----	----	----	----	54,666
1950	(4)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	62,200	4,200	----	----	4,500	200	100	----	0	71,200
1951	(2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	39,845	----	----	----	----	----	----	----	----	54,455
1957	(5)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	37,530	14,570	----	----	1,540	2,210	1,290	----	0	57,140
1961	(6)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	43,950	4,890	----	----	1,410	2,290	2,110	----	60	54,710
1970	(7)	29,200	15,300	----	60	1,855	1,500	100	----	----	48,015	3,633	1,689	80	907	520	960	854	0	0	8,643	32,833	16,989	80	967	2,375	2,460	954	0	0	56,658
1971	(7)	26,400	23,700	----	----	1,867	1,500	150	----	----	53,617	4,057	1,886	89	1,013	581	1,072	953	0	0	9,651	30,457	25,586	89	1,013	2,448	2,572	1,103	0	0	63,268
1972	(7)	23,400	18,000	----	80	1,591	1,500	85	----	----	42,656	3,228	1,500	71	806	462	853	758	0	0	7,678	26,628	17,500	71	886	2,053	2,353	843	0	0	50,334
1972	(8)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	36,080	1,390	----	----	1,400	----	----	----	60	42,290
1973	(7)	21,800	18,100	----	240	1,590	1,220	70	----	----	43,020	3,255	1,513	72	813	466	860	765	0	0	7,744	25,055	19,613	72	1,053	2,056	2,080	835	0	0	50,764
1974	(7)	20,200	23,700	----	250	1,540	1,070	155	----	----	46,915	3,550	1,650	78	886	508	938	834	0	0	8,445	23,750	25,350	78	1,136	2,048	2,008	989	0	0	55,360
1975	(7)	19,400	27,150	----	700	1,393	1,200	200	----	----	50,043	3,787	1,760	83	945	542	1,001	890	0	0	9,008	23,187	28,910	83	1,645	1,935	2,201	1,090	0	0	59,051
1976	(7)	20,375	11,800	----	1,200	1,162	1,868	480	----	----	36,885	2,791	1,297	61	697	400	738	656	0	0	6,639	23,166	13,097	61	1,897	1,562	2,606	1,136	0	0	43,524
1977	(7)	23,375	18,500	1,160	2,500	1,162	3,700	340	500	----	51,237	3,877	1,802	85	968	555	1,025	911	0	0	9,223	27,252	20,302	1,245	3,468	1,717	4,725	1,251	500	0	60,460
1978	(7)	23,400	16,250	----	1,700	1,180	3,200	311	----	----	46,041	3,484	1,619	77	870	499	921	819	0	0	8,287	26,884	17,869	77	2,570	1,679	4,121	1,130	0	0	54,328
1979	(7)	22,600	10,034	90	1,715	1,219	2,200	150	80	----	38,288	2,897	1,346	64	723	415	766	681	0	0	6,892	25,697	11,380	154	2,438	1,634	2,966	831	80	0	45,180
1980	(7)	22,600	12,395	50	425	1,349	3,880	315	----	----	40,994	3,102	1,442	88	774	444	820	729	0	0	7,379	25,702	13,837	118	1,199	1,793	4,680	1,044	0	0	48,373
1981	(7)	20,100	11,500	80	977	1,015	2,775	420	----	----	35,867	2,790	1,296	61	696	399	737	655	0	0	6,636	22,890	12,796	141	1,673	1,414	3,512	1,075	0	0	43,503
1982	(7)	16,300	12,850	180	1,433	1,046	340	625	----	----	32,774	2,480	1,153	55	619	355	655	583	0	0	5,899	18,780	14,003	235	2,052	1,401	995	1,208	0	0	38,673
1983	(7)	13,957	14,717	----	1,810	1,004	317	585	----	----	32,390	2,451	1,139	54	612	351	648	576	0	0	5,830	16,408	15,856	54	2,422	1,355	965	1,161	0	0	38,220
1984	(7)	12,058	12,888	61	1,447	1,047	260	597	----	----	28,348	2,145	997	47	535	307	567	504	0	0	5,103	14,213	13,885	108	1,983	1,354	827	1,101	0	0	33,451
1985	(7)	10,593	11,726	71	1,548	993	0	543	----	----	25,474	1,928	896	42	481	276	509	453	0	0	4,585	12,520	12,622	113	2,030	1,269	509	996	0	0	30,059
1986	(7)	8,461	9,719	85	1,451	862	----	389	----	----	20,968	1,587	737	35	396	227	419	373	0	0	3,774	10,047	10,457	120	1,847	1,090	419	762	0	0	24,742
1986	(9)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	9,860	1,330	----	----	1,970	----	----	----	30	15,530
1987	(7)	8,857	2,641	92	1,467	936	----	246	----	----	14,248	1,138	528	25	284	163	301	267	0	0	2,707	10,005	3,169	117	1,751	1,099	301	514	0	0	16,956
1988	(7)	7,598	7,674	74	1,668	965	----	389	----	----	18,369	1,622	754	35	405	232	429	381	0	0	3,857	9,220	8,428	110	2,073	1,197	429	770	0	0	22,226
1989	(7)	6,230	831	86	1,642	1,005	----	46	----	----	9,840	951	442	21	237	136	251	224	0	0	2,263	7,182	1,273	106	1,879	1,141	251	270	0	0	12,103
1990	(7)	6,223	1,023	110	1,519	1,057	----	47	----	----	9,979	1,049	467	23	282	150	277	246	0	0	2,495	7,271	1,511	133	1,781	1,206	277	294	0	0	12,474
1991	(7)	5,799	768	27	1,656	1,015	----	103	----	----	9,367	1,063	494	23	265	152	281	250	0	0	2,529	6,862	1,262	50	1,922	1,167	281	353	0	0	11,896
1992	(7)	5,281	5,412	4	1,832	1,031	----	149	----	----	13,609	1,647	765	36	411	236	435	387	0	0	3,918	6,928	6,177	40	2,043	1,267	435	536	0	0	17,526
1993	(7)	5,582	1,815	16	1,533	1,315	----	125	----	----	10,386	1,353	629	30	338	194	358	318	0	0	3,219	6,935	2,444	46	1,871	1,509	358	442	0	0	13,604
1994	(7)	5,528	2,621	21	1,319	1,505	----	191	----	----	11,184	1,362	633	30	340	195	360	320	0	0	3,240	6,890	3,254	51	1,659	1,700	360	511	0	0	14,424
1995	(7)	5,462	4,263	549	1,836	1,257	----	180	----	----	13,347	1,631	491	320	775	85	120	370	0	0	3,792	7,093	4,754	869	2,411	1,342	120	550	0	0	17,139
1996	(7)	5,537	3,712	2,324	1,493	1,196	----	186	----	----	14,447	1,551	729	1,046	1,262	190	180	188	0	0	5,146	7,088	4,441	3,370	2,755	1,386	180	374	0	0	19,593
1997	(7)	5,505	3,317	3,811	1,893	1,261	----	203	----	15	16,005	1,987	605	1,695	925	150	75	326	0	0	5,763	7,492	3,922	5,506	2,818	1,411	75	529	0	15	21,768
1998	(7)	5,265	1,560	5,252	2,377	1,457	----	179	----	24	16,115	2,035	345	2,887	605	150	75	145	320	0	6,562	7,300	1,905	8,139	2,982	1,607	75	324	320	24	22,677
1999	(7)	6,087	1,033	5,508	2,166	1,704	----	215	----	26	16,718	2,350	345	2,854	540	45	75	70	480	0	6,559	8,417	1,378	8,162	2,706	1,749	75	285	480	26	23,277
2000	(7)	6,165	1,074	8,132	2,284	1,959	----	129	----	33	19,755	2,555	378	2,655	1,040	165	408	115	797	0	8,113	8,720	1,452	10,787	3,304	2,124	408	244	797	33	27,868
2001	(7)	5,705	1,160	7,417	1,697	2,023	----	117	----	49	18,167	2,103	464	2,068	1,295	120	285	120	598	0	7,033	7,808	1,624	9,485	2,992	2,143	285	237	598	49	25,200
2002	(7)	5,203	1,307	9,964	1,686	1,327	----	228	----	54	19,770	2,755	395	4,164	537	120	40	95	459	0	8,565	7,958	1,702	14,128	2,223	1,447	40	323	459	54	28,335
2003	(7)	5,461	1,371	8,555	2,758	1,340	----	136	----	63	19,684	1,800	175	3,227	1,020	70	80	80	665	0	7,117	7,261	1,546	11,782	3,778	1,410	80	216	665	63	26,801
2004	(7)	5,728	1,282	7,403	2,833	1,279	----	131	----	74	18,730	1,975	501	3,551	455	147	40	85	394	66	7,214	7,703	1,783	10,954	3,288	1,426	40	216	394	140	25,944
2005	(7)	5,583	1,520	5,361	2,623	1,293	----	101	----	107	16,588	1,491	1,106	4,548	735	70	40	130	470	0	8,590	7,074	2,626	9,909	3,358	1,363	40	231	470	107	25,178
2006	(7)	5,556	1,960	3,754	1,838	1,304	----	77	----	113	14,602	1,185	905	4,372	1,404	498	0	0	562	0	8,926	6,741	2,865	8,126	3,242	1,802	0	77	562	113	23,528

