4 Basin Evaluation Programs

4.1 Recharge Calculations

4.1.1 Introduction

Main Basin aquifers are recharged by partial percolation of rainfall, applied water, stream flow, and subsurface inflow. Zone 7 calculates the recharge for each of these natural, sustainable yield components as follows:

- **Stream flow recharge** includes the following components:

    - **Natural stream recharge** - rain runoff into the streams, including both urban and rural runoff from over the groundwater basin and upper watershed runoff that recharges into the streambeds downstream.

    - **Artificial stream recharge** – SWP water released from the SBA or Lake Del Valle into the arroyos for the purpose of augmenting the natural stream recharge.

    - **Arroyo Valle Prior Rights recharge** – SWP or local water released from the SBA or Lake Del Valle to cover recharge that would have occurred if Lake Del Valle had not been constructed.

    - **Gravel-mining discharge into streams** – groundwater from pit dewatering and gravel washing operations discharged by the mining companies into the streams.

    Streambed recharge is calculated from daily stream flow and stream discharge records. The three primary recharge streams (Arroyos Valle, Mocho, and Las Positas) have gages upstream and downstream of the reaches in which recharge occurs. Recharge typically is calculated as the difference between stream inflows and downstream outflows.

- **Rainfall recharge** and **Applied water recharge** – Over the last few years, Zone 7 observed a significant departure between the groundwater storage results derived from the groundwater elevation and hydrologic inventory methods (Section 4.2). One hypothesis was that the areal recharge calculation spreadsheet model used to calculate both rainfall and applied water recharge was underestimating groundwater recharge. Consequently, in 2011, staff revamped the spreadsheet model, particularly with respect to the method for estimating rainfall runoff, in an effort to more accurately calculate areal recharge. The spreadsheet model was revised as follows:

- The spreadsheet model time-step was changed from monthly to daily.

- The spatial unit was changed from DWR nodes to groundwater model cells (500 ft by 500 ft).

- GIS mapping techniques were used to specify the dominant land use and source water type for each model cell.

- GIS mapping techniques were used to specify the SCS Curve Number (CN) for each model cell. The data from the Natural Resource Conservation Service's (formerly Soil Conservation Service or SCS) Soil Survey Geography database (SSURGO) and the technique described in the Iowa Stormwater Management Manual - 2C-5 NRCS TR-55 Methodology, Tables 2 to 4, Version 2, (December 5, 2008) were used to accomplish this work.

- The Potential Maximum Retention (S) was calculated for each model cell using the SCS Equation: $S = 1000/CN - 10$.

- SCS Curve Numbers and S Numbers were adjusted based on the Antecedent Runoff Condition (ARC; i.e., the percent moisture content of the cell) for each time-step (National Engineering Handbook Hydrology, NEH Part 630, Chapter 10, July 2004).

- Rainfall runoff (Q) was calculated from rainfall (P) for each day and model cell using the SCS Runoff Equation: $Q = (P - 0.2S)^2/(P + 0.8S)$ where $Q=0$ if $P < 0.2S$.

- Actual evapotranspiration (ET_{act}) for each cell was adjusted from the evapotranspiration (ET_0) using the formula: If ARC >= 50% then $ET_{act} = ET_0$; if ARC < 50% then $ET_{act} = 2 \times ARC \times ET_0$.

- The irrigation efficiency for the Agriculture-Vine category was changed from 80% to 95% to reflect modern, efficient irrigation techniques used for vineyards.

- Areal recharge was re-calculated using the new method for the period 1998-2010, as well as for 2011. For this work, a version of Zone 7's 2001 land use was re-created in GIS and used for the 1998 to 2005 period, and the 2011 land use layer was used for the 2006 to 2011 calculations. This extrapolation of single-year land use for multiple years was deemed appropriate because land use over the Main Basin has changed little over the last 15 years or so. Prior to 1998, land use changed significantly from year to year, and the difference between the results of the two groundwater storage methods were not large; therefore the original data were used for the prior periods for this revision.

Other variables that were assigned for each model cell (based on land use) including pervious area, impervious runoff to pervious area, percent of pervious area that is irrigated, irrigation season, and irrigation efficiency remained relatively unchanged from the previous model.

- **Subsurface inflow**, which occurs primarily in the upper aquifer, is estimated based on gradients across the Main Basin boundaries, aquifer structure, and the hydraulic conductivities of the aquifer sediments.

4.1.2 2011 Recharge

The revised areal recharge spreadsheet model was used to recalculate rainfall recharge and applied water recharge for 1998 to 2011, the years for which land use areas could be accurately estimated with the information currently available to staff. These revised recharge volumes were, in some cases, significantly different than previously calculated. For example, the revised spreadsheet model estimated rainfall recharge for the 2010 Water Year to be to be 6,796 AF while the original model estimated 3,174 AF (Zone 7, 2011b). The revised monthly recharge volumes using the new model and other monthly recharge volumes (e.g., stream recharge, subsurface inflow) are shown on Table 4.1-1 and are summed for the Water Year below.

Table: Recharge Volumes for 2011 Water Year

SOURCE	2011 Water Year (AF)	2010 Water Year (AF)
Natural Stream Recharge (not including Arroyo Valle Prior Rights)	7,441	9,177
Arroyo Valle Prior Rights	1,768	0
Artificial Stream Recharge	4,806	6,773
Rainfall Recharge*	8,104	6,782
Applied Water Recharge*	2,194	2,208
Subsurface Inflow (constant)	1,000	1,000
TOTAL RECHARGE	25,313	25,940

* Calculated using revised areal recharge spreadsheet model

These volumes are used to calculate the total Groundwater Storage in the Main Basin, which is discussed in Section 4.2.

4.2 Groundwater Storage

4.2.1 Introduction

Zone 7 computes the end-of-water-year storage for the Main Basin using two methods:

- Groundwater Elevations (GWE, Section 4.2.2)
- Hydrologic Inventory (HI, Section 4.2.3)

The Main Basin Storage is then calculated by averaging the two storage volumes determined by the two respective methods. Starting around 2000, the difference between the storage volumes from these two methods began to increase. Starting in 2008, both the GWE and HI methods have been improved in an

attempt to reconcile the difference between the two techniques. During 2011 the areal recharge calculations have been significantly changed as discussed in detail in Section 4.1.1. The results of these changes are discussed in Section 4.2.4 below.

4.2.2 Groundwater Elevation Method

For the GWE method, the Main Basin is divided into polygonal areas referred to as nodes. Each node has its own set of hydrogeologic parameters, such as storage coefficient, nodal thickness, and nodal area (Table 4.2-1 and Figure 4.2-1). The saturated thickness of the node is calculated using the nodal thickness, average groundwater elevations from the fall semiannual measuring event, and storage coefficient. The groundwater storage of each node is then calculated by multiplying the saturated thickness by the total area of the node. The total Main Basin groundwater storage is equal to the sum of all the nodal storage values for the 22 nodes in the Main Basin. Calculation results for the 2011 Water Year are presented in Table 4.2-2 and Table 4.2-3, and are discussed below in Section 4.2.4.

4.2.3 Hydrologic Inventory Method

The HI method for determining basin storage calculates the volume difference between groundwater supply and groundwater demand. The difference between supply and demand is the net recharge, which is added/subtracted to the previous year's ending storage value to arrive at the current year's ending storage value. The calculations assume 212 thousand AF (TAF) of storage at the beginning of the 1974 Water Year (from *DWR, 1974*). The groundwater supply and demand components are:

Table: Groundwater Supply and Demand Components

SUPPLIES	DEMANDS
Natural stream recharge	Municipal pumping
Artificial stream recharge	Agricultural pumping
Rainfall recharge	Gravel mining water use
Applied water recharge	Groundwater basin overflow
Subsurface groundwater inflow	

Each of the supply and demand components are monitored as part of a monitoring program or calculated using the results of a monitoring program.

The results of the calculations for the 2011 Water Year are presented in Table 4.2-4 and discussed below in Section 4.2.4.

4.2.4 2011 Storage Calculations

Groundwater Elevation (GWE) storage calculations before 1992 were calculated assuming a constant storage coefficient for the entire node. Table 4.2-2 shows GWE groundwater elevations and storage volumes for 1963 to 1991. Table 4.2-3 shows the groundwater elevations and storage volumes for 1992 to 2011 using the GWE method. Figure 4.2-1 shows the upper and lower aquifer groundwater elevations

used to calculate the GWE Method storage for the 2011 Water Year and includes the mean groundwater elevations for each node as calculated by GIS (using the *ArcGIS Spatial Analyst* extension).

