has yet been detected in any of the groundwater monitoring wells. An additional sampling event is planned for July 2012 to continue this investigation. The results of this investigation will be presented in 2013.

3.3 Surface Water Monitoring Program

3.3.1 Program Description

The objectives of Zone 7's Surface Water Monitoring Program are to:

- **Surface Water Flow Monitoring** – Quantify inflow and outflow of surface water entering and leaving the groundwater basin. Also, to quantify the portions recharging the groundwater basin's aquifers and the amounts being discharged from the groundwater basin by the gravel quarries' dewatering operations;

- **Surface Water Quality Monitoring** - Provide a record of water quality for the basin's recharge and discharge waters with which the groundwater basin's annual salt loading is calculated;

- **Del Valle Water Rights** - Satisfy the requirements of Zone 7's and Alameda County Water District's "water rights" for the Arroyo Valle. This involves quarterly sampling and continuous flow monitoring at two surface water stations; and

- **NPDES Permitting** - Monitor Zone 7's treated water discharges at the Del Valle Water Treatment Plant (DVWTP), and Patterson Pass Water Treatment Plant (PPWTP) (as required by National Pollutant Discharge Elimination System (NPDES) No. CAG382001, Order No. R2-2003-0062). Samples are taken above and below existing treatment plant discharge points during the first significant rainfall event of the season.

The Surface Water Monitoring Program focuses on the four main gaining and losing streams that impact the groundwater basin (i.e., Arroyo Valle, Arroyo Mocho, Arroyo Las Positas, and Arroyo De La Laguna), and the diversions and accretions that affect the flows into or from each of them. The program utilizes a network of telemetered recorder stations, meters, and staff gage sites (Figure 3.3-1 and Table 3.3-1) to compute the quantity of water flowing past each station. Once per year, water samples are collected from all ten recorder sites and four NPDES sites in the program and submitted to Zone 7's laboratory for analysis of metals and minerals; the same parameters that are routinely analyzed for in the Groundwater Monitoring Program.

3.3.2 2011 Results

3.3.2.1 General

The 2011 Surface Water Monitoring Program included ten surface water recorder stations (Table 3.3-2). Monthly total flows for the 2011 Water Year from the recording stations are presented in Table 3.3-3. All stations were maintained throughout the year and all records have been reviewed and archived as part of

the long-term historical record. For the 2011 Water Year, nine of the ten recorder stations were sampled and analyzed for metals and minerals. These results are presented on Table 3.3-4.

The following sections outline the Surface Water Program activities for the 2011 Water Year (listed by stream) and highlight the findings and conclusions from these activities:

3.3.2.2 Arroyo Valle

The following are items of special note for the Arroyo Valle in the 2011 Water Year:

- The peak flow recorded at the Arroyo Del Valle at Pleasanton station (ADVP) during the 2011 Water Year was 896 cubic feet per second (cfs) on March 24.

- For the 2011 Water Year discharge computations, the ADVP stage-discharge rating curve was updated for flows below 90 cfs to take into account control changes indicated by new discharge measurements.

- During the 2011 Water Year, watershed runoff total into Lake Del Valle was 28,634 AF, 111% of average.

- In the 2011 Water Year, Lake Del Valle flood releases (LDV_FLD_TTL) totaled 2,559 AF. Releases to the Arroyo Valle from the SBA (SBA_AV_TTL) totaled 3,905 AF.

- Cemex did not make any discharges into the Arroyo Valle in the 2011 Water Year (see Section 3.5.2).

- For the 2011 Water Rights objective, recorder flow data was collected at both Arroyo Valle near Livermore (AVNL) and Arroyo Valle at Pleasanton (ADVP). In addition, five water quality grab samples were collected at ADVP and four water quality grab samples were collected at AVNL. Zone 7 is required to maintain a “live stream” condition on the Arroyo Valle whenever water stored under the permit is available in Lake Del Valle. Zone 7’s recorder station record at ADVP verified that this permit condition was met during the 2011 Water Year. The results from the flow recorders and the water quality sampling are submitted to the State Water Rights Board each year to satisfy permit requirements.