(1) Tait, S.E., 1912
(2) Snyder, J. Herbert, 1955
(3) California Division of Water Resources, 1947
(4) State Water Resources Board, 1955
(5) California Department of Water Resources, 1963
(6) California Department of Water Resources, 1965
(7) Los Angeles and Kern County Agricultural Commissioners, 1970 - 2006 and 1994-2006
(8) California Department of Water Resources, 1974
(9) California Department of Water Resources, 1990

(1): Area Northern Boundary Unknown
(2, 3, and 7): Area Northern Boundary at Cottonwood-Willow Springs-Rosamond Fault
(4, 5, 6, and 9): Area Northern Boundary defined by Antelope Valley Hydrographic Unit (encompasses towns of Mojave and Boron)

Table D.3-1
Historical Agricultural Water Requirements by Investigator and Calculation Parameters
Antelope Valley Area of Adjudication
(all values in acre-feet)

	Reported Values (Snyder, 1955)[1]		Calculated from DWR Crop Acreages, DWR Crop Consumptive Use Values, and Irrigation Efficiencies of 70 - 90%[3]									Calculated from County Crop Report Acreages and CIMIS-Derived Applied Crop Water Duties (DU = 80%; Irrigation Efficiencies = 59 to 80%)											
	Total	Current Estimate[2]	Alfalfa	Other Pasture	Grain and Hay	Field	Deciduous	Truck	Vineyard	Total	Current Estimate[4]	Alfalfa/ Pasture	Grain	Carrots	Onions	Orchard	Sugar Beets	Melons and Squash	Potatoes	Grapes	Subtotal	Unreported Farms	Total	Historical Total
Applied Water Duties (af/ac)	1.4 - 7.5		3.0 (7.2)	2.8 (7.7)	0.8 (2.6)	1.5 (4.5)	2.2 (5.6)	1.4 (4.0)	2.4 (4.2)			6.5	2.6	3.9	4.5	4.9	4.6	2.8	2.8	3.7		(5% of Subtotal)		
Year																								
1919	64,200	77,565																						77,565
1920	66,600	80,606																						80,606
1925	96,600	121,746																						121,746
1927	131,400	167,566																						167,566
1929	160,000	204,724																						204,724
1930	141,600	180,112																						180,112
1935	102,600	130,176																						130,176
1940	168,400	202,348																						202,348
1945	210,800	255,311	90,000		13,000		4,520	1,480		109,000	256,416													255,311
1946	226,000	273,960																						273,960
1947	261,400	296,757																						296,757
1948	304,800	322,497																						322,497
1949	322,900	327,685																						327,685
1950	350,500	347,676	207,000	311	3,733	333	11,000	156	0	222,533	435,310													347,676
1951	366,200	362,549																						362,549
1957			138,900	20,480	16,651	4,736	4,840	2,580	0	188,187	334,387													334,387
1961			177,086	10,520	5,569	4,807	4,431	4,220	206	206,959	357,362													357,362
1970												213,415	44,170	312	4,351	11,638	11,317	2,670	0	0	287,875	14,394	302,268	302,268
1971												197,971	66,522	349	4,557	11,894	11,833	3,089	0	0	296,315	14,816	311,131	311,131
1972			147,429	6,720	1,589	5,679	4,400	1,420	206	167,441	287,087	173,080	45,500	277	3,986	10,060	10,824	2,361	0	0	246,089	12,304	258,393	258,393
1973												162,859	50,993	280	4,737	10,075	9,570	2,337	0	0	240,850	12,043	252,893	252,893
1974												154,374	65,910	305	5,113	10,036	9,236	2,769	0	0	247,746	12,387	260,133	260,133
1975												160,713	75,166	325	7,404	9,482	10,124	3,051	0	0	266,264	12,813	269,078	269,078
1976												150,579	34,053	240	8,535	7,652	11,986	3,160	0	0	216,224	10,811	227,036	227,036
1977												177,138	52,785	4,857	15,605	8,414	21,734	3,502	1,400	0	285,434	14,272	299,706	299,706
1978												174,744	46,460	299	11,563	8,226	18,956	3,163	0	0	263,411	13,171	276,582	276,582
1979												167,031	29,589	600	10,972	8,006	13,642	2,326	224	0	232,390	11,620	244,010	244,010
1980												167,062	35,975	461	5,397	8,786	21,627	2,923	0	0	242,132	12,107	254,239	254,239
1981												148,782	33,271	552	7,530	6,931	16,157	3,011	0	0	216,234	10,812	227,045	227,045
1982												122,069	36,407	915	9,234	6,865	4,579	3,381	0	0	183,451	9,173	192,624	192,624
1983												108,651	41,226	211	10,898	6,639	4,438	3,250	0	0	173,313	8,666	181,978	181,978
1984												92,383	36,049	422	8,823	6,636	3,804	3,082	0	0	151,300	7,565	158,865	158,865
1985												81,381	32,817	441	8,133	6,219	2,344	2,789	0	0	135,123	6,756	141,879	141,879
1986			37,757	4,200	1,520	129	6,191	4,760	103	54,660	95,923	65,307	27,188	468	8,313	5,339	1,929	2,133	0	0	110,676	5,534	116,210	116,210
1987												65,033	8,240	455	7,880	5,385	1,364	1,438	0	0	89,815	4,491	94,306	94,306
1988												59,929	21,912	428	9,327	5,867	1,872	2,156	0	0	101,591	5,080	106,671	106,671
1989												46,660	3,311	415	8,455	5,591	1,157	755	0	0	66,365	3,318	69,683	69,683
1990												47,263	3,927	519	8,014	5,917	1,275	822	0	0	67,738	3,387	71,125	71,125
1991												44,604	3,281	195	8,647	5,717	1,293	988	0	0	64,725	3,236	67,961	67,961
1992												45,028	16,061	156	9,193	6,208	2,002	1,502	0	0	80,151	4,008	84,158	84,158
1993												45,076	8,353	179	8,417	7,395	1,645	1,238	0	0	70,305	3,515	73,820	73,820
1994												44,782	8,450	199	7,466	8,328	1,856	1,429	0	0	72,320	3,616	75,937	75,937
1995												46,103	12,360	3,389	10,848	6,577	552	1,540	0	0	81,369	4,068	85,438	85,438
1996												46,059	11,547	13,143	12,395	6,791	828	1,047	0	0	91,820	4,591	96,411	96,411
1997												48,695	10,198	21,473	12,683	6,916	345	1,480	0	55	101,845	5,092	106,937	106,937
1998												47,453	4,953	31,742	13,417	7,874	345	908	896	90	107,678	5,384	113,062	113,062
1999												54,713	3,582	31,832	12,176	8,568	345	797	1,344	96	113,452	5,673	119,125	119,125
2000												56,681	3,774	42,069	14,667	10,407	1,877	683	2,232	122	132,712	6,636	139,348	139,348
2001												50,750	4,222	38,992	13,466	10,500	1,219	664	1,674	179	119,666	5,983	125,649	125,649
2002												51,729	4,425	55,099	10,002	7,092	184	904	1,285	201	130,922	6,546	137,468	137,468
2003												47,197	4,020	45,950	17,000	6,910	368	604	1,862	232	124,143	6,207	130,350	130,350
2004												50,068	4,636	42,721	14,797	6,936	184	606	1,103	519	121,620	6,081	127,701	127,701
2005												45,982	8,827	38,645	15,113	6,677	184	645	1,316	397	115,787	5,789	121,576	121,576
2006												43,817	7,449	31,691	14,589	8,830	0	216	1,674	418	108,583	5,429	114,012	114,012

