

3 Monitoring Programs

3.1 Climatological Monitoring Program

3.1.1 Program Description

The Zone 7 Climatological Monitoring Program network consists of seven rainfall stations, two pan evaporation stations, and one California Irrigation Management System (CIMIS) station located within the approximate 400-square-mile watershed of the Valley. The Zone 7 network stations provide sufficient high quality data for long-term studies, basin recharge calculations, and water management decisions. The boundary of the watershed, the location of the climatological stations, and the lines of equal annual rainfall (isohyets) are shown in Figure 3.1-1. Table 3.1-1 lists the stations and provides basic station information including the station ID, name, location, and mean annual precipitation or evaporation.

There are two basic types of rainfall stations used in Zone 7's climatological monitoring program: daily record stations and recorder stations. A daily record station, which is used to determine multi-day storm totals, consists of a rain gage at which, once-a-day, the observer measures and records the depth of rain that has fallen during the preceding 24 hours. A recorder station, which provides rainfall intensity for periods of less than 24-hours, consists of a computerized-tipping-bucket rain gage and a data recorder. These continuous-reading rain gages generally provide rainfall totals on a 15-minute frequency.

3.1.2 Program Changes for 2011 Water Year

In 2004, Zone 7 funded the installation of a CIMIS station at the Pleasanton Fairways Golf Course at the Alameda County Fairgrounds in Pleasanton. This station (CM-STA 191) records evapotranspiration, precipitation, solar radiation, air temperature, soil temperature, relative humidity, wind speed, and direction. The precipitation and evapotranspiration data from this station were incorporated into the program for the 2011 Water Year.

3.1.3 2011 Results

The 2011 Water Year rainfall in the Valley was above average at 122% of normal. Rainfall totals from individual stations ranged from 13.90 inches (106% of normal) at Station 24 (Patterson Pass Water Treatment Plant) to 33.69 inches (140%) at Station 44 (Mt. Hamilton). Evaporation was 64.84 inches (98% of normal) at the Lake Del Valle Station. Evapotranspiration was 48.47 inches (the station is too new to have established a "normal") at the CIMIS station.

The monthly precipitation totals for each of Zone 7's precipitation stations for the 2011 Water Year are shown in Table 3.1-2. Table 3.1-3 shows historical monthly data from Livermore (Station 15E), the network station with the longest historical record. Figure 3.1-2, a graph of cumulative rainfall from Station 15E, presents data for the 2011 Water Year, along with the driest water year (1977), the calculated average water year, the wettest year (1983), and the 2010 Water Year for comparison.

Table 3.1-4 provides the daily pan evaporation measured at Lake Del Valle (Station CM_STA LDV-EV) during the 2011 Water Year, and Table 3.1-5 shows monthly pan evaporation data going back to the 1969 Water Year.

3.2 Groundwater Elevation and Quality Monitoring Program

3.2.1 Program Description

The Groundwater Elevation and Quality Monitoring Program includes the measurement of groundwater levels in monitoring and production wells, and the collection and analyses of groundwater samples. These hydrologic data are needed to assess groundwater supplies (i.e., quantity, quality, and trends). The program focuses on the Main Basin, where groundwater is pumped for municipal uses. Other Zone 7 programs utilize the data collected in this program, and the results are used in water resources management planning and decision making.

There were a total of 240 wells in the Zone 7 groundwater monitoring program during the 2011 Water Year (shown on Figure 3.2-1). Each well in the program was monitored and/or sampled to fulfill one or more specific objective. Table 3.2-1 lists all of the wells in the program, the objective(s) of each monitoring well, and the frequency of monitoring or sampling for each objective. The objectives are summarized below:

Water Level Monitoring – depth-to-water level measurements are taken in various wells in the basin at the frequency specified below:

- **Semi-Annual (SA)** - groundwater level measurements are made twice per year during seasonal extremes (i.e., spring highs and fall lows) for storage tracking.
- **Monthly (M)** – monthly water level measurements are used to monitor subsidence triggers, adjust recharge operations, and identify when semi-annual water level measurements should be scheduled.

Groundwater Basin Quality –sampling of groundwater at the specified frequency for major minerals and metals to track changes over time:

- **Annual (A)** – Sampling is performed annually from each of the wells in the program except as noted below. Also, additional sampling and testing may be performed by an outside contractor or property owner if not sampled by Zone 7 staff.

**TABLE 3.1-1
ZONE 7 WATER AGENCY
CLIMATOLOGICAL STATIONS
2011 WATER YEAR**

PRECIPITATION NETWORK

Alameda County STATION	Computer SITE ID	STATION NAME	LOCATION	OBSERVER	ELEVATION	STATION ESTABLISHED		MEAN ANNUAL PRECIPITATION INCHES
						STORAGE GAGE (DAILY)	RECORDER RECORD	
15E	CM_STA 15E	NOAA LIVERMORE	WELLINGHAM DRIVE LIVERMORE	MR. RON HAFNER	480	1871	-	14.53
17	CM_STA 17	DEL VALLE PLANT	VALLECITOS ROAD LIVERMORE	ZONE 7 STAFF	640	1974	1978 to Present	16.14
24	CM_STA 24	PATTERSON PLANT	PATTERSON PASS ROAD LIVERMORE	ZONE 7 STAFF	680	1963	1969 to Present	13.15
34	CM_STA 34	MOCHO WELL FIELD	SANTA RITA ROAD PLEASANTON	ZONE 7 STAFF	340	1968	1970 to Present	18.03
44	CM_STA 44	MT HAMILTON	LICK OBSERVATORY MT HAMILTON	LICK OBSERVATORY	4209	1881	-	24.15
101	CM_STA 101	TASSAJARA	CAMINO TASSAJARA ROAD DANVILLE	MRS. JOAN HANSEN	800	1912	-	19.77
170	CM_STA 170	ZONE 7 OFFICE	PARKSIDE DRIVE PLEASANTON	ZONE 7 STAFF	330	1986	1986 to 2005	20.93
191	CM_STA 191	CIMIS STATION	ALAMEDA COUNTY FAIRGROUNDS PLEASANTON	DWR STAFF	335	-	2004 to Present	17.67