The results of the Hydrologic Inventory (HI) method for the 2011 Water Year are shown in Table 4.2-4. Historical HI method results from 1974 to 2011 are shown on Table 4.2-5 and Figure 4.2-2. These tables include the changes to the areal recharge calculations spreadsheet that calculates rainfall recharge, applied water recharge and agricultural groundwater pumping for the years 1998 to 2011 (described above in Section 4.1).

The GWE method resulted in a total storage of about 235 TAF at the end of the 2011 Water Year. Comparatively, the HI method yields an increase in storage of 4.9 TAF since 2010, resulting in a total storage of about 234 TAF for the end of the 2011 Water Year (229 TAF in 2010). Consequently, the 2011 Water Year total groundwater storage used by Zone 7, which is calculated as the mean of the two methods, is 235 TAF (Table 4.2-4).

One of Zone 7's groundwater basin management objectives is to maintain water levels above historical lows to minimize the risk of inducing land subsidence. Therefore, not all of the total groundwater storage is available for use. "Operational" or "Available" Storage (Table 4.2-4, Table 4.2-5, and Figure 4.2-2) represents the approximate amount of storage available above the historical low groundwater surface. The remainder (approximately of 128 TAF) is estimated reserves stored below historical lows. Available storage for the 2011 Water Year is about 107 TAF, which is about 85% of the assumed historical maximum (based on 126 TAF estimated for the 1983 Water Year).

Zone 7 continued its reevaluation of both calculation methods to investigate if the GWE method was overestimating the storage, if the HI method was underestimating storage, or a combination of both in 2011. This year, Zone 7 revised its areal recharge spreadsheet model as described in Section 4.1. These revisions resulted in revised inflow estimates for both rainfall and applied water, the net result of which significantly improved the agreement between the two storage estimates from the GWE and HI methods (Figure 4.2-2). Zone 7 staff will continue to calculate groundwater storage with both methods, and to evaluate each method's validity. This evaluation may include:

- Identifying possible sources of water not included in the HI method (e.g., subsurface inflow from the northeastern or southern boundaries of the Main Basin) or existing calculations that may be under-estimating inflow (e.g., recharge calculations).

- For those years when the two methods do not agree, comparing HI Method changes to Nodal groundwater elevations to isolate possible areas/nodes where the methods most disagree.

- Transferring previous gradient maps to *ArcGIS* and calculate average nodal groundwater elevations using the same method as that used since the 2007 Water Year.

- Revising GWE storage coefficients as new data becomes available and the groundwater model is improved.

- Obtaining older digital aerial photographs in order to develop land use GIS layers for years before 1998.

4.3 Salt Loading Calculations

4.3.1 Introduction

Zone 7's salt loading calculations take into account the addition and removal of minerals in the Main Basin by tracking the salt mass associated with the recharge and discharge components of the Hydrologic Inventory. In general, salts are added to the Main Basin through the recharge and application of water from:

- Natural stream recharge;
- Artificial supplemental stream recharge;
- Applied water (irrigation) recharge; and
- Subsurface groundwater inflow.

Salts are removed from the Main Basin through:

- Municipal pumping combined with wastewater export;
- Groundwater pumping combined with demineralization;
- Groundwater pumping from the Main Basin combined with Fringe Basin application;
- Mining area discharges and wet gravel export; and
- Groundwater basin outflow.

Furthermore, evaporation of groundwater in the mining area ponds and evapotranspiration have the effect of concentrating salts in the Main Basin as water is removed but the associated salts are left behind. In contrast, rainfall recharge dilutes the Main Basin salt concentrations as it adds essentially salt-free water to the system.

It is important to recognize that these salt loading calculations for the Main Basin are based on salt loading at the ground surface and expressed as a basin-wide cumulative change in salt concentration. For the salt loading calculations, salt concentrations are represented by the average Total Dissolved Solids (TDS) concentrations of each inflow and outflow component of the Hydrologic Inventory.

4.3.2 2011 Salt Loading

Hydrologic conditions and water operations in the 2011 Water Year resulted in a net calculated increase of approximately 40 tons of salt to the Main Basin (-4 tons in 2010), after accounting for the 2,006 tons of salt removed by Zone 7's new demineralization plant (Section 5.2.3). The weighted average TDS

concentration of all the waters recharging the Main Basin's aquifers in the 2011 Water Year was 371 mg/L, whereas the average TDS of the extracted groundwater was 461 mg/L. The inflow/outflow water and salt loading calculations for the 2011 Water Year are summarized on Table 4.3-1. Historical salt loading results from 1974 to 2011 are shown on Table 4.3-2. Figure 4.3-1 shows several graphs depicting the salt loading and its effect on the basin over time.

The revisions to the areal recharge volumes (Section 4.1) has resulted in a slight downward adjustment of the total salt loading; 79,097 tons of salt have been added to the Main Basin since 1973 (previously calculated to be about 89,700). This is equivalent to an average increase of about 2,082 tons of salt per year and an annual theoretical TDS increase of about 5.1 mg/L per year. During the drought from 2006 to 2009, the average basin-wide TDS increased about 16 mg/L per year due to the reduced recharge of lower TDS rainfall and stream recharge waters. However, because the basin experienced above-average rainfall (and rainfall recharge) over the last two years, and because of the additional salt removal provided by the new groundwater demineralization plant after coming on-line in 2009, the basin-wide average TDS has dropped slightly (Figure 4.3-1, Graph 2).

4.4 Modeling

4.4.1 Groundwater Model Overview

Zone 7 maintains a numerical groundwater model of the basin for predicting the consequences of a proposed groundwater basin management action. The model, originally created in Visual MODFLOW, has been converted to Groundwater Vistas and uses MODFLOW-SURFACT to perform the modeling calculations. In 2006 Zone 7 and HydroMetrics LLC (HydroMetrics) reevaluated, recalibrated, and revised the model as described in *Zone 7, 2006d*.

The active part of the groundwater model encompasses the Amador, Bernal, Bishop, Camp, Castle, Dublin, and Mocho II Subbasins of the Valley. The model consists of three layers: the upper aquifer (Layer 1), an aquitard (Layer 2), and the lower aquifer (Layer 3). Most municipal water supply production wells in the basin are screened in the lower aquifer (Layer 3). Many small private wells are screened in the upper aquifer (Layer 1).

Zone 7 last used the groundwater model in 2009 and 2010 to support long-term planning for the Zone 7's Water Systems Evaluation in an effort to identify the maximum groundwater Zone 7 could pump using existing wells during a six year drought without going below historical lows. For this optimization exercise, the model was run using a reiterative trial-and-error approach. All model runs were designed with six years of drought where Zone 7 pumping was the only variable in each scenario. All other inflows and outflows were calculated as representative of near-future, six-year-drought conditions. The model run results were presented in the Water Systems Evaluation report (Zone 7, 2011c).

4.4.1 2011 Groundwater Modeling

Beginning in 2011, Zone 7 plans to update the groundwater model so that it can better evaluate future groundwater management and salt mitigation strategies. The update effort will include:

- Converting the model software from MODFLOW SURFACT to MODFLOW NWT,
- Incorporating the MODFLOW Streams and Lakes Packages,
- Adding additional layers to the model that represent hydrostratigraphic boundaries identified in recent geologic studies, and
- Recalibrating the model using both water level and salt datasets.