1) Calculated from Reported Crop Acreages, Crop Consumptive Use Values, and Irrigation Efficiencies (41 - 51%)
2) Calculated from Snyder Crop Acreages and CIMIS-Derived Applied Crop Water Duties (DU=70%)
3) Crop Water Values shown are Consumptive Use Values (Irrigation Efficiencies not incorporated); Calculated Water Requirements utilize Irrigation Efficiencies of 100% (1945), 90% (1950), and 70% (all other survey years)
4) Calculated from DWR Crop Acreages and CIMIS-Derived Applied Crop Water Values (DU=70%) shown in parentheses in crop column headings

Table D.4-4
Historical Total Water Supply
Antelope Valley Area of Adjudication
(Acre-Feet per Year)

	Municipal/Industrial					Agricultural						Environmental		Combined					Total
Year	Groundwater	Imported Surface Water (AVEK, PWD, LCID)	Local Surface Water (PWD)	Surface Water (Total)	Total M&I Supply	Groundwater**	Imported Surface Water (AVEK)	Local Surface Water (LCID)	Surface Water (Total)	Recycled Water (LACSD, 14 and 20)	Total Ag Supply**	Recycled Water (LACSD 14)	Total Environmental Supply	Groundwater	Imported Surface Water	Local Surface Water	Surface Water (Total)	Recycled Water (LACSD)	Total Antelope Valley Water Supply
1946	9,467	0	1,000	1,000	10,467	273,960	0	0	0	0	273,960	0	0	283,427	0	1,000	1,000	0	284,427
1947	9,167	0	1,000	1,000	10,167	296,757	0	0	0	0	296,757	0	0	305,924	0	1,000	1,000	0	306,924
1948	8,953	0	1,000	1,000	9,953	322,497	0	0	0	0	322,497	0	0	331,449	0	1,000	1,000	0	332,449
1949	11,369	0	1,000	1,000	12,369	327,685	0	0	0	0	327,685	0	0	339,054	0	1,000	1,000	0	340,054
1950	8,993	0	1,000	1,000	9,993	347,676	0	0	0	0	347,676	0	0	356,669	0	1,000	1,000	0	357,669
1951	7,566	0	1,000	1,000	8,566	362,549	0	0	0	0	362,549	0	0	370,116	0	1,000	1,000	0	371,116
1952	6,821	0	1,000	1,000	7,821	357,856	0	0	0	0	357,856	0	0	364,676	0	1,000	1,000	0	365,676
1953	11,445	0	1,000	1,000	12,445	353,162	0	0	0	0	353,162	0	0	364,607	0	1,000	1,000	0	365,607
1954	14,248	0	1,000	1,000	15,248	348,468	0	0	0	0	348,468	0	0	362,716	0	1,000	1,000	0	363,716
1955	15,072	0	1,000	1,000	16,072	343,774	0	0	0	0	343,774	0	0	358,847	0	1,000	1,000	0	359,847
1956	18,321	0	2,422	2,422	20,743	339,081	0	0	0	0	339,081	0	0	357,402	0	2,422	2,422	0	359,824
1957	14,770	0	1,752	1,752	16,522	334,387	0	0	0	0	334,387	0	0	349,157	0	1,752	1,752	0	350,909
1958	13,697	0	2,434	2,434	16,131	340,131	0	0	0	0	340,131	0	0	353,827	0	2,434	2,434	0	356,261
1959	20,976	0	1,311	1,311	22,287	345,792	0	0	0	83	345,875	0	0	366,767	0	1,311	1,311	83	368,161
1960	17,217	0	385	385	17,602	351,535	0	0	0	83	351,618	0	0	368,752	0	385	385	83	369,220
1961	26,992	0	0	0	26,992	357,279	0	0	0	83	357,362	—	—	384,261	0	0	0	83	384,344
1962	31,471	0	5,534	5,534	37,005	351,143	0	0	0	97	351,240	—	—	382,614	0	5,534	5,534	97	388,245
1963	22,801	0	136	136	22,937	345,022	0	0	0	97	345,119	—	—	367,823	0	136	136	97	368,056
1964	26,309	0	262	262	26,565	338,862	0	0	0	135	338,997	—	—	365,166	0	262	262	135	365,563
1965	24,432	0	1,318	1,318	25,750	332,652	0	0	0	224	332,876	—	—	357,084	0	1,318	1,318	224	358,626
1966	28,659	0	0	0	28,659	326,530	0	0	0	224	326,754	—	—	355,188	0	0	0	224	355,412
1967	26,416	0	0	0	26,416	320,209	0	0	0	424	320,633	—	—	346,625	0	0	0	424	347,049
1968	29,604	0	3,150	3,150	32,754	314,087	0	0	0	424	314,511	—	—	343,692	0	3,150	3,150	424	347,266
1969	31,451	0	2,105	2,105	33,556	307,870	0	0	0	512	308,380	—	—	339,329	0	2,105	2,105	512	341,946
1970	27,168	0	1,396	1,396	28,564	299,910	0	1,849	1,849	509	302,268	—	—	327,078	0	3,245	3,245	509	330,832
1971	30,856	0	1,389	1,389	32,245	308,768	0	1,663	1,663	700	311,131	—	—	339,624	0	3,052	3,052	700	343,376
1972	34,942	338	1,360	1,698	36,640	256,102	0	1,587	1,587	704	258,393	—	—	291,044	338	2,947	3,285	704	295,033
1973	32,210	290	1,523	1,813	34,023	250,330	0	1,672	1,672	891	252,893	—	—	282,540	990	3,195	3,485	891	286,916
1974	31,566	400	938	1,338	32,904	257,676	0	1,651	1,651	806	260,133	—	—	289,242	400	2,589	2,989	906	293,037
1975	30,092	520	1,586	2,106	32,198	266,674	0	1,513	1,513	891	269,078	927	927	296,766	520	3,099	3,619	1,818	302,203
1976	30,410	589	1,151	1,740	32,150	197,450	27,295	1,400	28,695	891	227,036	1,559	1,559	227,859	27,884	2,551	30,435	2,450	260,744
1977	27,972	111	468	579	28,551	266,132	32,133	500	32,633	941	299,706	1,978	1,978	294,104	32,244	968	33,212	2,919	330,235
1978	23,908	5,479	2,024	7,503	31,411	236,470	37,428	1,688	39,116	996	276,582	2,456	2,456	260,378	42,907	3,712	46,619	3,452	310,449
1979	25,015	7,381	913	8,294	33,308	190,089	50,934	1,950	52,884	1,036	244,010	2,226	2,226	215,104	58,316	2,863	61,179	3,262	279,545
1980	24,679	7,069	913	7,982	32,660	193,276	58,054	1,950	60,004	958	254,239	2,442	2,442	217,955	66,123	2,863	67,986	3,400	289,941
1981	22,341	10,643	1,538	12,261	34,622	161,563	60,894	1,040	64,934	548	227,045	2,601	2,601	183,904	74,537	2,678	77,215	3,149	264,268
1982	26,321	6,921	1,680	8,601	34,922	151,987	39,053	1,604	40,657	0	192,524	2,336	2,336	178,287	45,974	3,264	49,258	2,936	229,882
1983	21,147	6,576	714	7,290	28,436	157,187	23,505	1,199	24,704	88	181,979	2,958	2,958	178,334	30,081	1,913	31,994	3,046	213,374
1984	28,220	10,518	927	11,445	39,665	138,821	18,176	1,464	19,640	404	158,865	2,755	2,755	167,041	28,694	2,391	31,085	3,159	201,286
1985	26,886	14,485	1,460	15,945	42,831	118,622	21,561	1,375	22,936	399	141,873	3,258	3,258	145,408	36,067	2,835	38,902	3,657	187,968
1986	31,687	17,710	332	18,042	49,729	100,527	14,381	1,250	15,631	52	116,210	4,356	4,356	132,214	32,091	1,582	33,673	4,408	170,295
1987	33,122	22,107	0	22,107	55,228	79,327	13,916	1,000	14,916	64	94,306	5,271	5,271	112,448	36,022	1,000	37,022	5,335	154,805
1988	36,314	20,442	1,330	21,772	58,086	89,484	14,154	1,000	15,154	2,033	106,671	3,777	3,777	125,798	34,596	2,330	36,926	5,810	168,533
1989	38,264	31,285	1,400	32,685	70,949	80,158	16,100	700	16,800	2,725	99,683	2,134	2,134	88,441	47,385	2,100	49,485	4,859	142,785
1990	35,599	36,450	110	36,560	72,160	52,326	14,775	200	14,975	3,824	71,125	2,451	2,451	87,925	51,225	310	51,535	6,275	145,735
1991	38,272	21,245	286	21,531	59,803	77,996	922	750	1,672	4,011	83,679	2,567	2,567	116,268	22,167	1,036	23,203	5,578	145,989
1992	33,867	27,549	3,465	31,014	64,881	77,274	2,323	900	3,223	3,661	84,158	3,520	3,520	111,141	29,972	4,365	34,337	7,181	152,559
1993	39,301	39,391	2,299	41,690	80,991	61,859	8,115	725	8,840	3,127	73,826	5,279	5,279	101,154	47,506	2,964	50,470	8,406	160,030
1994	45,733	42,646	867	43,513	89,246	59,737	11,637	800	12,437	3,762	75,937	5,109	5,109	105,470	54,283	1,667	55,950	8,871	170,292
1995	49,320	36,488	3,771	40,259	89,576	69,298	12,846	0	12,846	3,294	85,438	7,141	7,141	118,618	49,334	3,771	53,104	10,435	182,157
1996	50,511	45,906	3,043	48,948	99,459	74,664	18,245	0	18,245	3,602	96,411	7,501	7,501	125,075	64,151	3,043	67,194	11,103	203,372
1997	50,470	47,070	2,363	49,433	99,903	79,407	23,691	0	23,691	3,836	106,937	6,877	6,877	129,877	70,762	2,363	73,124	10,715	213,717
1998	43,670	40,862	5,040	45,901	89,571	91,938	17,710	0	17,710	3,414	113,062	8,706	8,706	136,608	58,572	5,040	63,612	12,120	211,339
1999	48,600	52,873	3,050	55,923	104,531	90,211	25,235	0	25,235	3,678	119,125	7,638	7,638	138,820	78,109	3,050	81,158	11,316	231,294
2000	48,821	53,566	6,500	60,066	108,887	106,746	29,221	0	26,221	4,381	139,348	7,120	7,120	155,568	81,786	6,500	88,287	11,501	255,355
2001	67,818	48,110	6,851	54,961	112,779	101,409	19,643	0	19,643	4,597	125,649	7,650	7,650	159,227	67,753	6,851	74,604	12,147	245,979
2002	53,600	59,704	0	59,704	113,304	120,702	10,138	0	10,138	6,628	137,468	7,839	7,839	174,301	69,843	0	69,843	14,467	258,611
2003	48,001	58,592	3,499	62,031	110,032	116,459	6,390	0	6,390	7,501	130,350	8,382	8,382	164,460	64,922	3,499	68,421	15,883	248,764
2004	54,361	58,124	3,959	62,083	116,464	111,877	7,682	0	7,682	8,142	127,701	9,239	9,239	166,258	65,806	3,959	69,765	17,381	253,404
2005	50,901	57,265	6,900	64,165	115,066	102,298	9,282	0	9,282	9,998	121,576	9,957	9,957	153,197	86,547	6,900	73,447	19,955	246,599
2006	43,960	70,023	4,173	74,196	118,156	89,484	12,731	0	12,731	11,797	114,012	9,611	9,611	133,444	82,753	4,173	86,926	21,408	241,778