- For Zone 7’s NPDES objective, Zone 7 is required to sample the South Tributary of the Arroyo Valle above and below the DVWTP following periods of high precipitation. During the 2011 Water Year, no water quality samples were taken due to a staff oversight.

3.3.2.3 Arroyo Mocho

The following are items of special note for the Arroyo Mocho in the 2011 Water Year:

- There was no flow at AMHAG about 16% of the water year.

- For the 2011 Water Year discharge computations, the AMP stage-discharge rating curve was updated for flows below about 1,000 cfs to take into account improved rating definition based on new discharge measurements. In addition, the AM_KB stage-discharge rating was updated for flows below about 150 cfs, also based on new discharge measurements.

- 4,113 AF of SWP water was released from the SBA to the Arroyo Mocho (SBA_AM) during the 2011 Water Year as part of Zone 7's artificial recharge and conjunctive use programs.

- Vulcan Materials discharged 7,116 AF into the Arroyo Mocho (see Section 3.5.2).

- For the first year of a multi-year sediment transport study, automated turbidity-triggered auto-samplers were deployed at AMHAG and AMP. Bedload and suspended sediment samples were also collected during high flow events by Zone 7's consultant, San Francisco Estuary Institute (SFEI).

3.3.2.4 Arroyo Las Positas

The following are items of special note for the Arroyo Las Positas in the 2011 Water Year:

- A total of 1,121 AF of artificial stream recharge releases were made into the Arroyo Las Positas (SBA_ALT) Oct. 1 through Oct 14, 2010 and May 31 through September 30, 2011. During the artificial stream recharge releases, TDS concentrations dropped from about 900 mg/L to about 400 mg/L (Table 3.3-4). During May to September releases, Zone 7 also sampled groundwater monitoring wells in the vicinity of the arroyo in an attempt to monitor the reduction of salt loading, if any, that the releases were having on the groundwater basin. The results of this sampling are discussed in Section 3.2.4.5.

- The peak flow recorded at the Arroyo Las Positas at Livermore station (ALPL) during the water year was 731 cfs on March 24 and the peak flow recorded at the Arroyo Las Positas at El Charro station (ALP_ELCH) was 949 cfs also on March 24.

- For the 2011 Water Year discharge computations, the ALPL stage-discharge rating was updated for flows below 20 cfs to take into account control changes indicated by new measurements.

- No water samples were collected at the Arroyo Las Positas near the PPWTP for the NPDES objective for the 2011 Water Year as no flow was observed during site visits.

- A turbidity-triggered auto-sampler was deployed at ALPL as part of a multi-year watershed sediment transport study. SFEI and Zone 7 staff also conducted bedload and suspended sediment sampling as part of the same study.

3.3.2.5 Arroyo De La Laguna

The following are items of special note for the Arroyo De La Laguna in the 2011 Water Year:

- Water flowed continuously down the Arroyo De La Laguna throughout the 2011 Water Year. The peak flow recorded at the Arroyo De La Laguna at Verona station (ADLLV) during the 2011 Water Year was 5,840 cfs on March 24.

- A total of 67,345 AF of water flowed out of the valley past ADLLV during the 2011 Water Year.

3.4 Subsidence Monitoring Program

3.4.1 Program Description

This monitoring program began in earnest in 2002. Prior to that, in 1994, Zone 7 had conducted a study of historical benchmark elevation data throughout the Main Basin to determine if there had been any recorded subsidence, possibly due to groundwater pumping from the basin. The conclusion then was that there was no evidence of significant inelastic (permanent) subsidence due to historical groundwater pumping.