EVAPORATION NETWORK

STATION ID	SITE ID	STATION NAME	LOCATION	OBSERVER	ELEVATION	STATION ESTABLISHED	MEAN ANNUAL EVAPORATION INCHES
LDV	CM_STA LDV-EV	LAKE DEL VALLE	ARROYO ROAD LIVERMORE	DWR STAFF	760	1969	66.14
LWRP	CM_STA LWRP-EV	LIVERMORE WATER RECLAMATION PLANT	JACK LONDON DRIVE LIVERMORE	LWRP STAFF	410	1974	70.65
191	CM_STA 191-ETO	CIMIS STATION (Evapotranspiration)	ALAMEDA COUNTY FAIRGROUNDS PLEASANTON	DWR STAFF	335	2004	49.91

**TABLE 3.1-2
ZONE 7 WATER AGENCY
MONTHLY PRECIPITATION DATA
2011 WATER YEAR**

MONTHLY PRECIPITATION IN INCHES

	STATION NUMBER								Network Average	% Average of Network
	15E	17	24	34	44	101	170	191		
OCT	1.00	0.80	0.87	0.95	2.51	1.31	1.23	1.00	1.21	120.2%
NOV	2.02	2.11	2.18	2.34	4.87	2.66	2.89	2.54	2.70	133.5%
DEC	3.87	4.30	2.87	5.05	6.90	6.15	6.18	5.06	5.05	165.9%
JAN	0.78	0.78	0.63	0.72	1.65	1.55	0.87	0.71	0.96	28.5%
FEB	2.69	4.24	2.50	3.98	5.13	3.51	5.08	4.24	3.92	118.8%
MAR	4.10	5.11	3.61	5.71	8.14	5.90	7.36	5.74	5.71	193.6%
APR	0.22	0.22	0.17	0.12	1.03	0.23	0.21	0.14	0.29	22.2%
MAY	0.46	0.69	0.23	0.61	1.94	0.89	0.88	0.69	0.80	131.5%
JUN	1.07	1.14	0.84	1.66	1.52	2.03	1.64	1.46	1.42	1100.1%
JUL	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	4.7%
AUG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
SEP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.6%
TOTAL	16.21	19.39	13.90	21.14	33.69	24.24	26.34	21.59	22.06	
% AVG	112%	120%	106%	117%	140%	123%	126%	122%	122%	

DISTRIBUTION OF DAILY PRECIPITATION

Number of days with precipitation greater than given rainfall total

Rainfall (inches)	STATION NUMBER								Network Average
	15E	17	24	34	44	101	170	191	
TRACE	76	68	70	68	103	74	75	82	76
0.1	41	44	35	41	64	49	40	43	45
0.5	9	9	9	13	22	18	16	15	14
1	1	5	0	5	6	2	7	4	4
2	0	0	0	0	0	0	1	0	0