*Approximated
**1991 Ag Groundwater Pumpage and Total Ag Supply includes an additional 15,636 af pumped to export to the California Aqueduct
—Designates unknown amount

M&I Groundwater Usage (Source: Problem Statement Appendix D-7 Table 3)

Year	LA WWD #40	Palmdale WD	Littlerock Creek ID	Quartz Hill WD	RCSD	AV Water Co	Palm Ranch ID	Desert Lake CSD	Boron CSD	EAFB	Mutual and Private WC (1)	Rural Resident	SUB TOTAL
1995	19,788	11,086	1,650	1,798	826	677	758	353	0	3,815	2,227	6,342	49,321
1996	19,339	9,508	1,790	2,306	2,027	747	1,147	353	0	3,735	2,518	7,041	50,511
1997	19,644	9,138	1,760	2,030	1,973	757	1,147	353	0	3,781	2,814	7,073	50,471
1998	17,589	8,062	1,520	1,231	1,541	655	1,147	353	0	2,732	2,500	6,341	43,670
1999	18,698	9,568	1,820	1,496	1,463	757	1,147	353	0	3,199	2,708	7,400	48,608
2000	17,419	9,625	1,810	1,419	1,461	827	1,147	353	0	3,712	3,341	7,709	48,822
2001	21,736	11,261	1,830	3,040	2,165	811	1,147	353	0	4,104	3,387	7,984	57,818
2002	21,196	8,261	1,950	2,801	2,359	787	1,536	353	0	3,090	3,246	8,021	53,599
2003	16,791	10,567	1,930	1,554	1,767	602	1,558	353	0	1,935	3,152	7,790	48,001
2004	21,281	10,990	2,230	1,347	1,989	595	814	353	0	3,015	3,522	8,245	54,380
2005	19,201	11,045	1,870	1,244	1,701	614	1,139	353	0	2,356	3,271	8,107	50,902
2006	12,277	11,320	2,150	1,386	2,212	534	591	353	0	1,985	2,901	8,251	43,960
2007													
2008													

(1) Does not reflect estimated 5,000 - 6,000 AF of additional pumping by Mutual Water Companies (John Ukkestad)

Appendix D-7: Table 3
Historical Groundwater Supply
Municipal and Industrial Users
Antelope Valley Area of Adjudication
(pumpage in acre-feet per year)