TABLE 4.1-1
Zone 7 Water Agency
Recharge Volumes (Acre-Feet)
2011 Water Year

Name	Site Id	Oct 2010	Nov 2010	Dec 2010	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	2011WY Total	*2010WY Total*	Normal	2011 % Norm
STREAM RECHARGE																	
AV Natural Recharge	AV_RN	182	380	832	165	396	487	0	14	140	7	2	0	2,605	*5,517*	2,159	121%
AV Artificial Recharge	AV_RC_Z7	368	110	59	218	13	0	0	0	0	0	0	0	768	*2,459*	1,898	40%
AV Recharge Prior Rights	AV_RC_PR	0	128	0	0	0	50	68	124	252	316	295	535	1,768	*0*	920	192%
AM Natural Recharge	AM_RN	162	307	744	114	524	202	282	180	184	98	113	98	3,008	*1,738*	2,403	125%
AM Artificial Recharge	AM_RC	514	259	0	0	264	56	34	380	317	616	644	587	3,671	*4,314*	4,873	75%
Mining Area Recharge to AM	AM_RM	333	234	327	197	141	211	273	199	201	280	232	210	2,838	*1,544*	NA	NA
ALP Natural Recharge	ALP_RN	150	165	177	167	153	177	145	166	62	66	44	47	1,519	*1,922*	1,306	116%
ALP ArtificialRecharge	ALP_RC	6	0	0	0	0	0	0	0	97	74	105	85	367	*0*	31	1184%
Total Natural Stream Recharge		**494**	**852**	**1,753**	**446**	**1,073**	**866**	**427**	**360**	**386**	**171**	**159**	**145**	**7,132**	***9,177***	**5,868**	**122%**
Total Prior Rights		**0**	**128**	**0**	**0**	**0**	**50**	**68**	**124**	**252**	**316**	**295**	**535**	**1,768**	***0***	**920**	**192%**
Total Artificial Recharge		**888**	**369**	**59**	**218**	**277**	**56**	**34**	**380**	**414**	**690**	**749**	**672**	**4,806**	***6,773***	**6,802**	**71%**
TOTAL STREAM RECHARGE		**1,382**	**1,349**	**1,812**	**664**	**1,350**	**972**	**529**	**864**	**1,052**	**1,177**	**1,203**	**1,352**	**13,706**	***15,950***	**13,590**	**101%**
RAINFALL RECHARGE																	
Rainfall Recharge	RC_RR	242	753	2,420	414	1,451	2,333	33	134	346	0	0	0	8,126	*6,796*	7,520	108%
APPLIED WATER RECHARGE																	
Urban - Municipal	RC_AW_U_MU	118	67	19	52	82	70	186	211	229	291	260	204	1,788	*1,831*	1,769	101%
Urban - Recycled Water	RC_AW_U_RW	5	6	5	5	6	5	5	5	5	7	6	6	67	*42*	18	370%
Agricultural - Municipal (SBA)	RC_AW_AG_MU	9	5	1	0	0	0	0	0	0	32	19	15	81	*88*	85	94%
Agricultural - Groundwater	RC_AW_AG_GW	9	5	1	0	0	0	0	0	0	36	19	15	86	*94*	91	95%
Golf Courses - Groundwater	RC_AW_G_GW	5	3	1	2	4	3	8	9	10	13	11	9	78	*80*	202	39%
Golf Courses - Recycled Water	RC_AW_G_RW	2	0	0	0	0	1	3	6	5	6	5	4	30	*32*	28	106%
TOTAL AW RECHARGE		**147**	**85**	**27**	**60**	**92**	**79**	**202**	**231**	**250**	**384**	**320**	**253**	**2,129**	***2,167***	**2,200**	**97%**
SUBSURFACE																	
Inflow	SS_INFLOW	84	84	84	84	84	84	84	84	84	84	80	80	1,000	*1,000*	1,000	100%
Outflow	SS_OUTFLOW	0	0	0	0	0	0	0	0	0	0	0	0	0	*0*	120	0%
TOTAL NATURAL RECHARGE (SY)		**967**	**1,902**	**4,284**	**1,004**	**2,700**	**3,413**	**814**	**932**	**1,317**	**955**	**854**	**1,013**	**20,155**	***19,141***	**17,388**	**116%**

ALP = Arroyo Las Positas
AM = Arroyo Mocho
AV = Arroyo Valle
SY = Sustainable Yield

Table 4.2-1
Zone 7 Water Agency
Nodal Constants for Storage Calculations

MAIN BASIN NODE	Data from 1963 to 1992 - One Aquifer					Data from 1992 to Present - Two Aquifers											
							Upper Aquifer						Lower Aquifer				
	Area (ft^2)	Top (ft MSL)	Bottom (ft MSL)	Thick (ft)	Storage Coef	Area (ft^2)	Top (ft MSL)	Bot Conf Lyr (ft MSL)	Bottom (ft MSL)	Thick (ft)	SY	SS	Top (ft MSL)	Bottom (ft MSL)	Thick (ft)	SY	SS
NODE 15	413	325	33	292	0.08	200	329	290	243	86	0.07	0.0024	205	33	172	0.20	0.0012
NODE 16	466	321	33	288	0.08	320	325	281	235	90	0.05	0.0024	195	33	162	0.20	0.0002
NODE 17	301	363	63	300	0.06	301	336	283	222	114	0.09	0.0024	179	63	116	0.20	0.00005
NODE 18	679	337	33	304	0.08	679	334	283	228	106	0.11	0.0024	196	33	163	0.20	0.0012
NODE 19	703	323	53	270	0.08	703	328	268	222	106	0.11	0.0024	199	53	146	0.20	0.0002
NODE 20	534	333	73	260	0.06	534	332	265	229	103	0.05	0.0024	215	73	142	0.20	0.00001
NODE 23	414	340	63	277	0.11	414	340	297	243	97	0.13	0.0024	191	63	128	0.20	0.0018
NODE 24	503	343	73	270	0.08	503	343	300	230	113	0.14	0.0024	196	73	123	0.20	0.0003
NODE 25	883	343	73	270	0.075	883	360	330	242	118	0.17	0.0024	222	73	149	0.20	0.0007
NODE 26	953	348	3	345	0.1	953	353	303	226	127	0.17	0.0024	182	3	179	0.20	0.0003
NODE 29	388	365	243	122	0.05	388	363	333	278	85	0.23	0.0024	229	229	0	0.20	0.0001
NODE 30	718	363	83	280	0.08	718	369	none	259	110	0.15	0.0024	230	83	147	0.20	0.0002
NODE 31	1213	333	3	330	0.11	1213	372	none	259	113	0.12	0.0024	239	3	236	0.20	0.0003
NODE 33	165	393	253	140	0.05	165	397	374	327	70	0.09	0.0024	307	253	54	0.20	0.0008
NODE 34	683	401	123	278	0.07	683	402	none	299	103	0.08	0.0024	283	123	160	0.20	0.0003
NODE 35	2357	405	113	292	0.07	2357	422	none	310	112	0.11	0.0024	297	113	184	0.20	0.0002
NODE 36	1753	483	403	80	0.07	1753	493	none	387	106	0.09	0.0024	381	381	0	0.20	0.00001
NODE 38	867	403	303	100	0.06	867	429	none	352	77	0.13	0.0024	339	303	36	0.20	0.0008
NODE 39	1839	496	333	163	0.06	1839	484	none	395	89	0.10	0.0024	378	333	45	0.20	0.0003
NODE 40	913	553	423	130	0.06	913	566	none	487	79	0.23	0.0024	473	423	50	0.20	0.00004
NODE 41	1624	753	663	90	0.06	1624	732	none	620	112	0.10	0.0024	607	607	0	0.20	0.00003
NODE 42	686	548	403	145	0.04	686	551	none	464	87	0.18	0.0024	450	403	47	0.20	0.0001

ft MSL Top and bottom elevations are in feet above Mean Sea Level (NAVD88)
Bot Conf Lyr Bottom elevation of upper aquifer confining layer
SY Specific Yield - used for unconfined conditions
SS Specific Storage - used for confined conditions

Table 4.2-2
Groundwater Elevations (ft) and Storage (AF)
Nodal Groundwater Elevation Method
Water Years 1963 - 1991