TABLE 3.1-3
ZONE 7 WATER AGENCY
MONTHLY PRECIPITATION (CM_STA 15E in inches), LIVERMORE
1871 to 2011 WATER YEARS

Year	OCTWY	NOVWY	DECWY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL OCT-SEP	TOTAL JULY-JUNE	% NORMAL OCT-SEP
1871	0.00	0.00	0.00	1.42	1.93	0.36	1.25	0.02	0.00	0.00	0.00	0.00	4.98	4.98	34%
1872	0.00	1.13	11.69	2.15	2.69	0.65	0.43	0.00	0.32	0.00	0.00	0.00	19.06	19.06	131%
1873	0.00	1.22	3.87	1.04	3.73	0.68	0.15	0.00	0.00	0.00	0.00	0.00	10.69	10.69	74%
1874	0.42	0.70	4.48	2.96	1.03	1.34	0.95	0.32	0.06	0.00	0.00	0.30	12.56	12.26	86%
1875	1.67	2.03	0.20	5.40	1.20	0.35	0.00	0.00	0.52	0.00	0.00	0.00	11.37	11.67	78%
1876	0.00	7.23	1.62	2.68	3.01	4.39	0.73	0.33	0.00	0.00	0.00	0.00	19.99	19.99	138%
1877	1.26	0.10	0.00	2.47	0.56	1.10	0.13	0.39	0.00	0.00	0.00	0.00	6.01	6.01	41%
1878	1.27	1.29	0.73	4.61	6.73	2.01	0.96	0.06	0.00	0.00	0.00	0.00	17.66	17.66	122%
1879	0.24	0.31	0.17	2.83	1.78	2.49	0.75	1.34	0.20	0.00	0.00	0.00	10.11	10.11	70%
1880	0.83	1.06	1.94	1.48	1.80	1.45	6.51	0.91	0.00	0.00	0.00	0.00	15.98	15.98	110%
1881	0.00	0.65	7.75	2.40	2.62	1.06	1.93	0.00	0.04	0.00	0.00	0.00	16.45	16.45	113%
1882	0.08	0.78	1.97	1.07	1.72	4.85	1.03	0.20	0.00	0.00	0.00	0.34	12.04	11.70	83%
1883	1.52	1.48	0.38	2.38	0.63	3.45	1.50	2.18	0.00	0.00	0.00	0.35	13.87	13.86	95%
1884	1.52	0.57	0.44	4.03	5.29	1.82	2.70	0.20	1.73	0.00	0.10	0.30	22.80	22.75	157%
1885	1.14	0.02	6.22	1.72	0.36	0.78	1.29	0.08	0.00	0.00	0.00	0.05	11.66	12.01	80%
1886	0.00	6.20	1.94	4.20	0.24	1.18	2.36	0.00	0.00	0.40	0.00	0.00	16.52	16.17	114%
1887	0.30	0.70	0.81	0.90	6.23	0.23	1.60	0.00	0.00	0.00	0.00	0.80	11.57	11.17	80%
1888	0.00	0.61	3.51	3.20	0.94	2.51	0.60	0.66	0.30	0.00	0.00	0.76	13.09	13.13	90%
1889	0.00	3.80	2.21	0.46	0.67	5.15	0.51	2.25	0.00	0.00	0.00	0.00	15.05	15.81	104%
1890	3.94	2.95	8.63	5.24	3.71	2.85	0.86	0.48	0.00	0.00	0.00	1.20	29.86	28.66	206%
1891	0.00	0.00	3.31	0.54	4.18	2.50	1.88	0.40	0.15	0.00	0.00	1.32	14.28	14.16	98%
1892	0.05	0.38	4.42	0.84	1.08	3.96	0.90	1.30	0.00	0.00	0.00	0.45	13.38	14.25	92%
1893	1.65	4.97	7.27	3.02	3.12	3.68	1.40	0.73	0.00	0.00	0.00	0.00	25.84	26.29	178%
1894	0.00	1.59	2.14	4.97	5.36	0.81	0.58	1.19	0.52	0.00	0.00	1.45	18.61	17.16	128%
1895	1.15	0.50	8.56	6.83	1.56	1.81	1.26	1.25	0.00	0.00	0.00	0.22	23.14	24.37	159%
1896	0.83	1.69	1.28	7.16	0.17	1.50	3.11	0.39	0.00	0.00	0.73	0.55	17.41	16.35	120%
1897	1.48	3.02	1.71	1.89	3.54	4.04	0.24	0.00	0.08	0.00	0.00	0.06	16.06	17.28	111%
1898	1.43	0.52	1.31	1.47	1.78	0.78	0.45	0.96	0.35	0.00	0.00	0.95	10.00	9.11	69%
1899	0.74	0.25	1.61	2.60	0.08	4.81	0.35	0.15	0.22	0.00	0.00	0.00	10.81	11.76	74%
1900	2.52	2.49	2.07	2.44	0.34	1.11	0.86	1.10	0.00	0.00	0.00	0.18	13.11	12.93	90%
1901	1.93	4.48	1.06	2.69	5.15	0.95	1.80	1.58	0.00	0.00	0.00	0.68	20.32	19.82	140%
1902	0.70	1.99	0.74	0.99	3.62	2.69	0.75	0.32	0.00	0.00	0.13	0.00	11.93	12.48	82%
1903	0.47	2.07	0.87	3.19	0.94	5.65	0.81	0.12	0.00	0.00	0.00	0.00	14.12	14.25	97%