Los Angeles County Waterworks District 40

Year	Reg. 4 Lancaster	Code	Transfer AVWC from Reg. 4 Lancaster	Code	Reg. 4 Lancaster Total	Code	Reg. 24	Code	Reg. 27	Code	Reg. 33	Code	Reg. 34 Palmdale	Code
1946	299.0	1	0	au	299.0	1	0		450.0	1	0		0	
1947	215.0	1	0	au	299.3	1	0		0.0	1	0		0	
1948	826.0	1	0	au	335.3	1	0		250.0	1	0		0	
1949	1,122.0	1	0	au	1,132.0	1	0		0.0	1	0		0	
1950	995.0	1	0	au	585.3	1	0		0.0	1	0		0	
1951	205.0	1	0	au	288.3	1	0		400.0	1	868.0		0	
1952	1,047.0	1	0	au	1,337.8	1	0		0.0	1	0		0	
1953	4,326.0	1	0	au	3,726.3	1	0		389.0	1	914.0		0	
1954	1,015.0	1	0	au	1,515.3	1	455.0		0.0	1	153.0		0	
1955	1,782.0	1	0	au	1,782.3	1	0		250.0	1	153.0		0	
1956	2,485.0	1	0	au	2,483.3	1	0		1,317.0	1	180.0		0	
1957	4,333.0	1	0	au	4,333.3	1	0		782.0	1	58.0		0	
1958	3,405.0	1	0	au	3,436.3	1	0		560.0	1	875.0		0	
1959	4,157.0	1	0	au	4,157.3	1	0		1,310.0	1	147.0		0	
1960	5,387.0	1	0	au	5,387.3	1	6.5		194.0	1	782.0		0	
1961	3,649.0	1	0	au	3,649.3	1	387.5		1,381.0	1	4,863.0		0	
1962	9,845.0	1	0	au	9,845.3	1	318.5		210.0	1	137.4		0	
1963	7,780.0	1	0	au	7,784.3	1	357.5		261.0	1	126.2		0	
1964	5,207.0	1	0	au	5,207.0	1	311.5		246.0	1	244.5		0	
1965	5,593.0	1	0	au	4,223.3	1	145.5		330.0	1	25.3		0	
1966	7,470.0	1	0	7	7,973.3	1	352.0		401.0	1	75.3		0	
1967	8,545.0	1	0	7	8,295.3	1	940.3		362.0	1	417.2		0	
1968	10,760.0	1	0	7	10,758.0	1	170.3		449.0	1	0		0	
1969	13,574.0	1	0	7	13,873.3	1	127.5		230.0	1	3,223.0		0	
1970	12,572.0	1	0	7	12,573.0	1	160.0		374.0	1	0		0	
1971	13,452.0	1	0	7	13,462.0	1	270.0		562.0	1	32.3		0	
1972	13,726.0	1	0	7	14,210.0	1	117.0		546.0	1	0		0	
1973	12,390.0	1	0	7	18,849.0	1	123.0		486.0	1	0		0	
1974	13,257.0	1	0	7	19,252.0	1	130.0		527.0	1	0		0	
1975	13,287.0	1	0	7	12,207.0	1	86.0		453.0	1	0		0	
1976	11,476.0	1	0	7	11,879.0	1	139.0		776.0	1	0		0	
1977	10,036.0	1	0	7	10,033.0	1	116.0		357.0	1	0		0	
1978	7,932.0	2	0	7	9,932.9	2	153.4	2	558.0	2	0	2	0	2
1979	8,247.7	2	0	7	8,847.7	2	179.2	2	550.1	2	0	2	0	2
1980	7,634.6	2	0	7	7,634.8	2	139.6	2	726.1	2	0	2	0	2
1981	7,858.3	2	0	7	7,858.3	2	53.1	2	550.4	2	0	2	0	2
1982	9,155.6	2	0	7	9,155.9	2	151.2	2	717.5	2	0	2	0	2

* AVWC estimated as historical total water requirement - historical AVEK surface water deliveries (total well includes historical total water requirement (no surface water deliveries)).

Source Codes
1 USGS, ... 1993
1a USGS, Lancaster ..., 2005
2 Lancaster
3 ...
4 ...
5 ...
6 ...
7 AVWC (Antelope Valley Water Co.)
8 ...
9 ...
10 ...

WDS000038

GW Usage Summary (AF)

	Problem Statement			U of C			
	M&I (1)	AG (1)	TOTAL	M&I (1)	AG (1)	TOTAL	Difference
Year							
1995	49,321	69,299	**118,620**	49,321	82,771	**132,091**	**13,471**
1996	50,511	74,570	**125,081**	50,511	89,880	**140,391**	**15,311**
1997	50,471	79,408	**129,879**	50,471	96,512	**146,983**	**17,104**
1998	43,670	92,535	**136,206**	43,670	110,675	**154,345**	**18,139**
1999	48,608	90,215	**138,824**	48,608	109,361	**157,969**	**19,145**
2000	48,822	106,748	**155,570**	48,822	128,997	**177,819**	**22,249**
2001	57,818	101,412	**159,230**	57,818	121,399	**179,217**	**19,987**
2002	53,599	120,699	**174,298**	53,599	143,139	**196,738**	**22,440**
2003	48,001	116,460	**164,461**	48,001	137,583	**185,584**	**21,124**
2004	54,380	111,876	**166,257**	54,380	132,526	**186,907**	**20,650**
2005	50,902	102,295	**153,197**	50,902	121,937	**172,839**	**19,642**
2006	43,960	89,484	**133,444**	43,960	107,710	**151,670**	**18,226**
2007							
2008							
High	**57,818**	**120,699**	**174,298**	**57,818**	**143,139**	**196,738**	**22,440**
Low	**43,670**	**69,299**	**118,620**	**43,670**	**82,771**	**132,091**	**13,471**
AVG	**50,005**	**96,250**	**146,255**	**50,005**	**115,208**	**165,213**	**18,957**

(1) Does not reflect estimated 5,000 - 6,000 AF of additional pumping by Mutual Water Companies (John Ukkestad)

			Total Applied Water Requirement (AF)													AVEK Surface Water Deliveries (AF)												
Parcel Group	Former Owner	Parcels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	Arcuri	83-87	309	309	309	309	309	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Bejulian	67	681	681	571	571	571	571	571	571	571	571	571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	eSolar	88-117	1,664	1,290	1,401	2,494	2,453	987	659	1,027	825	1,014	1,584	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Grimmway	0-24, 28-41,45	3,563	2,646	2,692	1,487	2,048	1,791	2,401	1,666	1,941	414	1,490	2,916	1,242	1,863	1,926	2,145	1,065	999	1,622	2,766	3,521	1,720	511	738	2,327	2,284
5	Harter	71-79	856	1,221	1,884	1,544	1,675	2,207	2,207	2,028	2,028	1,987	1,987	1,906	1,779	790	795	982	108	455	1.5	34.4	595.1	0.5	0	0	0.5	0
6	Robertson & Nikkel	25-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Sandhu	56	272	272	272	272	272	272	272	272	272	164	272	272	272	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Collins, Doyle, Wong	42-44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Bagnell, Faber	80-82	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Dennis	121	247	494	247	247	0	494	494	494	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Hemmerling	118,122,123,123A	1,339	1,584	797	792	0	547	547	1,089	542	542	542	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	O'Neil	124	275	275	275	275	0	275	275	275	275	275	275	275	275	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Reca	119	559	559	559	559	0	559	559	559	559	559	559	559	559	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Wilson	120	0	0	0	0	0	0	0	1,081	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Total	**9,767**	**9,333**	**9,007**	**8,550**	**7,329**	**7,704**	**7,987**	**9,065**	**7,015**	**5,527**	**7,282**	**5,930**	**4,129**	**2,653**	**2,721**	**3,127**	**1,173**	**1,454**	**1,624**	**2,800**	**4,116**	**1,721**	**511**	**738**	**2,327**	**2,284**