Zone 7's Well Master Plan (WMP), which was adopted by the Board in 2005, included a recommendation to conduct high precision leveling surveys twice a year; in spring when groundwater levels are relatively high and again in fall when groundwater levels are relatively low. The spring and fall survey results, along with results from previous years, are used to identify potential occurrences of inelastic subsidence, and to get a better handle on the limits of groundwater pumping stress that result in only elastic subsidence (i.e., subsidence that can be recovered by aquifer recharge).

The 2011 program included surveying elevations in a network of about 80 benchmarks and other survey points in the spring and fall at approximately the same time that basin-wide groundwater levels were measured (Section 3.2). Table 3.4-1 contains a list of all land surface elevation monitoring locations for the 2011 program, and Figure 3.4-1 shows the locations of each survey point. These points all tie into a main circuit (A1) that begins and ends at points in bedrock to the west and south of the Main Basin: Sites A1-1.0 and A1-17.0, respectively. Several smaller circuits (B1 to B5) branch off this main circuit. These benchmarks were surveyed by Kier & Wright Civil Engineers and Surveyors, Inc., of Pleasanton, California. For groundwater elevation reference points, Zone 7 also surveys small circuits in and around Zone 7 wells as needed. These small circuits branch off the Kier & Wright surveyed circuits.

Starting in 2009, staff began monitoring the elevation difference between the cement floor and the wellhead pedestals at several Zone 7 municipal wells. These sites (labeled in Table 3.4-1 with a suffix of "-Diff") are measured monthly to investigate whether there is any indication of inelastic subsidence occurring between Zone 7's semiannual surveying events.

3.4.2 2011 Results

Zone 7's survey points are graphed, along with Key Well water elevations, on Figure 3.4-2 (Bernal Subbasin) and Figure 3.4-3 (Amador Subbasin), Figure 3.4-4 (Bernal Subbasin - Hopyard 6 Well), Figure 3.4-5 (Amador Subbasin - Mocho Wellfield), and Figure 3.4-6 (Amador Subbasin - Stoneridge) show graphs of land surface elevation changes and groundwater elevation at Zone 7 municipal wells. These

TABLE 3.3-1
ZONE 7 WATER AGENCY
LIST OF SURFACE WATER STATIONS
2011 WATER YEAR

Station Name	Description	Gage Type	PROGRAM and FREQUENCY			
			Flow	Qual	Wtr Rights	NPDES
ARROYO VALLE - LINE E						
AVBLC	Arroyo Valle Below Lang Canyon	Recorder	R	A		
LDV_FLD_GATE	Lake Del Valle Flood Gate	Meter	D			
LDV_FLD_TTL	Lake Del Valle Total Flood Release	None	D			
AVRUNOFF	Arroyo Valle Runoff	None	D			
SBA_TO2_AV	SBA Turnout 2 to Arroyo Valle	Meter	D			
AVNL	Arroyo Valle Near Livermore	Recorder	R	Q	Q	
SBA_TO1_AV	SBA Turnout 1 to Arroyo Valle	Meter	D			
SBA_AV_TTL	SBA Turnouts to Arroyo Valle - Total	None	D			
STRIB_ADVWTP	South Tributary Above DVWTP	None				A
DVWTP_DISCH	DVWTP Discharge to South Tributary	Meter	D			
STRIB_KB	South Tributary at Kalthoff Bridge	None				A
MA_LS_SC	Lonestar Discharge to Shadow Cliffs	Meter	D			
MA_LS_AV	Lonestar Discharge to Arroyo Valle	Meter	D			
AV_DIV_SC	Arroyo Valle Diversion to Shadow Cliffs	Meter	D			
ADVP	Arroyo Valle at Pleasanton	Recorder	R	Q	Q	
ARROYO MOCHO - LINE G						
AMNL	Arroyo Mocho Near Livermore	Recorder	R	A		
SBA_AM	SBA Turnout to Arroyo Mocho	Meter	D			
WEN_DIV_AM	Wente Diversion from Arroyo Mocho	Meter	D			
AMHAG	Arroyo Mocho At Livermore	Recorder	R	A		
MA_CM_AM	Calmat Dishcarge to Arroyo Mocho	None	D			
AM_KB	Arroyo Mocho at Kaiser Bridge	Recorder	R	A		
AMP	Arroyo Mocho Near Pleasanton	Recorder	R	A		
ARROYO LAS POSITAS - LINE H						
SBA_ALTC	SBA Turnout to Altamont Creek	Meter	D			
LIV_DIV_BPT	Livermore Diversion from Brushy Peak Trib	Meter	D			
ALP_APPWTP	Arroyo Las Positas above PPWTP	None				A
PPWTP_DISCH	PPWTP Discharge to Arroyo Las Positas	Meter	D			
ALP_BPPWTP	Arroyo Las Positas below PPWTP	None				A
LLNL_ALP	LLNL Treated Groundwater Discharge to ALP	Meter	D	D		
LLNL_SECO	LLNL Treated Groundwater Discharge to ALP	Meter	D	D		
ALPL	Arroyo Las Positas at Livermore	Recorder	R	A		
ALP_ELCH	Arroyo Las Positas at El Charro	Recorder	R	A		
ARROYO DE LA LAGUNA - LINE B						
ADLLV	Arroyo De La Laguna at Verona	Recorder	R	A		