1904	0.00	2.16	0.59	0.89	4.18	3.71	1.56	0.24	0.00	0.00	0.32	1.62	15.27	13.33	105%
1905	1.00	0.78	1.42	2.43	2.30	3.12	0.93	1.89	0.00	0.00	0.00	0.00	13.87	15.81	95%
1906	0.00	1.01	1.18	5.56	2.67	5.18	0.95	1.61	0.56	0.00	0.00	0.20	18.92	18.72	130%
1907	0.03	1.34	6.45	3.22	1.86	8.85	0.47	0.16	0.56	0.00	0.00	0.00	22.94	23.14	158%
1908	0.81	0.04	3.90	2.27	1.35	0.73	0.28	0.53	0.00	0.00	0.00	0.03	9.94	9.91	68%
1909	0.27	0.60	1.55	10.18	3.96	1.94	0.00	0.00	0.05	0.00	0.00	0.62	19.17	18.58	132%
1910	0.75	1.68	5.77	2.50	1.14	1.90	0.10	0.00	0.04	0.00	0.00	0.10	13.98	14.50	96%
1911	0.29	0.10	1.32	12.60	1.42	4.45	0.69	0.24	0.07	0.00	0.00	0.00	21.18	21.28	146%
1912	0.43	0.29	1.71	2.66	0.20	1.99	0.73	0.94	0.65	0.00	0.00	0.48	10.08	9.60	69%
1913	0.71	0.44	0.81	2.63	0.38	1.65	0.54	0.58	0.01	0.27	0.02	0.00	8.04	8.23	55%
1914	0.00	2.47	3.17	7.10	2.11	0.66	0.76	0.45	0.19	0.00	0.00	0.00	16.91	17.20	116%
1915	0.45	0.33	3.96	4.16	5.79	1.50	0.66	2.66	0.00	0.00	0.00	0.00	19.51	19.51	134%
1916	0.00	0.76	4.41	11.35	2.17	1.47	0.21	0.05	0.00	0.00	0.00	0.44	20.86	20.42	144%
1917	0.50	0.68	3.28	1.06	3.37	1.08	0.15	0.02	0.00	0.00	0.00	0.04	10.18	10.58	70%
1918	0.00	0.43	0.66	0.59	3.08	3.32	0.61	0.00	0.00	0.00	0.00	5.72	14.41	8.73	99%
1919	0.39	2.38	1.51	1.03	4.58	2.33	0.05	0.00	0.00	0.00	0.00	0.48	12.75	17.99	88%
1920	0.15	0.33	2.21	0.22	0.71	3.52	1.07	0.00	0.13	0.00	0.00	0.00	8.34	8.82	57%
1921	2.03	1.43	3.81	3.38	0.59	0.83	0.16	1.05	0.00	0.00	0.00	0.05	13.33	13.28	92%
1922	0.15	1.17	3.38	1.51	5.46	1.83	0.23	0.27	0.00	0.00	0.00	0.00	14.00	14.05	96%
1923	0.54	2.86	5.43	1.80	0.65	0.15	2.15	0.00	0.02	0.00	0.00	0.82	14.42	13.60	99%
1924	0.25	0.76	0.87	1.40	0.93	0.65	0.28	0.07	0.00	0.00	0.00	0.00	5.21	6.03	36%
1925	1.30	1.53	2.63	1.02	3.74	1.14	1.75	1.41	0.04	0.00	0.00	0.00	14.56	14.56	100%
1926	0.00	0.97	1.14	2.44	3.58	0.16	3.11	0.11	0.00	0.00	0.00	0.00	11.51	11.51	79%
1927	0.93	2.83	0.78	1.74	3.49	1.54	1.73	0.10	0.18	0.00	0.00	0.03	13.35	13.32	92%
1928	1.71	1.43	2.00	1.46	0.89	3.43	1.43	0.45	0.00	0.00	0.00	0.00	12.80	12.83	88%
1929	0.00	2.57	2.76	1.26	0.87	1.07	0.70	0.03	0.83	0.00	0.00	0.00	10.09	10.09	69%
1930	0.01	0.00	1.81	3.64	1.91	1.88	1.14	0.43	0.00	0.00	0.00	0.20	11.02	10.82	76%
1931	0.58	1.15	0.26	3.45	1.67	0.57	0.36	0.93	0.11	0.00	0.00	0.00	9.08	9.28	62%
1932	0.27	1.89	5.63	1.29	3.15	0.19	0.41	0.37	0.00	0.00	0.00	0.00	13.20	13.20	91%
1933	0.00	0.51	2.03	4.51	0.44	2.09	0.13	0.70	0.03	0.00	0.00	0.01	10.45	10.44	72%
1934	0.75	0.00	3.69	1.29	2.86	0.00	0.13	0.60	0.53	0.00	0.00	0.27	10.12	9.86	70%
1935	0.62	2.71	2.32	3.53	0.52	3.16	3.28	0.00	0.00	0.00	0.04	0.00	16.18	16.41	111%
1936	0.79	0.21	1.53	3.28	6.76	0.71	0.63	0.46	0.10	0.00	0.00	0.00	14.47	14.51	100%
1937	0.40	0.02	3.26	3.38	4.13	5.07	0.68	0.17	0.20	0.00	0.00	0.00	17.31	17.31	119%
1938	0.55	2.46	4.57	2.40	6.14	4.09	0.90	0.02	0.00	0.00	0.00	0.00	21.13	21.13	145%
1939	1.00	1.08	0.52	2.40	1.57	2.18	0.53	0.18	0.00	0.00	0.00	0.16	9.62	9.46	66%