Land Use Data

				(Indicates change from data)						Crop 1 Applied Water (AF)														
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
0	4	Kern	359-011-02	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	59	59	35	81	0	0	81	0	0	0	0	81	0	0	0
1	4	Kern	359-011-03	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	59	59	35	81	0	0	81	0	0	0	0	81	0	0	0
2	4	Kern	359-011-04	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	59	59	35	81	0	0	81	0	0	0	0	81	0	0	0
3	4	Kern	359-011-05	Carrot	Onion	Fallow	Fallow	Carrot	Fallow	82	82	36	0	82	0	82	82	99	0	0	82	0	0	0
4	4	Kern	359-011-06	Carrot	Onion	Fallow	Fallow	Carrot	Fallow	82	82	36	0	82	0	0	82	99	0	0	82	0	0	0
5	4	Kern	359-011-07	Carrot	Onion	Fallow	Fallow	Carrot	Fallow	82	82	36	0	82	0	0	82	99	0	0	82	0	0	0
6	4	Kern	359-011-08	Carrot	Fallow	Fallow	Fallow	Carrot	Fallow	78	78	34	44	78	0	0	78	0	0	0	78	0	0	0
7	4	Kern	359-011-09	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	34	34	79	0	0	0	0	0	0	0	0	0	0	0	0
8	4	Kern	359-011-10	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	36	36	83	0	0	0	0	0	0	0	0	0	0	0	0
9	4	Kern	359-011-11	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	36	36	83	0	0	61	83	0	0	0	0	0	0	0	0
10	4	Kern	359-011-12	Fallow	Fallow	Fallow	Fallow	Fallow	Carrot	36	36	83	0	0	94	83	0	0	0	0	0	83	0	0
11	4	Kern	359-011-13	Fallow	Fallow	Parsnip	Barley	Fallow	Carrot	84	36	61	84	0	95	84	0	0	84	71	0	84	0	0
12	4	Kern	359-011-14	Parsnip	Fallow	Fallow	Parsnip	Parsnip	Fallow	84	36	61	84	0	0	84	84	0	0	84	84	0	0	0
13	4	Kern	359-011-15	Parsnip	Fallow	Fallow	Barley	Fallow	Fallow	95	36	61	0	84	84	0	84	0	0	71	0	0	0	0
14	4	Kern	359-011-16	Fallow	Parsnip	Fallow	Barley	Fallow	Parsnip	91	35	58	0	0	80	0	0	80	0	68	0	80	0	0
15	4	Kern	359-011-17	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	58	58	34	79	0	0	0	0	0	0	0	0	0	0	0
16	4	Kern	359-011-18	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	61	61	36	83	0	0	0	0	0	0	0	0	0	0	0
17	4	Kern	359-011-19	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	61	61	36	83	0	0	0	0	0	0	0	0	0	0	0
18	4	Kern	359-011-20	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	61	61	36	83	0	0	0	0	0	0	0	0	0	0	0
19	4	Kern	359-011-21	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	79	34	34	0	90	0	79	58	0	0	0	79	0	0	0
20	4	Kern	359-011-22	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	83	36	36	0	94	0	83	60	0	0	0	83	0	0	0
21	4	Kern	359-011-23	Carrot	Fallow	Fallow	Fallow	Carrot	Fallow	42	36	36	0	83	0	0	83	0	0	0	83	0	47	0
22	4	Kern	359-011-24	Carrot	Fallow	Fallow	Fallow	Carrot	Fallow	94	36	36	0	83	0	0	83	0	0	0	83	0	0	0
23	4	Kern	359-011-27	Cultural	Cultural	Cultural	Cultural	Cultural	Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	4	Kern	359-020-50	Fallow	Onion	Fallow	Fallow	Barley	Carrot	332	242	377	0	332	166	0	499	754	0	532	564	665	377	145
25	6	Kern	359-041-05	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	6	Kern	359-041-07	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	6	Kern	359-041-08	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	4	Kern	359-174-01	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	0	0	36	83	0	0	83	0	0	83	0	0	0
29	4	Kern	359-174-02	Barley	Fallow	Carrot	Fallow	Fallow	Carrot	60	60	0	0	36	0	83	70	0	83	70	0	83	0	0
30	4	Kern	359-174-03	Barley	Fallow	Carrot	Fallow	Fallow	Carrot	60	60	0	0	36	0	83	70	0	83	70	0	83	0	0
31	4	Kern	359-174-04	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	0	0	36	83	94	0	83	0	0	83	0	0	0
32	4	Kern	359-174-05	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	83	0	36	83	94	0	83	0	0	83	0	0	0

Land Use Data

				(* indicates change from data)						Crop 1 Applied Water (AF)															
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
33	4	Kern	359-174-06	Sudangrass	Fallow	Carrot	Fallow	Fallow	Carrot	60	60	36	83	36	0	83	70	0	83	70	0	83	0	0
34	4	Kern	359-174-07	Potato	Fallow	Carrot	Fallow	Fallow	Carrot	58	58	34	79	34	0	79	58	0	79	67	0	79	0	0
35	4	Kern	359-174-08	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	79	34	79	0	34	79	90	0	79	0	0	79	0	0	0
36	4	Kern	359-174-09	Fallow	Carrot	Fallow	Fallow	Carrot	Fallow	94	36	83	0	60	83	94	0	83	0	0	83	0	0	0
37	4	Kern	359-174-10	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	60	60	36	83	60	0	83	60	0	0	0	83	0	0	0
38	4	Kern	359-174-11	Potato	Fallow	Fallow	Fallow	Carrot	Fallow	60	60	36	83	60	0	83	60	0	0	0	83	0	0	0
39	4	Kern	359-174-12	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	85	32	75	0	54	75	85	0	75	0	0	75	0	0.83	0.83
40	4	Kern	359-174-14	Cultural	Cultural	Cultural	Cultural	Cultural	Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	4	Kern	359-240-04	Fallow	Fallow	Fallow	Fallow	Carrot	Fallow	339	339	339	144	192	385	339	0	339	0	385	678	0	0	147
42	8	Kern	359-331-17	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	8	Kern	359-331-19	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	8	Kern	359-331-25	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	4	Kern	359 011-01	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	29	29	18	40	0	0	40	0	0	0	0	40	0	0.83	0.83
56	7	Kern	359-041-30	Alfalfa	Alfalfa	Carrot	Alfalfa	Alfalfa	Alfalfa	272	272	272	272	272	272	272	272	272	164	272	272	272	0	0
67	2	Kern	261-196-10	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	571	571	571	571	571	571	571	571	571	571	571	0	0	110	110
68	15	Kern	359-041-29	Fallow	Alfalfa	Carrot	Alfalfa	Alfalfa	Alfalfa	272	231	272	272	272	272	272	0	272	164	272	272	272	0	0
69	15	Kern	359-041-31	Alfalfa	Alfalfa	Carrot	Alfalfa	Alfalfa	Alfalfa	272	272	272	272	272	272	272	272	272	164	272	272	272	0	0
70	15	Kern	359-041-32	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	245	245	245	245	245	245	245	0	245	147	245	245	245	0.83	0.83
71	5	Kern	359-175-01	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Barley	403	323	323	73	242	537	537	537	537	537	537	537	274	0	0
72	5	Kern	359-175-02	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Barley	18	11	11	12	18	18	18	18	18	18	18	18	9	0	0
73	5	Kern	359-175-03	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Barley	18	11	11	12	18	18	18	18	18	18	18	18	9	0	0
74	5	Kern	359-175-04	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0	0
75	5	Kern	359-321-01	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	0	284	71	296	296	593	593	593	593	593	593	593	593	0	0
76	5	Kern	359-321-02	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	0	195	71	296	296	593	593	593	593	593	593	593	593	0	0
77	5	Kern	359-324-18	Carrot	Carrot	Barley	Barley	Alfalfa	Alfalfa	147	147	147	147	147	147	147	88	88	75	75	147	147	0	0
78	5	Kern	359-324-20	Carrot	Carrot	Barley	Barley	Fallow	Barley	150	150	150	150	150	150	150	90	90	77	77	0	77	0	0
79	5	Kern	359-324-21	Carrot	Carrot	Barley	Barley	Fallow	Barley	120	151	151	151	151	151	151	91	91	77	77	0	77	0	0
80	9	Kern	359-331-24	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0	0
81	9	Kern	359-331-26	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	9	Kern	359-331-27	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	1	Kern	359-041-15	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	158	158	158	158	158	0	0	0	0	0	0	0	0	0	0
84	1	Kern	359-041-24	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0
85	1	Kern	359-041-25	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0
86	1	Kern	359-041-26	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0