WATER	NODE 15		NODE 16		NODE 17		NODE 18		NODE 19		NODE 20		NODE 23		NODE 24		NODE 25		NODE 26		NODE 29		NODE 30	
YEAR	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag
MAX_83_SPR	305.6	9,106	307.5	10,345	300.5	4,343	309.8	15,199	313.2	14,802	308.4	7,638	307.6	11,276	304.9	9,450	324.4	16,848	306.5	29,209	353.1	2,194	330.5	14,390
MIN_62_FALL	192.6	5,372	230.6	7,478	237.0	3,197	186.1	8,479	210.1	9,004	169.2	3,178	226.3	7,573	210.0	5,634	220.6	9,973	238.0	22,681	237.8	0	237.5	9,047
MIN_66_FALL	188.6	5,240	219.6	7,068	224.3	2,967	186.9	8,523	211.9	9,105	244.0	5,575	239.4	8,170	210.6	5,658	245.3	11,609	250.1	23,835	263.6	458	253.0	9,937
1963	200.8	5,643	231.0	7,493	243.4	3,312	201.2	9,300	222.4	9,696	204.6	4,313	250.0	8,653	222.3	6,129	235.1	10,934	257.2	24,511	247.4	144	252.2	9,891
1964	179.5	4,939	219.5	7,065	232.3	3,112	188.4	8,604	210.1	9,004	230.7	5,149	238.0	8,106	207.5	5,533	227.7	10,444	246.7	23,511	253.2	256	241.9	9,300
1965	192.1	5,356	218.4	7,024	231.9	3,105	199.3	9,196	215.9	9,330	235.6	5,306	256.5	8,949	214.0	5,795	238.8	11,179	257.7	24,559	264.4	473	257.7	10,207
1968	218.5	6,228	222.1	7,161	198.2	2,496	209.4	9,745	221.0	9,617	200.5	4,181	249.6	8,634	225.1	6,241	255.8	12,305	248.4	23,673	275.8	695	247.5	9,621
1969	227.8	6,535	230.5	7,475	234.6	3,153	237.9	11,293	253.3	11,434	232.1	5,194	249.7	8,639	234.6	6,624	286.9	14,364	250.2	23,844	265.6	497	237.9	9,070
1970	241.1	6,975	232.6	7,553	231.2	3,092	240.3	11,423	252.6	11,394	251.8	5,825	250.9	8,694	229.3	6,410	240.9	11,318	244.1	23,263	253.7	266	232.5	8,760
1971	254.5	7,417	254.0	8,351	247.2	3,381	255.5	12,249	266.0	12,148	260.9	6,116	251.6	8,725	236.1	6,684	240.1	11,265	251.3	23,949	261.3	413	234.2	8,857
1972	244.9	7,100	241.9	7,900	238.0	3,215	245.4	11,701	240.6	10,719	253.4	5,876	242.7	8,320	229.8	6,430	240.2	11,271	244.4	23,291	254.6	283	238.6	9,110
1973	250.3	7,279	251.6	8,261	247.2	3,381	188.6	8,615	257.8	11,687	257.8	6,017	255.7	8,912	239.2	6,809	259.3	12,536	256.6	24,454	266.6	516	250.9	9,816
1974	254.0	7,401	255.0	8,388	255.0	3,522	257.0	12,331	258.0	11,698	267.0	6,312	266.0	9,381	246.0	7,082	265.0	12,914	247.0	23,539	247.0	136	253.0	9,937
1975	261.0	7,632	262.0	8,649	264.0	3,684	266.0	12,820	266.0	12,148	264.0	6,216	269.0	9,518	251.0	7,283	258.0	12,450	262.0	24,969	253.0	252	256.0	10,109
1976	276.0	8,128	272.0	9,022	278.0	3,937	279.0	13,526	280.0	12,935	277.0	6,632	270.0	9,563	262.0	7,726	278.0	13,775	265.0	25,255	259.0	369	266.0	10,684
1977	266.0	7,797	262.0	8,649	270.0	3,793	269.0	12,982	270.0	12,373	269.0	6,376	265.0	9,336	254.0	7,404	258.0	12,450	260.0	24,778	258.0	349	259.0	10,282
1978	256.0	7,467	259.0	8,537	259.0	3,594	259.0	12,439	262.0	11,923	267.0	6,312	263.0	9,245	246.0	7,082	240.0	11,258	257.0	24,492	252.0	233	255.0	10,052
1979	266.0	7,797	270.0	8,947	270.0	3,793	273.0	13,200	275.0	12,654	272.0	6,472	271.0	9,609	264.0	7,807	281.0	13,973	266.0	25,350	270.0	582	263.0	10,512
1980	282.0	8,326	284.0	9,469	285.0	4,064	285.0	13,852	288.0	13,385	284.0	6,857	284.0	10,201	280.0	8,450	290.0	14,570	281.0	26,779	285.0	873	282.0	11,603
1981	290.0	8,590	292.0	9,767	293.0	4,208	294.0	14,340	297.0	13,891	292.0	7,113	291.0	10,520	286.0	8,692	300.0	15,232	288.0	27,446	290.0	970	283.0	11,660
1982	289.0	8,557	291.0	9,730	292.0	4,190	293.0	14,286	295.0	13,779	291.0	7,081	290.0	10,474	282.0	8,531	296.0	14,967	286.0	27,256	285.0	873	281.0	11,545
1983	294.0	8,723	295.0	9,879	297.0	4,280	297.0	14,503	300.0	14,060	295.0	7,209	298.0	10,839	293.0	8,974	305.0	15,563	295.0	28,114	298.0	1,125	289.0	12,005
1984	297.0	8,822	297.0	9,954	298.0	4,298	298.0	14,558	301.0	14,116	297.0	7,273	299.0	10,884	298.0	9,175	311.0	15,960	298.0	28,399	297.0	1,106	292.0	12,177
1985	296.0	8,789	296.0	9,916	296.0	4,262	295.0	14,395	298.0	13,948	294.0	7,177	298.0	10,839	295.0	9,054	309.0	15,828	297.0	28,304	289.0	951	288.0	11,948
1986	286.5	8,475	287.4	9,596	288.4	4,125	288.2	14,025	291.1	13,559	286.7	6,943	285.6	10,274	284.2	8,619	295.1	14,907	283.7	27,037	282.2	819	276.2	11,270
1987	283.1	8,362	283.3	9,443	283.9	4,044	283.7	13,781	286.5	13,301	282.0	6,792	278.7	9,960	275.6	8,273	289.8	14,556	271.2	25,845	283.7	848	274.2	11,155
1988	277.0	8,161	278.4	9,260	278.9	3,953	277.6	13,450	281.5	13,020	277.3	6,642	264.8	9,327	252.9	7,360	266.6	13,020	246.7	23,511	260.8	404	252.4	9,903
1989	267.2	7,837	270.9	8,981	271.5	3,820	271.3	13,107	274.0	12,598	270.1	6,411	262.5	9,222	241.9	6,917	257.4	12,411	238.3	22,710	254.2	275	244.5	9,449
1990	256.5	7,484	262.8	8,679	262.6	3,659	261.5	12,575	264.3	12,052	265.5	6,264	262.2	9,208	238.3	6,772	253.9	12,179	238.4	22,720	250.4	202	238.6	9,110
1991	212.0	6,013	235.5	7,661	225.5	2,989	246.0	11,733	229.5	10,095	261.5	6,136	256.4	8,944	233.7	6,587	242.6	11,430	234.9	22,386	241.9	37	239.4	9,156

GWE = Groundwater elevations in feet above Mean Sea Level (NGVD29)
Groundwater elevations compiled from selected wells in each node.
Storage: (GWE - Basin Bottom) x Nodal Specific Yield x Node Area
Water levels in Node 36 were not measured before 1992

Table 4.2-2
Groundwater Elevations (ft) and Storage (AF)
Nodal Groundwater Elevation Method
Water Years 1963 - 1991