Table 3.1-3
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**TABLE 3.1-3
ZONE 7 WATER AGENCY
MONTHLY PRECIPITATION (CM_STA 15E in inches), LIVERMORE
1871 to 2011 WATER YEARS**

Year	OCTWY	NOVWY	DECWY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL OCT-SEP	TOTAL JULY-JUNE	% NORMAL OCT-SEP
1940	1.23	0.15	0.78	8.13	5.14	2.60	0.35	0.14	0.00	0.00	0.00	0.25	18.77	18.68	129%
1941	0.50	0.43	4.63	3.24	4.19	2.07	2.76	0.23	0.00	0.00	0.03	0.00	18.08	18.30	124%
1942	0.72	0.89	5.34	3.89	1.68	1.42	3.10	1.00	0.00	0.00	0.00	0.09	18.13	18.07	125%
1943	1.08	3.05	1.73	4.48	1.68	2.39	1.14	0.00	0.06	0.00	0.00	0.00	15.61	15.70	107%
1944	0.30	0.53	1.23	2.36	4.89	1.01	0.94	0.73	0.00	0.00	0.00	0.00	11.99	11.99	83%
1945	0.77	3.41	2.03	0.87	3.68	3.19	0.20	0.17	0.00	0.00	0.02	0.00	14.34	14.32	99%
1946	1.07	2.07	2.98	0.76	1.23	1.69	0.02	0.61	0.00	0.24	0.00	0.02	10.69	10.45	74%
1947	0.02	2.93	2.07	0.69	1.45	2.34	0.53	0.17	0.36	0.00	0.00	0.00	10.56	10.82	73%
1948	1.84	0.85	0.51	0.20	1.11	2.79	2.50	1.03	0.16	0.03	0.00	0.00	11.02	10.99	76%
1949	0.46	0.34	2.71	1.39	2.47	3.38	0.02	0.34	0.00	0.03	0.16	0.05	11.35	11.14	78%
1950	0.08	1.20	1.21	4.65	1.54	1.44	0.85	0.59	0.01	0.00	0.00	0.08	11.65	11.81	80%
1951	1.84	5.95	4.95	2.23	1.81	1.82	0.55	0.35	0.06	0.00	0.00	0.00	19.56	19.64	135%
1952	1.04	3.01	6.07	7.60	1.40	2.36	2.20	0.16	0.04	0.00	0.00	0.10	23.98	23.88	165%
1953	0.01	2.11	6.33	2.07	0.05	1.12	1.42	0.61	0.59	0.00	0.15	0.00	14.46	14.41	100%
1954	0.21	1.33	0.64	2.19	2.27	3.00	0.73	0.16	0.27	0.00	0.00	0.04	10.84	10.95	75%
1955	0.00	1.68	3.33	2.45	1.69	0.38	1.28	0.65	0.00	0.00	0.01	0.01	11.48	11.50	79%
1956	0.01	1.31	10.15	5.49	1.15	0.14	1.92	0.63	0.00	0.00	0.00	0.63	21.43	20.82	147%
1957	0.79	0.03	0.48	2.65	2.23	1.30	1.14	2.65	0.04	0.00	0.00	0.05	11.36	11.94	78%
1958	1.06	0.37	1.62	3.16	5.37	4.44	3.74	0.66	0.41	0.00	0.00	0.02	20.85	20.88	143%
1959	0.09	0.14	0.86	2.45	3.59	0.29	0.35	0.00	0.00	0.00	0.07	1.89	9.73	67%	
1960	0.00	0.00	0.75	2.98	4.12	0.60	0.48	0.42	0.00	0.02	0.00	0.01	9.38	11.31	65%
1961	0.05	2.92	1.25	2.08	1.04	1.92	1.03	0.69	0.19	0.00	0.13	0.16	11.46	11.20	79%
1962	0.15	2.24	0.82	0.73	5.61	1.82	0.22	0.00	0.00	0.00	0.00	0.00	11.59	11.88	80%
1963	3.64	0.28	1.55	1.40	4.50	2.60	3.47	0.70	0.00	0.00	0.00	0.33	18.47	18.14	127%
1964	0.93	3.18	0.19	2.37	0.08	1.57	0.21	0.48	0.32	0.00	0.12	0.04	9.49	9.66	65%
1965	0.85	2.44	4.91	2.11	0.59	1.73	1.53	0.00	0.00	0.00	0.21	0.00	14.37	14.32	99%
1966	0.03	4.22	3.23	1.05	1.17	0.17	0.33	0.10	0.12	0.17	0.00	0.11	10.70	10.63	74%
1967	0.00	3.43	2.35	6.14	0.29	4.15	4.65	0.19	0.48	0.00	0.00	0.02	21.70	21.96	149%
1968	0.24	0.88	1.62	3.93	0.90	2.40	0.43	0.15	0.00	0.00	0.00	0.00	10.55	10.57	73%
1969	0.43	2.48	3.04	6.28	4.76	0.55	1.24	0.08	0.00	0.00	0.00	0.00	18.86	18.86	130%
1970	1.10	0.49	2.34	5.38	1.18	1.42	0.40	0.07	0.32	0.00	0.00	0.00	12.70	12.70	87%
1971	0.41	5.24	5.27	1.19	0.33	1.75	1.37	0.54	0.00	0.00	0.00	0.13	16.23	16.10	112%
1972	0.04	0.46	3.27	0.90	0.79	0.14	0.64	0.00	0.04	0.00	0.00	0.58	6.86	6.41	47%
1973	2.98	4.91	2.22	5.50	3.38	2.63	0.29	0.03	0.00	0.00	0.00	0.08	22.02	22.52	152%
1974	2.08	3.71	3.80	1.50	0.71	2.69	1.62	0.00	0.00	0.00	0.00	0.00	16.11	16.19	111%
1975	0.50	0.66	1.98	0.84	3.65	5.24	1.42	0.00	0.06	0.10	0.35	0.00	14.80	14.35	102%