Land Use Data

				(: indicates change from data)						Crop 1 Applied Water (AF)															
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
87	1	Kern	359-041-27	Domestic	Domestic	Domestic	Domestic	Domestic	Domestic	30	30	30	30	30	0	0	0	0	0	0	0	0	0.83	0.83
88	3	Kern	261-193-02	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	3	Kern	261-193-03	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	3	Kern	261-193-06	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	3	Kern	261-193-07	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	3	Kern	261-193-08	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	3	Kern	261-193-09	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	3	Kern	261-193-10	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	3	Kern	261-193-15	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
96	3	Kern	261-193-17	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
97	3	Kern	261-193-18	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
98	3	Kern	261-193-20	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0
99	3	Kern	261-193-22	Fallow	Fallow	Carrot	Carrot	Fallow	Fallow	0	0	0	41	0	0	0	0	0	83	83	0	0	0	0
100	3	Kern	261-193-23	Barley	Carrot	Fallow	Carrot	Fallow	Fallow	0	0	0	166	0	166	0	140	166	0	166	0	0	0	0
101	3	Kern	261-193-24	Fallow	Fallow	Barley	Barley	Fallow	Fallow	0	0	0	162	0	162	0	0	0	137	137	0	0	0	0
102	3	Kern	261-193-25	Fallow	Fallow	Carrot	Carrot	Fallow	Fallow	0	0	0	0	0	0	0	0	0	81	81	0	0	0	0
103	3	Kern	261-193-26	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	81	0	0	0	0	0
104	3	Kern	261-194-28	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	363	363	320	320	320	0	0	0	0	0	0	0	0	0	0
105	3	Kern	261-194-29	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	363	363	320	320	320	0	0	0	0	0	0	0	0	0	0
106	3	Kern	261-194-30	Carrot	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	162	0	0	162	0	0	0	0	0	0	0
107	3	Kern	261-194-36	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	95	95	84	84	84	0	0	0	0	0	0	0	0	0	0
108	3	Kern	261-194-37	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	95	95	84	84	84	0	0	0	0	0	0	0	0	0	0
109	3	Kern	261-194-38	Cultural	Cultural	Cultural	Cultural	Cultural	Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	3	Kern	261-194-39	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0	0
111	3	Kern	261-194-45	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	3	Kern	261-194-46	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	3	Kern	261-194-47	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	3	Kern	261-196-08	Fallow	Fallow	Fallow	Barley	Fallow	Fallow	747	374	593	1,317	1,317	659	659	558	659	558	1,117	0	0	0	0
115	3	Kern	261-193-05	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	3	Kern	261-193-19	Fallow	Fallow	Carrot	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0
117	3	Kern	261-194-35	Carrot	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	166	0	0	166	0	0	0	0	0	0	0
118	11	LA	3258-001-038	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Fallow	Fallow	542	542	0	0	0	0	0	542	542	542	542	0	0	0	0

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				(* indicates change from data)						Crop 1 Applied Water (AF)														
Map ID	Parcel Group	County	Parcel #	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001
119	13	LA	3258-001-040	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	559	559	559	559	0	559	559	559	559	559	559	559	559	0	0
120	14	LA	3261-001-004	Alfalfa	Fallow	Fallow	Fallow	Fallow	Fallow	0	0	0	0	0	0	0	1,081	0	0	0	0	0	0	0
121	10	LA	3261-001-002	Alfalfa	Fallow	Fallow	Fallow	Fallow	Fallow	247	247	247	247	0	494	494	494	0	0	0	0	0	0	247
122	11	LA	3261-001-003	Alfalfa	Fallow	Fallow	Fallow	Fallow	Fallow	547	547	547	547	0	547	547	547	0	0	0	0	0	0	0
123	11	LA	3258-001-001	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	245	490	245	245	0	0	0	0	0	0	0	0	0	0	0
124	12	LA	3258-001-024	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	275	275	275	275	0	275	275	275	275	275	275	275	275	0	0
126	15	LA	3258-001-031	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	3,211	2,408	3,211	3,211	3,211	2,151	3,211	3,211	3,211	3,211	3,211	3,211	3,211	0	0
127	15	LA	3258-001-030	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	1,084	1,084	1,084	1,084	1,084	1,084	542	1,084	1,084	1,084	1,084	1,084	1,084	0	0
128	11	LA	3258-001-025	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0

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Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)											
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	4	Kern	359-011-02	0	0	0	0	0	0	0	0	0	0	0	59	59	35	81	0	0	81	0	0	0	0	81	0
1	4	Kern	359-011-03	0	0	0	0	0	0	0	0	0	0	0	59	59	35	81	0	0	81	0	0	0	0	81	0
2	4	Kern	359-011-04	0	0	0	0	0	0	0	0	0	0	0	59	59	35	81	0	0	81	0	0	0	0	81	0
3	4	Kern	359-011-05	0	0	0	0	0	0	0	0	0	0	0	82	82	36	0	82	0	82	82	93	0	0	82	0
4	4	Kern	359-011-06	0	0	0	0	0	0	0	0	0	0	0	82	82	36	0	82	0	0	82	93	0	0	82	0
5	4	Kern	359-011-07	0	0	0	0	0	0	0	0	0	0	0	82	82	36	0	82	0	0	82	93	0	0	82	0
6	4	Kern	359-011-08	0	0	0	0	0	0	0	0	0	0	0	78	78	34	44	78	0	0	78	0	0	0	78	0
7	4	Kern	359-011-09	0	0	0	0	0	0	0	0	0	0	0	34	34	79	0	0	0	0	0	0	0	0	0	0
8	4	Kern	359-011-10	0	0	0	0	0	0	0	0	0	0	0	36	36	83	0	0	0	0	0	0	0	0	0	0
9	4	Kern	359-011-11	0	0	0	0	0	0	0	0	0	0	0	36	36	83	0	0	61	83	0	0	0	0	0	0
10	4	Kern	359-011-12	0	0	0	0	0	0	0	0	0	0	0	36	36	83	0	0	94	83	0	0	0	0	0	83
11	4	Kern	359-011-13	0	0	0	0	0	0	0	0	0	0	0	84	36	61	84	0	95	84	0	0	84	71	0	84
12	4	Kern	359-011-14	0	0	0	0	0	0	0	0	0	0	0	84	36	61	84	0	0	84	84	0	0	84	84	0
13	4	Kern	359-011-15	0	0	0	0	0	0	0	0	0	0	0	95	36	61	0	84	84	0	84	0	0	71	0	0
14	4	Kern	359-011-16	0	0	0	0	0	0	0	0	0	0	0	91	35	58	0	0	80	0	0	90	0	68	0	80
15	4	Kern	359-011-17	0	0	0	0	0	0	0	0	0	0	0	58	58	34	79	0	0	0	0	0	0	0	0	0
16	4	Kern	359-011-18	0	0	0	0	0	0	0	0	0	0	0	61	61	36	83	0	0	0	0	0	0	0	0	0
17	4	Kern	359-011-19	0	0	0	0	0	0	0	0	0	0	0	61	61	36	83	0	0	0	0	0	0	0	0	0
18	4	Kern	359-011-20	0	0	0	0	0	0	0	0	0	0	0	61	61	36	83	0	0	0	0	0	0	0	0	0
19	4	Kern	359-011-21	0	0	0	0	0	0	0	0	0	0	0	79	34	34	0	90	0	79	58	0	0	0	79	0
20	4	Kern	359-011-22	0	0	0	0	0	0	0	0	0	0	0	83	36	36	0	94	0	83	60	0	0	0	83	0
21	4	Kern	359-011-23	0	0	0	0	0	0	0	0	0	0	0	89	36	36	0	83	0	0	83	0	0	0	83	0
22	4	Kern	359-011-24	0	0	0	0	0	0	0	0	0	0	0	94	36	36	0	83	0	0	83	0	0	0	83	0
23	4	Kern	359-011-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	4	Kern	359-020-50	145	189	242	0	0	0	0	0	0	0	0	710	387	522	189	575	166	0	499	754	0	532	564	665
25	6	Kern	359-041-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	6	Kern	359-041-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	6	Kern	359-041-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	4	Kern	359-174-01	0	0	0	0	0	0	0	0	0	0	0	94	36	0	0	36	83	0	0	83	0	0	83	0
29	4	Kern	359-174-02	0	0	0	0	0	0	0	0	0	0	0	60	60	0	0	36	0	83	70	0	83	70	0	83
30	4	Kern	359-174-03	0	0	0	0	0	0	0	0	0	0	0	60	60	0	0	36	0	83	70	0	83	70	0	83
31	4	Kern	359-174-04	0	0	0	0	0	0	0	0	0	0	0	94	36	0	0	36	83	94	0	83	0	0	83	0
32	4	Kern	359-174-05	0	0	0	0	0	0	0	0	0	0	0	94	36	83	0	36	83	94	0	83	0	0	83	0