WATER	NODE 31		NODE 33		NODE 34		NODE 35		NODE 38		NODE 39		NODE 40		NODE 41		NODE 42		TOTAL	TOTAL
YEAR	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	w/N41	(Rounded)
MAX_83_SPR	294.9	39,349	323.3	604	327.3	9,911	360.0	41,248	420.6	6,274	446.8	12,888	567.8	8,096	680.7	2,017	423.5	645	265,833	266,000
MIN_62_FALL	226.5	30,222	272.2	183	221.7	4,862	220.1	18,165	300.3	16	353.6	2,604	530.4	6,048	685.7	2,504	388.8	0	156,222	156,000
MIN_66_FALL	262.1	34,972	232.2	0	270.5	7,195	241.5	21,696	356.0	2,913	353.0	2,538	579.6	8,743	672.1	1,179	469.3	1,902	179,283	179,000
1963	254.9	34,011	270.7	171	236.8	5,584	248.4	22,835	293.4	0	377.3	5,219	540.2	6,585	687.0	2,631	426.0	713	177,766	178,000
1964	267.1	35,639	275.2	208	230.2	5,269	246.2	22,472	349.1	2,554	343.0	1,434	571.8	8,316	685.4	2,475	427.8	763	174,151	174,000
1965	243.8	32,530	275.2	208	235.7	5,532	255.2	23,957	353.9	2,804	357.9	3,078	575.4	8,513	685.4	2,475	429.3	804	180,378	180,000
1968	300.3	40,069	274.6	203	262.2	6,799	270.2	26,431	355.0	2,861	383.9	5,947	528.1	5,922	677.9	1,742	431.9	875	191,446	191,000
1969	257.7	34,385	274.6	203	235.8	5,536	320.6	34,747	340.9	2,128	382.5	5,793	492.2	3,955	685.7	2,504	481.1	2,225	199,597	200,000
1970	270.4	36,079	274.6	203	234.5	5,474	310.9	33,146	333.2	1,727	389.5	6,565	479.7	3,270	672.9	1,257	434.3	941	193,636	194,000
1971	300.0	40,029	274.6	203	239.3	5,704	323.3	35,192	342.3	2,200	388.8	6,488	494.5	4,081	690.9	3,011	471.2	1,954	208,418	208,000
1972	278.4	37,147	274.6	203	239.8	5,728	317.6	34,252	361.2	3,184	394.7	7,139	491.4	3,911	677.8	1,734	477.2	2,118	200,633	201,000
1973	304.4	40,616	274.6	203	257.5	6,574	323.3	35,192	376.5	3,980	416.4	9,533	510.1	4,936	677.0	1,656	505.1	2,884	213,857	214,000
1974	252.0	33,624	258.0	66	257.0	6,550	294.0	30,358	390.0	4,682	451.0	13,351	541.0	6,628	680.0	1,949	517.0	3,210	213,060	213,000
1975	250.0	33,358	261.0	91	263.0	6,837	293.0	30,193	389.0	4,630	449.0	13,130	538.0	6,464	677.0	1,656	509.0	2,991	215,080	215,000
1976	268.0	35,759	274.0	198	277.0	7,506	302.0	31,678	388.0	4,578	450.0	13,241	539.0	6,519	677.0	1,656	510.0	3,018	225,705	226,000
1977	251.0	33,491	262.0	99	266.0	6,980	296.0	30,688	386.0	4,474	444.0	12,579	539.0	6,519	674.0	1,364	510.0	3,018	215,782	216,000
1978	244.0	32,557	251.0	8	249.0	6,167	295.0	30,523	384.0	4,370	446.0	12,799	540.0	6,574	671.0	1,072	507.0	2,936	209,641	210,000
1979	271.0	36,160	278.0	231	280.0	7,650	316.0	33,988	390.0	4,682	453.0	13,572	539.0	6,519	674.0	1,364	512.0	3,073	227,933	228,000
1980	280.0	37,360	291.0	338	295.0	8,367	325.0	35,473	390.0	4,682	454.0	13,682	540.0	6,574	675.0	1,462	513.0	3,101	239,466	239,000
1981	280.0	37,360	303.0	437	304.0	8,797	331.0	36,463	392.0	4,786	457.0	14,013	541.0	6,628	676.0	1,559	518.0	3,238	245,712	246,000
1982	277.0	36,960	292.0	347	295.0	8,367	323.0	35,143	390.0	4,682	454.0	13,682	535.0	6,300	674.0	1,364	514.0	3,128	241,242	241,000
1983	296.0	39,495	312.0	512	313.0	9,227	342.0	38,278	393.0	4,838	462.0	14,565	544.0	6,793	680.0	1,949	522.0	3,348	254,277	254,000
1984	301.0	40,162	312.0	512	312.0	9,180	349.0	39,433	394.0	4,890	462.0	14,565	544.0	6,793	680.0	1,949	525.0	3,430	257,635	258,000
1985	295.0	39,362	293.0	355	300.0	8,606	319.0	34,483	391.0	4,734	450.0	13,241	566.0	7,998	678.0	1,754	540.0	3,842	249,782	250,000
1986	282.9	37,747	296.2	381	295.8	8,405	330.6	36,397	391.4	4,755	424.3	10,405	551.5	7,204	678.3	1,783	530.2	3,573	240,298	240,000
1987	272.6	36,373	292.3	349	290.0	8,128	318.0	34,318	387.1	4,531	409.9	8,816	545.7	6,886	675.4	1,501	524.4	3,414	230,675	231,000
1988	266.5	35,559	266.4	135	264.5	6,909	294.7	30,468	384.4	4,390	409.3	8,750	561.6	7,757	674.0	1,364	524.3	3,411	216,752	217,000
1989	246.0	32,824	267.8	147	267.1	7,033	310.7	33,108	388.6	4,609	420.5	9,986	568.7	8,146	673.6	1,325	522.7	3,367	214,282	214,000
1990	248.8	33,197	262.8	106	261.3	6,756	300.7	31,464	388.9	4,625	419.9	9,920	569.1	8,168	672.1	1,179	525.0	3,430	209,746	210,000
1991	233.6	31,169	257.6	63	246.8	6,062	292.2	30,056	385.8	4,463	403.0	8,055	553.7	7,324	673.8	1,345	525.5	3,444	195,148	195,000

GWE = Groundwater elevations in feet above Mean Sea Level (NGVD29)
Groundwater elevations compiled from selected wells in each node.
Storage: (GWE - Basin Bottom) x Nodal Specific Yield x Node Area
Water levels in Node 36 were not measured before 1992

Table 4.2-3
Groundwater Elevations (ft) and Storage (AF)
Nodal Groundwater Elevation Method
Water Years 1992 - 2011

UPPER AQUIFER

WATER	NODE 15		NODE 16		NODE 17		NODE 18		NODE 19		NODE 20		NODE 23		NODE 24		NODE 25		NODE 26		NODE 29		NODE 30		NODE 31	
YEAR	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag
1992	242.0	0	258.6	386	312.4	1,686	261.4	2,365	287.9	5,620	275.6	1,553	263.8	1,146	249.1	1,289	286.7	6,914	252.6	4,439	341.8	1,069	327.8	7,935	252.6	0
1993	250.0	99	262.9	454	287.4	1,669	262.4	2,436	266.7	3,655	276.6	1,554	268.0	1,377	256.3	1,773	297.2	8,545	258.4	5,398	344.9	1,072	332.9	8,519	268.6	1,446
1994	268.4	357	271.6	594	292.6	1,673	271.3	3,073	275.9	5,599	276.3	1,554	273.7	1,693	261.9	2,144	295.9	8,348	259.3	5,558	343.8	1,071	333.6	8,599	273.4	2,164
1995	282.1	549	283.6	893	299.8	1,677	283.9	4,424	288.1	5,621	284.0	1,563	280.8	2,084	276.9	3,145	305.0	9,766	264.6	6,438	346.5	1,074	335.7	8,839	279.5	3,076
1996	283.3	565	284.8	893	300.5	1,678	284.9	4,425	289.7	5,624	285.0	1,564	280.8	2,081	275.4	3,049	304.2	9,631	264.6	6,430	345.4	1,073	335.2	8,776	281.8	3,420
1997	284.1	577	285.1	894	300.5	1,678	285.7	4,426	294.4	5,632	285.3	1,565	281.5	2,119	272.7	2,865	300.7	9,086	263.3	6,215	345.0	1,072	339.3	9,246	276.7	2,658
1998	286.4	609	288.2	896	302.7	1,679	288.9	4,431	295.5	5,634	287.9	1,568	283.1	2,207	272.1	2,825	305.6	9,855	266.9	6,811	346.3	1,073	325.8	7,710	283.0	3,600
1999	280.7	529	281.1	746	298.3	1,676	281.8	3,820	292.7	5,629	282.9	1,562	279.6	2,018	268.0	2,555	311.3	10,745	263.8	6,298	344.4	1,072	315.0	6,469	277.9	2,837
2000	277.6	486	279.9	726	297.5	1,676	280.2	3,710	294.4	5,632	282.0	1,561	278.3	1,946	253.3	1,570	310.6	10,629	266.6	6,761	344.0	1,071	315.8	6,565	275.9	2,538
2001	265.0	309	270.4	574	292.5	1,673	269.1	2,913	284.3	5,614	270.8	1,547	273.7	1,691	256.4	1,780	308.1	10,247	258.9	5,488	339.3	1,067	306.2	5,461	252.5	0
2002	286.3	608	267.6	530	290.3	1,671	265.1	2,629	287.5	5,620	269.1	1,545	271.1	1,551	260.2	2,030	284.9	6,633	260.1	5,686	338.7	1,067	313.5	6,298	251.6	0
2003	284.2	578	267.1	522	290.1	1,671	264.5	2,584	288.1	5,621	269.3	1,545	274.0	1,711	270.8	2,738	289.7	7,371	274.3	8,040	342.7	1,070	316.8	6,676	276.4	2,619
2004	284.4	581	265.9	502	289.1	1,670	263.8	2,536	279.7	5,606	269.2	1,545	276.0	1,819	275.0	3,019	296.2	8,394	279.3	8,856	342.2	1,070	317.6	6,770	268.3	1,403
2005	292.0	663	279.3	717	297.5	1,676	279.1	3,628	293.9	5,631	276.2	1,554	285.6	2,345	291.0	4,087	306.3	9,971	289.8	10,597	343.7	1,071	326.4	7,778	289.7	4,606
2006	301.2	667	293.7	900	315.8	1,688	294.9	4,441	297.6	5,638	291.8	1,573	297.5	2,598	305.2	4,038	315.2	11,357	300.2	12,311	344.5	1,072	328.0	7,961	301.5	6,360
2007	294.0	664	296.3	757	305.9	1,507	295.1	3,944	295.9	3,828	296.9	934	298.7	2,970	300.1	4,694	313.1	11,022	301.0	12,457	334.2	4,719	318.0	6,813	323.7	9,692
2008	291.7	663	290.2	753	302.5	1,504	292.0	3,939	293.2	3,823	290.0	926	297.6	2,969	298.3	4,575	312.4	10,916	301.5	12,534	333.2	4,719	325.6	7,683	322.2	9,461
2009	288.2	634	287.6	751	301.1	1,503	286.9	3,931	291.8	3,820	289.0	925	292.5	2,725	289.3	3,975	306.4	9,985	294.1	11,314	331.4	4,583	322.0	7,271	321.1	9,295
2010	288.6	640	287.8	751	299.5	1,502	288.1	3,933	291.5	3,820	288.4	924	291.7	2,684	289.3	3,977	306.0	9,913	289.9	10,612	331.4	4,581	321.1	7,166	318.8	8,953
2011	297.7	666	290.8	753	299.9	1,503	287.9	3,932	292.5	3,821	289.6	925	292.5	2,723	289.5	3,989	306.2	9,953	291.4	10,859	331.8	4,617	323.8	7,477	321.9	9,416