1976	1.27	0.08	0.21	0.30	1.46	0.48	0.39	0.00	0.18	0.00	0.91	0.95	6.23	4.82	43%
1977	0.50	0.50	0.73	1.15	0.83	0.82	0.16	1.01	0.00	0.10	0.00	0.22	6.02	7.56	41%
1978	0.13	1.34	3.07	5.44	2.95	3.07	2.49	0.01	0.00	0.00	0.00	0.04	18.54	18.82	128%
1979	0.00	2.16	0.58	4.52	3.19	1.86	0.88	0.34	0.00	0.06	0.00	0.00	13.59	13.57	94%
1980	1.51	1.13	2.66	4.16	4.24	1.36	1.32	0.48	0.00	0.70	0.00	0.00	17.56	16.92	121%
1981	0.04	0.28	1.18	3.97	1.11	2.94	0.61	0.11	0.00	0.00	0.00	0.06	10.30	10.94	71%
1982	2.07	3.44	2.57	5.29	2.16	5.58	1.50	0.00	0.28	0.00	0.01	1.48	24.38	22.95	168%
1983	2.24	3.72	2.80	6.28	5.56	6.14	3.51	0.21	0.00	0.00	0.50	1.02	31.98	31.95	220%
1984	0.27	5.44	3.44	0.33	1.87	1.00	0.53	0.01	0.03	0.00	0.00	0.04	12.96	14.44	89%
1985	1.25	4.71	1.51	0.48	1.25	2.62	0.32	0.07	0.22	0.00	0.03	0.13	12.59	12.47	87%
1986	0.89	2.69	1.97	2.04	7.11	4.09	0.40	0.14	0.00	0.01	0.00	0.45	19.79	19.49	136%
1987	0.04	0.08	0.92	1.83	3.47	2.30	0.16	0.09	0.00	0.00	0.00	0.00	8.89	9.35	61%
1988	0.87	1.40	2.30	1.78	0.38	0.26	1.15	0.45	0.10	0.00	0.00	0.00	8.69	8.69	60%
1989	0.11	1.92	2.03	0.81	0.95	2.94	0.88	0.08	0.10	0.00	0.00	1.33	11.15	9.82	77%
1990	1.13	1.02	0.10	1.54	2.46	0.87	0.37	1.78	0.00	0.02	0.00	0.06	9.35	10.60	64%
1991	0.08	0.39	1.45	0.31	2.20	5.87	0.34	0.35	0.08	0.00	0.21	0.04	11.32	11.15	78%
1992	1.65	0.31	1.19	1.39	4.61	1.97	0.43	0.00	0.09	0.00	0.00	0.00	11.64	11.89	80%
1993	0.90	0.15	4.99	6.41	4.53	2.91	0.63	0.51	0.30	0.00	0.00	0.00	21.33	21.33	147%
1994	0.57	2.00	1.81	0.94	3.33	0.15	1.20	1.78	0.04	0.00	0.00	0.00	11.82	11.82	81%
1995	0.58	3.08	1.36	6.64	0.33	6.66	1.02	0.92	0.70	0.00	0.00	0.00	21.29	21.29	147%
1996	0.00	0.01	5.37	5.17	4.10	2.34	1.91	1.05	0.00	0.00	0.00	0.00	19.95	19.95	137%
1997	1.08	2.55	4.43	5.81	0.15	0.06	0.15	0.29	0.17	0.00	0.42	0.00	15.11	14.69	104%
1998	0.28	4.23	1.95	5.47	7.30	2.37	1.37	2.00	0.13	0.00	0.00	0.18	25.28	25.52	174%
1999	0.54	2.48	0.73	3.23	3.33	1.67	0.99	0.08	0.01	0.00	0.03	0.04	13.13	13.24	90%
2000	0.15	1.26	0.25	4.61	4.87	1.25	0.59	0.69	0.18	0.00	0.01	0.24	14.10	13.92	97%
2001	1.97	0.49	0.45	1.92	2.89	1.22	1.80	0.00	0.12	0.00	0.00	0.09	10.95	11.11	75%
2002	0.37	1.92	5.09	0.72	0.62	1.65	0.16	0.68	0.00	0.00	0.00	0.00	11.21	11.30	77%
2003	0.00	2.65	7.01	0.66	1.31	1.07	3.09	0.95	0.00	0.00	0.29	0.00	17.03	16.74	117%
2004	0.02	2.02	3.57	2.19	4.01	0.39	0.18	0.11	0.00	0.00	0.00	0.58	13.07	12.78	90%
2005	2.77	0.89	3.01	2.81	3.55	3.41	1.53	1.03	0.05	0.00	0.00	0.25	19.30	19.63	133%
2006	0.17	0.65	5.40	2.22	1.32	4.79	2.60	0.34	0.00	0.00	0.00	0.00	17.49	17.74	120%
2007	0.20	1.68	2.25	0.52	3.92	0.33	0.44	0.11	0.00	0.00	0.00	0.21	9.66	9.45	66%
2008	1.12	0.71	2.05	4.79	1.89	0.10	0.02	0.00	0.00	0.00	0.00	0.00	10.68	10.89	74%
2009	0.33	1.40	1.56	1.34	3.31	2.29	0.23	0.51	0.11	0.00	0.00	0.31	11.39	11.08	78%
2010	2.79	0.21	2.02	3.53	2.36	1.57	2.10	0.24	0.00	0.00	0.00	0.00	14.82	15.13	102%
2011	1.00	2.02	3.87	0.78	2.69	4.10	0.22	0.46	1.07	0.00	0.00	0.00	16.21	16.21	112%
COUNT	141	141	141	141	141	141	141	141	141	140	140	140	140	140	140
MAXIMUM	3.94	7.23	11.69	12.60	7.30	8.85	6.51	2.66	1.73	0.70	0.91	5.72	31.98	31.95	220%
MINIMUM	0.00	0.00	0.00	0.20	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.98	4.82	34%
MEAN	0.71	1.62	2.63	2.93	2.49	2.19	1.07	0.47	0.12	0.02	0.04	0.24	14.53	14.53	100%