R = Recorder
D = Daily
Q = Quarterly
A = Annual

TABLE 3.3-2
Zone 7 Water Agency
Surface Water Monitoring
Recorder Station Details

	Station Name	Site Id	Gage	Gage Datum	Drainage and Area	Data Collected By	Location* Lat.	Long
Arroyo Valle (AV)	Arroyo Valle below Lang Canyon	AVBLC	Water stage (Stilling well) Concrete control	750.00'	Upland Valle Drainage Basin; 130 mi^2	USGS	2029018	6218632
	Arroyo Valle Near Livermore	AVNL	Water stage (Stilling well) Concrete control	510.44'	AV below dam and SBA Releases; 147 mi^2 (regulated flow due to dam)	USGS	2051872	6197234
	Arroyo Valle at Pleasanton	ADVP	Water stage (transducer) Concrete control	312.66'	Valle Drainage Basin; 171 mi^2	Zone 7	2068336	6161483
Arroyo Mocho (AM)	Arroyo Mocho near Livermore	AMNL	Water stage (transducer) Concrete control	746.47'	Upland Mocho Drainage Basin; 38.2 mi^2	Zone 7	2052947	6212841
	Arroyo Mocho at Livermore	AMHAG	Water stage (transducer) Concrete control	374.78'	AM before mining discharges; 50.8 mi^2	Zone 7	2071596	6181235
	Arroyo Mocho at Kaiser Bridge	AM_KB	Water stage (transducer) Concrete control	325.47'	AM before confluence with ALP; 60.2 mi^2	Zone 7	2077841	6171655
	Arroyo Mocho near Pleasanton	AMP	Water stage (Stilling well) Concrete control	323.77'	Mocho Drainage Basin; 141 mi^2	Zone 7	2076846	6164322
Arroyo Las Positas (ALP)	Arroyo Las Positas at Livermore	ALPL	Water stage (transducer) Concrete control	460.99'	Upland Positas Drainage Basin; 53.3 mi^2	Zone 7	2079760	6193222
	Arroyo Las Positas at El Charro	ALP_ELCH	Water stage (transducer) Conductivity Concrete control	338.82'	Positas Drainage Basin; 75.0 mi^2	Zone 7	2078400	6172552
Arroyo De La Laguna (ADLL)	Arroyo de la Laguna near Verona	ADLLV	Water stage (bubbler) Conductivity Concrete control	280.00'	Laguna Drainage Basin; 403 mi^2	USGS	2053613	6161313