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Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)											
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
33	4	Kern	359-174-06	0	0	0	0	0	0	0	0	0	0	0	60	60	36	83	36	0	83	70	0	83	70	0	83
34	4	Kern	359-174-07	0	0	0	0	0	0	0	0	0	0	0	58	58	34	79	34	0	79	58	0	79	67	0	79
35	4	Kern	359-174-08	0	0	0	0	0	0	0	0	0	0	0	79	34	79	0	34	79	90	0	79	0	0	79	0
36	4	Kern	359-174-09	0	0	0	0	0	0	0	0	0	0	0	94	36	83	0	60	83	94	0	83	0	0	83	0
37	4	Kern	359-174-10	0	0	0	0	0	0	0	0	0	0	0	60	60	36	83	60	0	83	60	0	0	0	83	0
38	4	Kern	359-174-11	0	0	0	0	0	0	0	0	0	0	0	60	60	36	83	60	0	83	60	0	0	0	83	0
39	4	Kern	359-174-12	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	86	33	76	1	55	76	86	1	76	1	1	76	1
40	4	Kern	359-174-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	4	Kern	359-240-04	247	0	0	339	247	0	0	0	0	0	0	339	486	586	144	192	723	586	0	339	0	385	678	0
42	8	Kern	359-331-17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	8	Kern	359-331-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	8	Kern	359-331-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	4	Kern	359-011-01	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	30	30	18	41	1	1	41	1	1	1	1	41	1
56	7	Kern	359-041-30	0	0	0	0	0	0	0	0	0	0	0	272	272	272	272	272	272	272	272	272	164	272	272	272
67	2	Kern	261-196-10	0	0	0	0	0	0	0	0	0	0	0	681	681	571	571	571	571	571	571	571	571	571	0	0
68	15	Kern	359-041-29	0	0	0	0	0	0	0	0	0	0	0	272	231	272	272	272	272	272	0	272	164	272	272	272
69	15	Kern	359-041-31	0	0	0	0	0	0	0	0	0	0	0	272	272	272	272	272	272	272	272	272	164	272	272	272
70	15	Kern	359-041-32	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	246	246	246	246	246	246	246	1	246	148	246	246	246
71	5	Kern	359-175-01	0	0	0	0	0	0	0	0	0	0	0	403	323	323	73	242	537	537	537	537	537	537	537	274
72	5	Kern	359-175-02	0	0	0	0	0	0	0	0	0	0	0	18	11	11	12	18	18	18	18	18	18	18	18	9
73	5	Kern	359-175-03	0	0	0	0	0	0	0	0	0	0	0	18	11	11	12	18	18	18	18	18	18	18	18	9
74	5	Kern	359-175-04	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
75	5	Kern	359-321-01	474	202	178	0	0	0	0	0	0	0	0	0	234	546	499	475	593	593	593	593	593	593	593	593
76	5	Kern	359-321-02	474	202	178	0	0	0	0	0	0	0	0	0	195	546	499	475	593	593	593	593	593	593	593	593
77	5	Kern	359-324-18	0	0	0	0	0	0	0	0	0	0	0	147	147	147	147	147	147	147	88	88	75	75	147	147
78	5	Kern	359-324-20	0	0	0	0	0	0	0	0	0	0	0	150	150	150	150	150	150	150	90	90	77	77	0	77
79	5	Kern	359-324-21	0	0	0	0	0	0	0	0	0	0	0	120	151	151	151	151	151	151	91	91	77	77	0	77
80	9	Kern	359-331-24	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
81	9	Kern	359-331-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	9	Kern	359-331-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	1	Kern	359-041-15	0	0	0	0	0	0	0	0	0	0	0	158	158	158	158	158	0	0	0	0	0	0	0	0
84	1	Kern	359-041-24	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	0	0	0	0	0	0	0	0
85	1	Kern	359-041-25	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	0	0	0	0	0	0	0	0
86	1	Kern	359-041-26	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	0	0	0	0	0	0	0	0

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Map ID	Parcel Group	County	Parcel #	Crop 2 Applied Water (AF)											Total Applied Water (AF)											
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
87	1	Kern	359-041-27	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	31	31	31	31	31	1	1	1	1	1	1	1	1
88	3	Kern	261-193-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	3	Kern	261-193-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	3	Kern	261-193-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	3	Kern	261-193-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	3	Kern	261-193-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	3	Kern	261-193-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	3	Kern	261-193-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	3	Kern	261-193-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
96	3	Kern	261-193-17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
97	3	Kern	261-193-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
98	3	Kern	261-193-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0
99	3	Kern	261-193-22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	0	0	0	0	83	83	0	0
100	3	Kern	261-193-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166	0	166	0	140	166	0	166	0	0
101	3	Kern	261-193-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	0	162	0	0	0	137	137	0	0
102	3	Kern	261-193-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	81	0	0
103	3	Kern	261-193-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	0	0	0
104	3	Kern	261-194-28	0	0	0	0	0	0	0	0	0	0	0	363	363	320	320	320	0	0	0	0	0	0	0	0
105	3	Kern	261-194-29	0	0	0	0	0	0	0	0	0	0	0	363	363	320	320	320	0	0	0	0	0	0	0	0
106	3	Kern	261-194-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	0	0	162	0	0	0	0	0
107	3	Kern	261-194-36	0	0	0	0	0	0	0	0	0	0	0	95	95	84	84	84	0	0	0	0	0	0	0	0
108	3	Kern	261-194-37	0	0	0	0	0	0	0	0	0	0	0	95	95	84	84	84	0	0	0	0	0	0	0	0
109	3	Kern	261-194-38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	3	Kern	261-194-39	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
111	3	Kern	261-194-45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	3	Kern	261-194-46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	3	Kern	261-194-47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	3	Kern	261-196-08	0	0	0	0	0	0	0	0	0	0	0	747	374	593	1,317	1,317	659	659	558	659	558	1,117	0	0
115	3	Kern	261-193-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	3	Kern	261-193-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0
117	3	Kern	261-194-35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166	0	0	166	0	0	0	0	0
118	11	LA	3258-001-038	0	0	0	0	0	0	0	0	0	0	0	542	542	0	0	0	0	0	542	542	542	542	0	0

Land Use Data

				Crop 2 Applied Water (AF)											Total Applied Water (AF)											
Map ID	Parcel Group	County	Parcel #	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
119	13	LA	3258-001-040	0	0	0	0	0	0	0	0	0	0	0	559	559	559	559	0	559	559	559	559	559	559	559	559
120	14	LA	3261-001-004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,081	0	0	0	0	0
121	10	LA	3261-001-002	0	0	0	0	0	0	0	0	0	0	0	247	494	247	247	0	494	494	494	0	0	0	0	0
122	11	LA	3261-001-003	0	0	0	0	0	0	0	0	0	0	0	547	547	547	547	0	547	547	547	0	0	0	0	0
123	11	LA	3258-001-001	0	0	0	0	0	0	0	0	0	0	0	245	490	245	245	0	0	0	0	0	0	0	0	0
124	12	LA	3258-001-024	0	0	0	0	0	0	0	0	0	0	0	275	275	275	275	0	275	275	275	275	275	275	275	275
126	15	LA	3258-001-031	0	0	0	0	0	0	0	0	0	0	0	3,211	2,408	3,211	3,211	3,211	2,151	3,211	3,211	3,211	3,211	3,211	3,211	3,211
127	15	LA	3258-001-030	0	0	0	0	0	0	0	0	0	0	0	1,084	1,084	1,084	1,084	1,084	1,084	542	1,084	1,084	1,084	1,084	1,084	1,084
128	11	LA	3258-001-025	0	0	0	0	0	0	0	0	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0	0

Crop	AW (AF/yr)	Source
Alfalfa	7.65	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Barley	3.9	Irrigation Technology Reasearch Center, Fresno State (2008) indicates same as sudangrass
Carrot	4.6	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Cultural	0	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Domestic	0.83	Palmdale single family home water usage (2005)
Fallow	0	
Garlic	5.22	Irrigation Technology Reasearch Center, Fresno State (2008) indicates same as Onion
Oat	2.0	Actual reported AW requirement on that farm by Grimmway (9/28/12) due t Aug-Nov growing season
Onion	5.22	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Parsnip	4.6	Assumed to be equal to carrot
Pasture	7.45	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Peach	5.36	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Potato	3.35	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Rye	2.0	Actual reported AW requirement on that farm by Grimmway (9/28/12) due t Aug-Nov growing season
Sugar beet	4.96	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Sudangrass	3.9	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Watermelon	3.11	Nebecker (4/19//07) and Orloff & Hansen (UC Davis, 4/22/08)
Wheat	2.0	Actual reported AW requirement on that farm by Grimmway (9/28/12) due t Aug-Nov growing season