Table 3.1-3
Page 2 of 2

TABLE 3.1-4
ZONE 7 WATER AGENCY
DAILY PAN EVAPORATION, LAKE DEL VALLE, LIVERMORE
(CM_STA LDV-EV, in inches)
2011 WATER YEAR

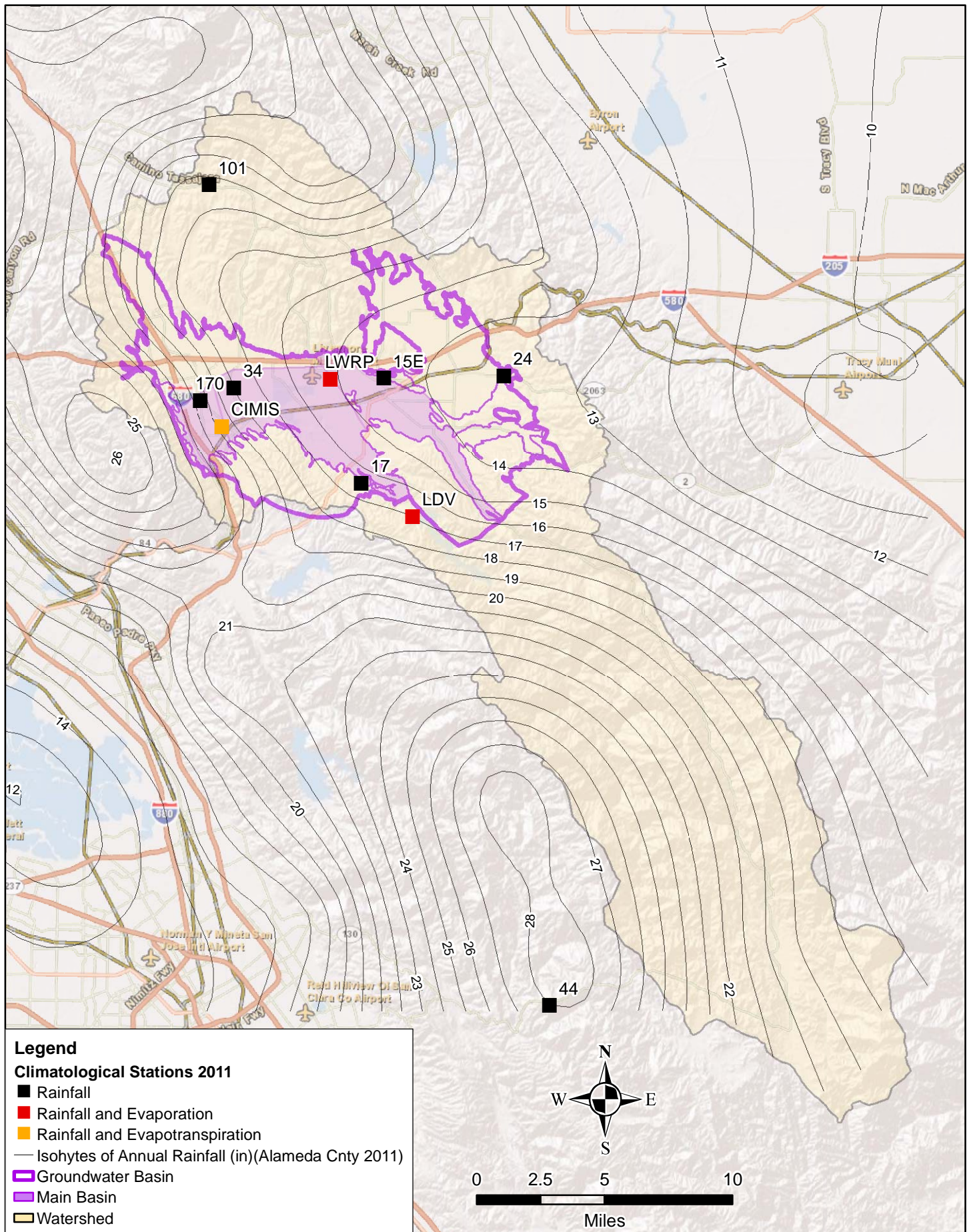
AVERAGE MONTH	5.07	2.39	1.45	1.38	1.89	3.55	5.37	7.69	9.25	10.59	9.71	7.82
YEAR TO DATE	5.07	7.46	8.91	10.28	12.17	15.72	21.09	28.77	38.03	48.61	58.32	66.14
DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.26	0.11	0.05	0.04	0.04	0.09	0.29	0.31	0.04	0.26	0.30	0.23
2	0.16	0.10	0.05	0.03	0.14	0.13	0.21	0.40	0.17	0.40	0.32	0.33
3	0.22	0.17	0.04	0.02	0.13	0.09	0.13	0.30	0.22	0.43	0.29	0.38
4	0.25	0.10	0.01	0.02	0.09	0.10	0.30	0.32	0.10	0.43	0.32	0.33
5	0.09	0.13	0.01	0.02	0.09	0.10	0.19	0.34	0.06	0.41	0.27	0.24
6	0.18	0.12	0.12	0.03	0.17	0.09	0.19	0.37	0.35	0.44	0.29	0.33
7	0.13	0.04	0.05	0.02	0.17	0.04	0.21	0.30	0.23	0.42	0.30	0.42
8	0.17	0.03	0.05	0.02	0.13	0.12	0.16	0.12	0.30	0.43	0.26	0.36
9	0.15	0.08	0.01	0.01	0.16	0.07	0.12	0.13	0.25	0.38	0.29	0.36
10	0.20	0.08	0.03	0.05	0.12	0.06	0.17	0.30	0.29	0.33	0.35	0.30
11	0.23	0.07	0.02	0.04	0.13	0.06	0.17	0.33	0.28	0.30	0.35	0.30
12	0.29	0.11	0.07	0.00	0.09	0.11	0.18	0.17	0.21	0.35	0.30	0.24
13	0.31	0.10	0.03	0.03	0.11	0.14	0.16	0.25	0.25	0.20	0.36	0.23
14	0.31	0.15	0.04	0.01	0.14	0.06	0.17	0.25	0.28	0.27	0.29	0.23
15	0.30	0.15	0.02	0.04	0.06	0.09	0.20	0.18	0.45	0.25	0.35	0.22
16	0.25	0.12	0.02	0.07	0.15	0.13	0.13	0.09	0.33	0.30	0.36	0.27
17	0.18	0.13	0.04	0.02	0.04	0.11	0.19	0.08	0.32	0.21	0.30	0.22
18	0.04	0.13	0.02	0.04	0.01	0.11	0.20	0.07	0.29	0.24	0.30	0.30
19	0.11	0.07	0.00	0.11	0.00	0.05	0.13	0.15	0.30	0.29	0.33	0.30
20	0.13	0.02	0.06	0.10	0.00	0.10	0.18	0.15	0.45	0.32	0.30	0.35
21	0.15	0.03	0.04	0.10	0.07	0.01	0.16	0.29	0.45	0.38	0.25	0.37
22	0.10	0.04	0.03	0.01	0.08	0.01	0.25	0.23	0.45	0.37	0.23	0.35
23	0.04	0.02	0.04	0.09	0.06	0.08	0.09	0.28	0.45	0.32	0.35	0.30
24	0.06	0.06	0.03	0.10	0.06	0.06	0.14	0.30	0.30	0.31	0.35	0.35
25	0.05	0.06	0.03	0.11	0.04	0.07	0.14	0.18	0.35	0.30	0.38	0.28
26	0.11	0.08	0.03	0.10	0.06	0.05	0.15	0.10	0.30	0.29	0.36	0.12
27	0.09	0.02	0.05	0.09	0.03	0.04	0.29	0.24	0.27	0.31	0.30	0.20
28	0.12	0.01	0.05	0.07	0.09	0.00	0.16	0.22	0.37	0.38	0.28	0.28
29	0.15	0.03	0.04	0.08		0.16	0.26	0.20	0.09	0.27	0.35	0.35
30	0.08	0.07	0.01	0.01		0.14	0.32	0.23	0.02	0.35	0.27	0.27
31	0.07		0.04	0.05		0.17		0.25		0.31	0.27	
MONTHLY TOTAL	4.98	2.43	1.13	1.53	2.46	2.64	5.64	7.13	8.22	10.25	9.62	8.81
PERCENT AVERAGE	98%	102%	78%	111%	130%	74%	105%	93%	89%	97%	99%	113%
TOTAL TO DATE	4.98	7.41	8.54	10.07	12.53	15.17	20.81	27.94	36.16	46.41	56.03	64.84
PERCENT AVERAGE	98%	99%	96%	98%	103%	97%	99%	97%	95%	95%	96%	98%