LOWER AQUIFER

WATER	NODE 15		NODE 16		NODE 17		NODE 18		NODE 19		NODE 20		NODE 23		NODE 24		NODE 25		NODE 26		NODE 29		NODE 30		NODE 31	
YEAR	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag
1992	229.9	1,759	225.9	2,651	229.5	1,601	240.2	5,439	236.9	5,574	273.9	3,656	229.9	2,781	235.6	2,989	236.0	6,967	231.4	8,913	236.4	0	260.1	5,735	232.9	15,003
1993	252.0	1,765	252.0	2,652	249.9	1,601	253.5	5,450	256.3	5,577	275.9	3,656	251.8	2,798	255.0	2,992	263.8	6,985	251.5	8,919	261.2	1	263.7	5,735	265.1	15,013
1994	269.8	1,769	269.6	2,654	265.9	1,602	267.1	5,460	270.3	5,579	274.2	3,656	253.3	2,799	256.9	2,992	262.5	6,984	252.2	8,919	264.2	1	266.4	5,736	267.8	15,014
1995	281.7	1,772	281.6	2,654	278.2	1,602	282.0	5,472	281.8	5,581	283.2	3,656	266.4	2,809	274.6	2,994	280.8	6,995	267.6	8,924	269.8	1	295.9	5,740	280.4	15,018
1996	282.1	1,772	281.9	2,654	279.9	1,602	281.5	5,471	282.6	5,581	285.2	3,656	275.8	2,816	273.3	2,994	277.9	6,994	263.9	8,923	270.2	2	289.2	5,739	279.3	15,018
1997	283.3	1,772	281.2	2,654	281.0	1,602	283.6	5,473	283.4	5,581	285.3	3,656	264.3	2,807	262.7	2,993	265.7	6,986	259.3	8,921	281.8	2	274.7	5,737	272.5	15,015
1998	285.7	1,773	286.2	2,655	285.4	1,602	289.2	5,477	287.2	5,581	285.0	3,656	264.5	2,808	277.4	2,995	268.0	6,987	263.3	8,923	273.3	2	280.5	5,738	274.6	15,016
1999	280.7	1,772	281.7	2,654	275.6	1,602	273.7	5,465	278.7	5,580	282.9	3,656	252.0	2,798	260.3	2,992	263.5	6,984	253.9	8,920	264.1	1	269.6	5,736	264.4	15,012
2000	276.7	1,771	278.3	2,654	275.3	1,602	277.3	5,468	278.4	5,580	282.0	3,656	249.5	2,796	259.7	2,992	252.7	6,977	255.6	8,920	260.3	1	273.7	5,737	259.6	15,010
2001	265.0	1,768	266.8	2,653	269.0	1,602	265.9	5,459	267.9	5,579	270.8	3,656	222.4	2,776	249.4	2,991	233.8	6,965	241.5	8,916	242.5	0	247.0	5,733	243.1	15,004
2002	264.6	1,768	259.6	2,653	261.8	1,602	257.0	5,452	268.6	5,579	269.1	3,656	225.0	2,778	236.2	2,989	215.3	6,957	230.8	8,913	243.2	1	256.4	5,734	244.1	15,005
2003	259.9	1,767	259.9	2,653	263.4	1,602	250.8	5,447	268.0	5,579	267.1	3,656	261.0	2,805	252.9	2,991	260.8	6,983	269.4	8,924	273.8	2	283.5	5,739	269.5	15,014
2004	255.7	1,766	257.5	2,653	261.6	1,602	256.2	5,452	258.1	5,577	269.2	3,656	261.0	2,805	254.4	2,992	255.2	6,979	257.8	8,921	269.3	1	278.8	5,738	267.3	15,013
2005	270.7	1,769	277.2	2,654	281.9	1,602	274.3	5,466	275.8	5,580	277.2	3,656	275.2	2,816	281.3	2,995	279.2	6,994	283.6	8,928	292.2	2	301.9	5,741	285.9	15,020
2006	286.3	1,773	291.3	2,655	294.1	1,602	288.7	5,477	291.3	5,582	291.8	3,656	294.1	2,830	295.4	2,997	296.9	7,006	299.4	8,933	302.3	3	309.3	5,742	297.1	15,024
2007	294.9	1,775	294.3	2,655	296.2	1,602	295.8	5,483	297.0	5,583	300.9	3,656	298.0	2,833	298.7	2,998	293.7	7,004	299.5	8,933	303.9	3	303.8	5,742	296.1	15,024
2008	282.1	1,772	280.3	2,654	288.1	1,602	286.2	5,475	288.4	5,582	294.9	3,656	287.6	2,825	291.1	2,997	287.4	7,000	294.8	8,932	292.8	2	292.5	5,740	286.6	15,021
2009	286.1	1,773	284.8	2,654	288.1	1,602	283.4	5,473	285.7	5,581	283.3	3,656	278.0	2,818	276.0	2,995	266.2	6,986	277.7	8,927	278.1	2	279.4	5,738	271.3	15,015
2010	285.9	1,773	284.3	2,654	288.7	1,602	283.7	5,473	284.8	5,581	284.5	3,656	283.4	2,822	280.2	2,995	272.7	6,990	276.6	8,926	281.2	2	276.9	5,738	272.0	15,015
2011	290.3	1,774	289.4	2,655	290.3	1,602	289.3	5,478	286.1	5,581	284.4	3,656	286.1	2,824	284.7	2,996	280.3	6,995	284.2	8,929	285.6	2	283.1	5,738	282.5	15,019

GWE = Groundwater elevations in feet above Mean Sea Level (NAVD88)
Groundwater elevations from 1992 - 2006 compiled from program wells in each node.
Groundwater elevations after 2006 calculated using ArcGIS (created Grid representing gradient, then calculated Mean for each node).
Storage Upper = ((GWE - Bottom Confining Layer) x Specific Storage + (Bottom Confining Layer/GWE - Bottom Aquifer) x Specific Yield) x Node Area
Storage Lower = ((GWE - Top Aquifer) x Specific Storage + (Top Aquifer - Bottom Aquifer) x Specific Yield) x Node Area

Table 4.2-3
Groundwater Elevations (ft) and Storage (AF)
Nodal Groundwater Elevation Method
Water Years 1992 - 2011