* State Plane Coordinates Ca. Zone III, NAD83

TABLE 3.3-3
ZONE 7 WATER AGENCY
SURFACE WATER MONITORING
MONTHLY SUMMARY OF STREAM FLOWS (ACRE-FEET)
RECORDER STATIONS
2011 WATER YEAR

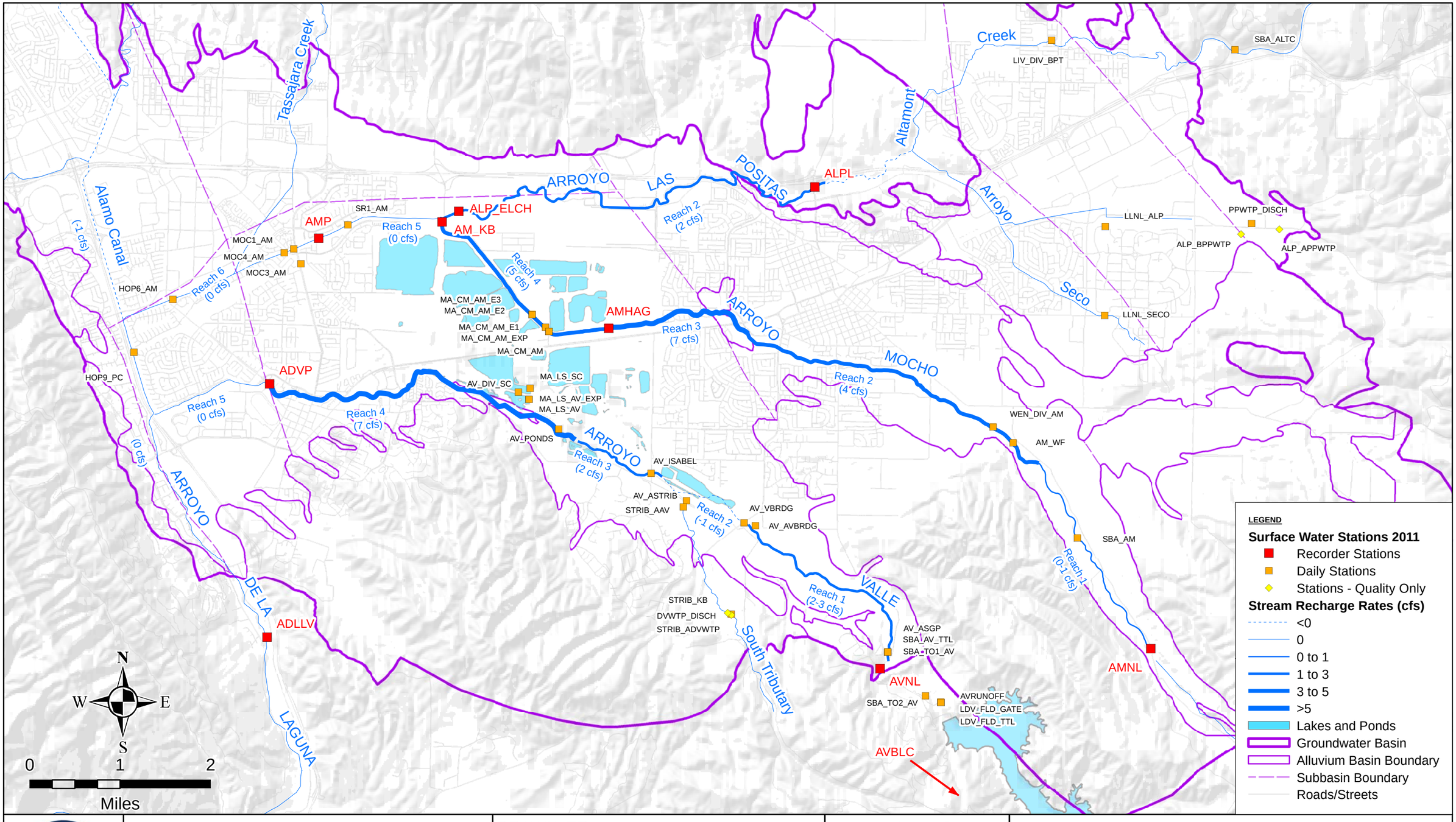
MONTH	ARROYO VALLE Below LANG CANYON* AVBLC	ARROYO VALLE Near LIVERMORE* AVNL	ARROYO VALLE At PLEASANTON ADVP	ARROYO MOCHO Near LIVERMORE AMNL	ARROYO MOCHO At LIVERMORE AMHAG	ARROYO MOCHO At KAISER BRIDGE AM_KB	ARROYO MOCHO Near PLEASANTON AMP	ARROYO LAS POSITAS At LIVERMORE ALPL	ARROYO LAS POSITAS At EL CHARRO ALP_ELCH	ARROYO DE LA LAGUNA At VERONA* ADLLV
OCT	0	29	48	0	257	558	1,036	309	363	1,980
NOV	68	35	142	0	187	244	731	438	671	2,775
DEC	2,618	55	451	306	453	750	1,922	792	1,307	8,819
JAN	1,440	98	113	112	66	360	762	287	407	2,398
FEB	6,264	27	463	991	1,413	1,257	1,779	555	1,108	8,366
MAR	15,249	12,474	9,864	3,079	3,827	3,698	5,332	1,283	2,506	31,256
APR	2,013	67	278	367	87	639	959	297	309	2,541
MAY	599	131	262	157	50	564	887	256	320	2,182
JUN	340	19	158	123	41	400	896	435	532	2,858
JUL	43	10	149	28	99	352	1,002	424	364	1,482
AUG	0	3	130	8	121	214	671	482	432	1,361
SEP	0	339	59	2	139	300	758	440	394	1,329
TOTAL	**28,634**	**13,286**	**12,117**	**5,172**	**6,739**	**9,336**	**16,735**	**5,998**	**8,713**	**67,345**