PAN EVAPORATION IN INCHES, RECORDED BETWEEN 900 AND 1300 HRS. STATION ESTABLISHED OCTOBER 1969.

TABLE 3.1-5
ZONE 7 WATER AGENCY
MONTHLY PAN EVAPORATION, LAKE DEL VALLE, LIVERMORE
(CM_STA LDV-EV, in inches)
1969 to 2011 WATER YEARS

Year	OCTWY	NOVWY	DECWY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL OCT-SEP	TOTAL JULY-JUNE	% NORMAL OCT-SEP
1969	3.20	2.50	1.54	0.66	1.08	4.89	5.92	9.99	7.84	11.38	11.77	8.32	69.09	NA	104%
1970	4.04	2.94	1.12	1.23	2.29	4.96	5.83	8.88	8.88	11.52	9.92	9.16	70.77	71.64	107%
1971	5.07	2.14	1.05	1.33	2.12	3.67	5.17	6.54	8.91	10.92	10.30	9.12	66.34	66.60	100%
1972	5.91	3.01	1.49	1.53	2.01	4.74	6.52	8.84	10.03	11.63	10.40	7.12	73.23	74.42	111%
1973	3.67	1.30	0.93	1.14	1.20	2.98	6.36	8.69	10.59	10.89	10.21	7.33	65.29	66.01	99%
1974	4.70	1.86	0.85	1.40	1.73	2.40	4.16	7.31	9.14	9.68	9.73	7.94	60.90	61.98	92%
1975	5.52	2.15	1.44	1.73	1.99	3.01	3.64	8.27	8.63	9.45	9.39	7.45	62.67	63.73	95%
1976	3.72	2.28	1.58	2.45	1.96	3.94	5.56	8.47	9.85	9.80	7.05	6.80	63.46	66.10	96%
1977	4.82	2.75	2.59	1.08	2.12	3.84	7.15	5.48	9.28	11.24	8.89	6.74	65.98	62.76	100%
1978	5.12	2.70	1.37	0.99	1.43	2.57	3.73	8.69	8.91	10.52	10.24	7.90	64.17	62.38	97%
1979	5.80	2.24	1.51	1.25	1.29	2.29	4.80	8.36	11.02	10.40	9.23	9.47	67.66	67.22	102%
1980	4.14	1.85	1.95	1.66	1.40	3.82	4.78	6.22	8.18	9.41	9.17	7.16	59.74	63.10	90%
1981	5.86	3.30	1.79	1.08	2.18	2.83	5.80	8.11	11.82	11.34	10.23	7.72	72.06	68.51	109%
1982	4.43	2.10	1.14	1.23	2.10	2.25	4.59	7.55	7.31	10.34	10.58	6.83	60.45	61.99	91%
1983	4.53	1.50	1.54	1.72	1.54	2.17	4.05	6.71	8.34	10.44	9.35	7.82	59.71	59.85	90%
1984	4.37	1.86	1.08	1.52	1.79	4.29	5.32	9.04	9.88	11.99	9.80	9.24	70.18	66.76	106%
1985	4.02	1.63	1.11	1.18	2.70	3.09	5.95	7.75	10.40	11.49	9.23	6.38	64.93	68.86	98%
1986	5.05	2.27	1.11	1.11	1.75	3.55	4.96	7.44	8.67	10.20	8.88	6.10	61.09	63.01	92%
1987	4.84	3.47	1.22	1.45	2.08	3.19	6.43	7.90	8.73	8.46	8.97	7.29	64.03	64.49	97%
1988	4.71	1.71	1.50	1.21	2.94	5.17	5.30	7.22	8.92	11.46	8.90	7.90	66.94	63.40	101%
1989	4.81	1.85	1.64	1.39	1.57	2.75	5.75	7.70	9.30	11.30	9.14	6.41	63.61	65.02	96%
1990	4.86	2.95	1.75	1.57	1.83	3.64	5.74	7.86	9.18	10.19	9.21	7.09	65.87	66.23	100%
1991	6.56	3.48	1.95	1.86	2.44	2.63	5.00	6.42	8.50	10.25	8.00	7.61	64.70	65.33	98%
1992	6.45	3.03	1.71	0.96	1.65	2.84	5.91	8.87	8.23	10.01	10.76	7.82	68.24	65.51	103%
1993	5.12	2.79	1.19	1.21	1.42	2.83	4.93	6.61	9.64	10.23	10.02	8.18	64.17	64.33	97%
1994	4.65	3.27	1.22	1.49	1.36	4.12	5.23	6.38	10.01	10.03	10.31	7.44	65.51	66.16	99%
1995	4.94	1.66	0.76	0.73	1.61	2.33	4.75	5.22	8.18	10.06	10.39	7.65	58.28	57.96	88%
1996	6.23	2.80	0.88	1.33	1.66	3.85	6.38	8.12	9.68	12.03	11.13	7.48	71.57	69.03	108%
1997	5.44	2.05	1.04	1.02	2.67	4.82	6.45	8.95	9.40	10.32	8.78	8.52	69.46	72.48	105%
1998	5.25	1.82	1.60	1.19	0.96	2.80	4.36	4.13	7.10	9.91	10.57	7.51	57.20	56.83	86%
1999	4.51	1.63	1.41	1.32	1.58	2.93	5.25	7.04	8.70	10.51	8.58	7.53	60.99	62.36	92%
2000	6.86	2.73	2.51	1.57	1.55	3.91	5.48	7.16	9.66	9.23	9.82	7.86	68.35	68.06	103%
2001	3.84	1.84	1.68	1.45	2.20	4.14	4.86	10.05	10.92	9.78	9.75	7.98	68.49	67.89	104%
2002	6.56	2.56	1.47	1.97	2.56	4.63	5.65	7.82	9.87	11.08	9.87	9.13	73.17	70.60	111%
2003	5.64	3.23	1.73	1.26	2.31	4.04	4.05	7.62	9.78	12.14	9.23	8.84	69.87	69.74	106%
2004	6.71	1.72	1.12	1.08	2.22	4.99	7.38	8.66	9.46	10.16	9.88	8.76	72.14	73.55	109%
2005	4.86	2.21	1.54	1.14	1.54	3.20	4.93	6.60	8.37	11.13	10.65	7.41	63.58	63.19	96%
2006	5.19	2.50	1.50	1.52	2.47	3.04	3.81	8.54	9.82	12.43	9.37	8.42	68.61	67.58	104%
2007	5.27	2.09	2.22	1.98	1.71	4.34	5.86	8.58	9.59	9.814	10.45	7	68.90	71.86	104%
2008	4.45	3.25	1.68	1.37	2.14	4.60	6.65	8.66	10.37	10.54	10.54	8.42	72.67	70.43	110%
2009	6.27	2.40	1.35	2.04	1.95	3.90	6.24	8.52	9.09	11.053	10.12	8.63	71.566	71.26	108%
2010	4.84	3.00	1.28	1.20	1.61	3.91	4.65	6.40	9.52	10.2	9.08	8.26	63.95	66.21	97%
2011	4.98	2.43	1.13	1.53	2.46	2.64	5.64	7.13	8.22	10.25	9.62	8.46	64.49	63.70	97%
COUNT	43	43	43	43	43	43	43	43	43	43	43	43	42	41	42
MAXIMUM	6.86	3.48	2.59	2.45	2.94	5.17	7.38	10.05	11.82	12.43	11.77	9.47	73.23	74.42	111%
MINIMUM	3.20	1.30	0.76	0.66	0.96	2.17	3.64	4.13	7.10	8.46	7.05	6.10	57.20	56.83	86%
MEAN	5.07	2.39	1.45	1.38	1.89	3.55	5.37	7.69	9.25	10.59	9.71	7.82	66.14	66.15	100%

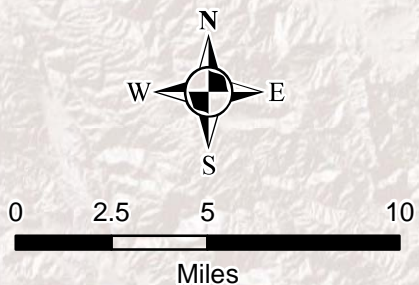
Table 3.1-5



Legend

Climatological Stations 2011

- Rainfall
- Rainfall and Evaporation
- Rainfall and Evapotranspiration
- Isohyets of Annual Rainfall (in)(Alameda Cnty 2011)
- ▭ Groundwater Basin
- ▭ Main Basin
- ▭ Watershed



ZONE 7 WATER AGENCY
 100 North Canyons Parkway
 Livermore, CA 94551

DRAWN: TR/MG
 REVIEWED: MK/MG
 File: E:\MONITOR\PR\2011\WY1
 Fig3.1-1-CMSiteMap2011.mxd

Scale: 1" = 5 miles
 Date: May 21, 2012
 FIGURE 3.1-1

Climatological Monitoring Stations with Average Rainfall (in)

**FIGURE 3.1-2
ZONE 7 WATER AGENCY
Graph of Livermore Rainfall (Station 15E NOAA)**