UPPER AQUIFER

WATER	NODE 33		NODE 34		NODE 35		NODE 36		NODE 38		NODE 39		NODE 40		NODE 41		NODE 42		TOTAL	TOTAL
YEAR	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	Upper	(Rounded)
1992	357.7	475	350.2	2,831	310.2	98	434.1	8,147	385.9	3,764	416.9	3,967	534.4	9,684	675.6	8,594	525.2	8,117	80,078	80,000
1993	363.4	564	347.9	2,705	330.9	5,639	441.5	9,435	394.0	4,672	450.4	10,139	561.4	15,176	679.6	9,214	534.7	9,371	104,913	105,000
1994	360.8	522	348.2	2,721	346.9	9,906	440.3	9,226	393.7	4,638	447.0	9,509	561.1	15,128	677.6	8,904	529.0	8,618	111,599	112,000
1995	365.4	595	354.6	3,078	343.1	8,890	440.5	9,261	399.5	5,299	454.7	10,943	563.2	15,542	680.9	9,416	537.1	9,687	121,859	122,000
1996	364.6	581	356.1	3,157	335.3	6,797	439.0	9,000	399.6	5,308	454.7	10,928	563.2	15,542	680.8	9,400	537.5	9,740	119,662	120,000
1997	367.3	623	357.1	3,215	340.8	8,275	441.2	9,383	398.4	5,176	447.1	9,544	564.0	15,711	680.0	9,276	535.8	9,516	118,751	119,000
1998	367.9	634	357.7	3,248	340.7	8,249	439.9	9,157	398.6	5,197	453.5	10,709	565.1	15,939	682.9	9,726	538.2	9,832	121,589	122,000
1999	364.8	585	354.5	3,070	343.6	9,033	439.8	9,139	398.1	5,135	456.1	11,190	562.9	15,487	679.5	9,199	536.8	9,648	118,442	118,000
2000	363.4	563	358.5	3,289	348.0	10,208	439.5	9,087	398.1	5,136	451.7	10,384	563.3	15,562	679.4	9,183	537.5	9,740	118,023	118,000
2001	361.8	538	352.1	2,936	311.4	419	439.7	9,122	394.0	4,676	443.7	8,909	570.2	16,976	676.9	8,795	531.5	8,948	99,685	100,000
2002	359.7	505	352.3	2,947	348.9	10,430	439.6	9,104	396.0	4,904	445.9	9,312	574.8	17,901	677.1	8,826	530.2	8,777	108,575	109,000
2003	362.6	550	356.2	3,162	347.5	10,057	440.3	9,226	396.5	4,960	450.2	10,098	574.9	17,921	677.6	8,904	531.4	8,935	116,560	117,000
2004	362.5	549	354.6	3,077	322.2	3,309	439.9	9,157	395.6	4,854	448.5	9,788	571.0	17,129	678.6	9,059	530.8	8,856	109,548	110,000
2005	364.8	584	358.1	3,267	358.2	12,929	440.0	9,174	398.1	5,140	452.1	10,457	574.8	17,901	679.0	9,121	533.1	9,159	132,057	132,000
2006	366.2	606	361.0	3,431	343.2	8,923	440.0	9,162	397.6	5,085	448.9	9,867	571.0	17,127	680.3	9,320	534.5	9,349	133,474	133,000
2007	366.6	613	342.7	2,419	354.2	11,863	440.2	9,197	393.9	4,661	437.9	7,832	541.1	11,062	680.0	9,273	518.4	7,220	128,142	128,000
2008	369.9	665	346.9	2,652	351.2	11,055	440.0	9,167	394.4	4,721	440.3	8,282	539.4	10,707	678.0	8,963	519.0	7,305	127,981	128,000
2009	366.3	608	346.6	2,636	358.4	12,991	448.2	10,593	393.8	4,658	444.7	9,093	541.3	11,100	690.6	10,915	520.9	7,557	130,865	131,000
2010	366.6	613	350.2	2,833	359.5	13,274	449.8	10,882	396.7	4,984	450.6	10,178	540.6	10,959	690.7	10,927	522.9	7,824	131,929	132,000
2011	368.2	639	352.6	2,965	358.6	13,043	449.3	10,788	397.0	5,013	451.9	10,411	540.4	10,903	690.7	10,926	521.7	7,665	132,989	133,000

LOWER AQUIFER

WATER	NODE 33		NODE 34		NODE 35		NODE 36		NODE 38		NODE 39		NODE 40		NODE 41		NODE 42		TOTAL	TOTAL
YEAR	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	GWE	Storag	Upper	(Rounded)
1992	236.9	479	234.9	5,618	250.2	22,775	409.5	1	397.9	1,649	370.1	4,233	534.4	2,268	675.6	3	492.2	1,758	101,851	102,000
1993	264.0	479	274.7	5,618	283.0	22,775	421.1	1	398.6	1,649	401.2	4,246	561.4	2,269	679.6	3	517.0	1,760	101,942	102,000
1994	269.8	479	271.0	5,618	287.1	22,775	405.2	0	397.4	1,648	381.3	4,235	561.1	2,269	677.6	3	508.9	1,759	101,950	102,000
1995	284.4	479	292.7	5,620	309.7	22,782	404.2	0	409.4	1,657	422.0	4,258	563.2	2,269	680.9	3	520.0	1,760	102,046	102,000
1996	284.7	479	287.4	5,619	302.2	22,778	407.1	1	408.3	1,656	425.8	4,260	563.2	2,269	680.8	3	522.2	1,760	102,045	102,000
1997	281.9	479	304.7	5,622	307.5	22,781	425.0	1	402.7	1,652	409.7	4,251	564.0	2,269	680.0	3	517.7	1,760	102,017	102,000
1998	279.6	479	303.4	5,622	308.7	22,781	419.5	1	404.1	1,653	404.0	4,248	562.4	2,269	682.9	4	525.7	1,760	102,028	102,000
1999	266.3	479	293.0	5,620	313.3	22,784	416.6	1	405.7	1,654	408.6	4,250	562.9	2,269	679.5	3	526.1	1,760	101,993	102,000
2000	257.7	479	288.9	5,619	306.6	22,780	405.6	0	404.8	1,653	417.2	4,255	563.3	2,269	679.4	3	526.8	1,760	101,984	102,000
2001	234.2	479	258.0	5,618	265.2	22,775	399.4	0	398.6	1,649	405.6	4,249	464.4	2,266	676.9	3	515.0	1,759	101,900	102,000
2002	216.8	479	263.4	5,618	261.3	22,775	403.1	0	399.7	1,650	414.3	4,253	574.8	2,269	677.1	3	510.0	1,759	101,892	102,000
2003	264.1	479	292.1	5,620	298.5	22,776	409.8	1	400.5	1,650	408.3	4,250	488.2	2,266	677.6	3	518.2	1,760	101,965	102,000
2004	255.5	479	285.1	5,618	284.3	22,775	410.9	1	398.1	1,649	407.1	4,249	510.3	2,267	678.6	3	516.7	1,760	101,954	102,000
2005	286.9	479	312.5	5,624	312.8	22,783	413.8	1	401.1	1,651	421.9	4,258	574.8	2,269	679.0	3	521.9	1,760	102,052	102,000
2006	307.4	479	318.7	5,625	318.4	22,786	416.0	1	403.0	1,652	415.3	4,254	516.9	2,267	680.3	3	520.4	1,760	102,108	102,000
2007	309.1	479	309.9	5,623	335.5	22,794	414.0	1	370.3	1,630	410.6	4,251	507.9	2,267	670.0	3	501.7	1,759	102,096	102,000
2008	297.7	479	293.0	5,620	318.2	22,786	412.0	1	367.8	1,628	398.3	4,244	504.6	2,267	659.6	2	502.1	1,759	102,042	102,000
2009	287.8	479	282.9	5,618	314.7	22,784	449.3	1	372.8	1,631	388.0	4,239	504.9	2,267	638.9	1	503.1	1,759	101,998	102,000
2010	288.3	479	282.0	5,618	316.0	22,785	451.2	1	374.9	1,633	408.9	4,250	513.8	2,267	639.3	1	509.9	1,759	102,021	102,000
2011	290.2	479	282.1	5,618	319.4	22,787	452.7	1	374.6	1,633	408.0	4,250	516.2	2,267	639.1	1	516.1	1,760	102,043	102,000

GWE = Groundwater elevations in feet above Mean Sea Level (NAVD88)
Groundwater elevations from 1992 - 2006 compiled from program wells in each node.
Groundwater elevations after 2006 calculated using ArcGIS (created Grid representing gradient, then calculated Mean for each node).
Storage Upper = ((GWE - Bottom Confining Layer) x Specific Storage + (Bottom Confining Layer/GWE - Bottom Aquifer) x Specific Yield) x Node Area
Storage Lower = ((GWE - Top Aquifer) x Specific Storage + (Top Aquifer - Bottom Aquifer) x Specific Yield) x Node Area

TABLE 4.2-4
ZONE 7 WATER AGENCY
GROUNDWATER STORAGE - HYDROLOGIC INVENTORY (HI) METHOD
2011 WATER YEAR
(ACRE-FEET except where indicated)