* USGS Stations

TABLE 3.3-4
ZONE 7 WATER AGENCY
WATER QUALITY RESULTS FOR SURFACE WATER SAMPLES
2011 Water Year

							Mineral Constituents (mg/L)									Select Metals (mg/L)				TDS	Hard
SITE ID	DATE	TIME	FLOW (cfs)	TEMP. °C	EC umhos/cm	pH	Ca	Mg	Na	K	HCO3	SO4	Cl	NO3	SiO2	B	As	Fe	Mn	mg/L	mg/L
ADLLV	Aug 8, 11	14:35	31	24.3	850	8.3	46	37	87	2.2	271	75	96	0.97	13.0	0.74	0.0028	<0.05	<0.01	496	270
ADVP	Dec 8, 10	12:30	3.7	10.9	346	7.8	25	14	23	2.6	116	15	41	<0.44	6.2	0.16	0.0013	0.092	0.016	185	119
ADVP	Mar 15, 11	11:15	2.6	15.1	409	7.6	29	13	30	2.2	117	19	49	0.75	4.6	0.15	0.0018	0.18	0.031	206	126
ADVP	Jul 26, 11	14:30	3.1	24.3	452	7.8	32	19	39	4.4	178	27	35	<0.44	6.2	0.72	0.0032	<0.05	<0.01	251	161
ADVP	Aug 8, 11	14:55	2.5	22.9	437	7.9	32	17	36	2.0	171	26	37	<0.44	5.0	0.26	0.0017	<0.05	<0.01	240	149
ADVP	Aug 30, 11	13:36	1.6	21.9	411	7.8	27	17	32	1.9	155	21	33	0.31	4.1	0.24	0.0014	<0.05	<0.01	213	138
ALP_ELCH	May 31, 11	14:45	5*	16.9	1527	8.4	82	37	224	2.0	390	93	228	8.37	19.9	3.8	0.0028	<0.05	<0.01	895	355
ALP_ELCH	Aug 5, 11	12:12	8.9	20.7	724	8.1	40	20	86	1.6	218	37	92	3.94	11.9	1.27	0.0021	<0.05	<0.01	402	185
ALP_ELCH	Sep 22, 11	15:30	6.3	22.6	791	8.2	47	21	87	2.0	236	39	98	6.29	16.3	1.32	0.0022	<0.05	<0.01	436	203
ALPL	May 31, 11	15:05	3.9	16.2	1615	8.2	63	58	227	1.7	435	89	237	16.56	24.0	3.9	0.0026	<0.05	<0.01	937	398
ALPL	Aug 4, 11	11:15	7.5*	19.6	688	8.1	38	25	86	1.6	215	36	93	5.98	13.8	1.28	0.0022	<0.05	<0.01	408	195
ALPL	Sep 22, 11	14:35	7	22.4	730	8.2	41	22	75	1.5	233	34	97	7.22	16.9	1.08	0.002	<0.05	<0.01	413	195
AM_KB	Aug 5, 11	11:10	7.5	23.4	673	8.5	38	42	42	2.4	234	41	82	1.95	17.0	0.31	0.0021	<0.05	<0.01	388	270
AMHAG	Mar 15, 11	11:45	1.4	15.9	573	8.6	34	32	37	2.0	226	37	42	<0.44	3.4	0.30	<0.001	0.48	0.016	307	219
AMHAG	Aug 5, 11	10:05	3.9	19.5	318	7.8	17	16	25	1.6	124	17	25	<0.44	9.4	0.17	0.0014	<0.05	<0.01	173	108
AMNL	Aug 4, 11	10:40	0.18	19.9	1141	7.7	64	107	55	3.4	673	64	61	1.20	15.3	1.00	0.0014	<0.05	0.03	705	602
AMNL	Aug 31, 11	13:15	0.04	20.6	1506	7.7	72	131	72	3.7	722	55	135	2.17	15.8	1.40	0.0012	<0.05	0.062	845	720
AMP	Aug 5, 11	12:52	17	25.1	726	9.1	40	32	73	2.4	211	43	96	1.95	13.5	0.80	0.0025	<0.05	<0.01	431	232
AVNL	Dec 8, 10	13:15	0.95	10.5	1049	7.7	78	44	87	3.6	295	173	97	<0.44	21.1	1.25	0.0011	0.057	0.14	650	375
AVNL	Mar 15, 11	12:10	0.95	16.3	1140	7.9	90	40	97	3.5	324	182	90	<0.44	18.7	1.35	0.0015	0.13	0.15	683	388
AVNL	Jul 26, 11	15:05	0.1	25.8	1293	8.0	91	50	133	4.7	359	226	127	<0.44	22.7	1.8	0.0016	<0.05	0.047	834	432
AVNL	Aug 8, 11	11:12	0.07	20.6	1330	7.9	114	39	133	4.7	361	232	129	<0.44	23.5	1.84	0.0017	<0.05	0.054	856	447
SBA_ALTC	Jun 16, 11	12:20	5.3*	22.5	268	7.7	14	7	32	1.5	68	21	28	1.73	10.4	0.38	0.0014	0.09	0.01	149	63
SBA_ALTC	Sep 22, 11	13:10	5*	25.0	217	7.8	14	7	18	1.2	78	11	17	0.89	13.9	<0.10	0.0018	<0.05	<0.01	122	62

* Daily Average



ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

DRAWN: TR | SCALE: 1 in = 1 Mile

REVIEWED: RG/CW | DATE: May 28, 2012

FILE: E:\MONITOR\SW\2011WY\Fig3.3-1-SWStations11.mxd

FIGURE 3.3-1
Surface Water Monitoring Program
Surface Water Sites in 2011 Program
Livermore Valley Groundwater Basin