	WATER YEAR	NORMAL YEAR	PERCENT NORMAL
INDICES			
Rainfall at Livermore (inches)	16.21	14.53	112%
8 Station Rainfall Index (Northern CA)(inches)	72.80	50.17	145%
Evaporation at Lake Del Valle (inches)	64.49	66.16	97%
Arroyo Valle Stream flow (AF)	28,634	21,690	132%
SUPPLY TOTAL (AF)	**25,313**	**21,300**	**119%**
Stream Recharge	**14,015**	**14,400**	**97%**
[1] Natural Stream Recharge	7,441	5700*	131%
Arroyo Valle	*2,914*	*1800*	*162%*
Arroyo Mocho	*3,008*	*2,600*	*116%*
Arroyo Las Positas	*1,519*	*1,300*	*117%*
[1] Arroyo Valle Prior Rights	1,768	900*	196%
[3] Artificial Stream Recharge	4,806	7,800	62%
Arroyo Valle	*768*	*1,900*	*40%*
Arroyo Mocho	*3,671*	*5,870*	*63%*
Arroyo Las Positas	*367*	*30*	*1223%*
[1] **Rainfall Recharge**	**8,104**	**3500***	**232%**
[1] **Applied Water Recharge**	**2,194**	**1600***	**137%**
Urban - Municipal	1,788	1,280	140%
Urban - Recycled Water	133	26	502%
Agricultural - Municipal (SBA)	120	92	131%
Agricultural - Groundwater	16	12	132%
Golf Courses - Groundwater	78	146	53%
Golf Courses - Recycled Water	59	43	138%
[1] **Subsurface Inflow**	**1,000**	**1800***	**56%**
DEMAND TOTAL (AF)	**20,405**	**20,655**	**99%**
Municipal Pumping	**13,430**	**15,555**	**86%**
[4] Zone 7	6,264	7,800	80%
[2] *Zone 7 pumping for DSRSD*	*646*	*645**	*100%*
GW through Demin Membranes	*2,131*	*NA*	-
Demin Permeate to Z7 Distribution System	*1,624*	*NA*	-
[2] City of Pleasanton	3,435	3500*	98%
[2] California Water Service	2,673	3070*	87%
[2] SFWD	442	450*	98%
[2] Fairgrounds	301	310*	97%
[2] Domestic	107	200*	54%
[2] Golf Courses	208	225*	92%
3S1E_1P3	*0*	*0*	*0%*
GWP_Castle	*187*	*200*	*94%*
Tri Valley Golf	*21*	*20*	*105%*
[2] **Agricultural Pumping**	**93**	**400***	**23%**
Calculated	93	400	23%
[2] **Mining Use**	**6,882**	**4600***	**150%**
Mining Discharges (Export) to Stream	4,277	700	611%
Evaporation	1,905	3,200	60%
Processing	700	700	100%
[1] **Subsurface Overflow**	**0**	**100***	**0%**
SUBTOTALS (AF)			
[1] **Sustainable Yield - Natural Recharge**	20,507	13,400	153%
[2] **Sustainable Yield - Demand Components**	14,786	13,400	110%
[3] **Zone 7 - Artificial Recharge (Stream)**	4,806	7,800	62%
[4] **Zone 7 - Municipal Pumping**	6,264	7,800	80%
NET RECHARGE (Supply - Demand)	**4,908**	**645**	**761%**

TOTAL STORAGE (AF)	**2011 WY**	**2010 WY**
Hydrologic Inventory (HI)	234,239	229,331
Nodal GW Elevations (NGE)	235,032	233,950
Average Storage: (HI + NGE)/2	234,636	231,641
Available Storage: Avg Storage - Reserve (128K AF)	106,636	103,641

* Original estimates for Sustainable Yield components

TABLE 4.2-5
ZONE 7 WATER AGENCY
LIVERMORE VALLEY MAIN GROUNDWATER BASIN
HYDROLOGIC INVENTORY AND STORAGE IN ACRE-FEET
1974-2011 WATER YEARS

	WATER YEAR (Oct - Sep)																																	1974 - 2011	
COMPONENTS	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**AVG**	**TOTAL**
INDICES																																							
Rainfall at Livermore (in)	16.11	14.8	6.23	6.02	18.54	13.59	17.56	10.3	24.38	31.98	12.96	12.59	19.79	8.89	8.69	11.15	9.35	11.32	11.64	21.33	11.82	21.29	19.95	15.11	25.28	13.13	14.1	10.95	11.21	17.03	13.07	19.3	17.49	9.66	10.68	11.39	14.82	16.21	15	
8 Station Rain Index (N. CA)(in)	78.55	48.79	28.3	19.04	71.56	39.09	59.56	37.63	84.82	88.49	58.07	37.82	72.07	28.56	34.86	50.13	35.97	32.17	36.01	65.32	31.83	85.39	61.31	68.76	82.4	54.75	56.7	32.97	46.32	59.7	47.25	57.4	80.1	37.28	34.94	46.84	53.57	72.8	53	
Evap at Lake Del Valle (in)	60.9	62.67	63.46	65.98	64.17	67.66	59.74	72.06	60.45	59.71	70.18	64.93	61.09	64.03	66.94	63.61	65.87	64.7	68.24	64.17	65.51	58.28	71.57	69.464	57.2	60.99	68.348	68.49	73.17	69.87	72.14	63.58	68.614	68.904	72.67	71.566	63.95	64.49	66	
Arroyo Valle Stream flow (AF)	30538	28307	475	177	43749	9721	45800	5817	61427	125882	25653	7282	67903	3023	1506	1988	815	9909	11692	52831	3424	67142	51058	54115	87819	15169	18949	8156	7848	19648	11410	26930	28325	2027	18059	11231	12914	28634	26509	1,007,352
SUPPLY	**18,109**	**21,400**	**11,078**	**8,632**	**24,753**	**22,143**	**23,748**	**18,726**	**29,833**	**35,289**	**15,408**	**8,630**	**20,697**	**6,485**	**7,871**	**10,953**	**10,121**	**12,466**	**10,343**	**28,244**	**15,792**	**28,771**	**22,212**	**23,819**	**28,643**	**22,010**	**24,264**	**17,190**	**25,481**	**32,330**	**20,618**	**34,015**	**25,911**	**14,409**	**16,481**	**18,964**	**25,939**	**25,314**	**20,187**	**767,089**
Stream Recharge	**11,340**	**15,400**	**6,910**	**3,820**	**16,330**	**16,110**	**16,480**	**15,040**	**16,420**	**17,158**	**9,486**	**4,747**	**9,045**	**3,565**	**4,549**	**7,880**	**7,026**	**8,347**	**5,247**	**14,714**	**11,838**	**13,058**	**11,109**	**12,284**	**13,603**	**10,813**	**12,842**	**8,768**	**16,527**	**22,038**	**13,215**	**21,630**	**13,946**	**7,710**	**7,896**	**10,548**	**15,950**	**14,015**	**11,774**	**447,403**
Natural Stream Recharge[1]	6,060	7,110	1,100	630	8,850	2,860	4,850	2,200	8,620	14,387	8,326	3,541	8,168	2,696	2,653	2,589	2,250	4,418	3,997	8,247	3,080	7,259	7,743	6,607	10,533	5,091	4,178	4,679	4,809	9,017	3,788	10,074	7,395	2,092	5,361	5,317	9,177	7,441	5,716	217,193
Arroyo Valle	*2,400*	*2,950*	*360*	*290*	*2,450*	*1,290*	*1,750*	*840*	*2,970*	*4,893*	*2,580*	*751*	*2,831*	*527*	*679*	*458*	*418*	*1,215*	*970*	*2,754*	*735*	*2,818*	*1,426*	*2,753*	*4,401*	*1,796*	*1,389*	*2,440*	*2,259*	*4,397*	*1,447*	*5,980*	*3,043*	*660*	*2,843*	*2,947*	*5,517*	*2,914*	*2,188*	*83,140*
Arroyo Mocho	*3,160*	*3,760*	*540*	*140*	*5,900*	*1,170*	*2,500*	*880*	*4,810*	*8,514*	*4,616*	*1,716*	*4,176*	*843*	*902*	*809*	*428*	*1,883*	*1,711*	*3,903*	*1,263*	*3,144*	*5,226*	*2,670*	*4,560*	*1,833*	*1,539*	*961*	*1,279*	*2,980*	*1,082*	*2,854*	*3,104*	*543*	*1,428*	*820*	*1,738*	*3,008*	*2,431*	*92,394*
Arroyo las Positas	*500*	*400*	*200*	*200*	*500*	*400*	*600*	*480*	*840*	*980*	*1,130*	*1,074*	*1,161*	*1,326*	*1,072*	*1,322*	*1,404*	*1,320*	*1,315*	*1,591*	*1,082*	*1,297*	*1,091*	*1,184*	*1,572*	*1,462*	*1,250*	*1,278*	*1,271*	*1,640*	*1,259*	*1,240*	*1,248*	*889*	*1,090*	*1,550*	*1,922*	*1,519*	*1,096*	*41,660*
Arroyo Valle Prior Rights[1]	1,771	1,540	115	0	1,038	984	1,419	922	1,848	1,870	1,160	1,206	877	869	724	971	288	668	337	846	876	1,127	398	362	727	548	644	660	1,131	1,612	1,343	293	1,930	807	306	1,247	0	1,768	927	35,231
Artificial Stream Recharge[2]	3,509	6,750	5,695	3,190	6,442	12,266	10,211	11,918	5,952	901	0	0	0	0	1,172	4,320	4,488	3,261	914	5,621	7,883	4,672	2,968	5,314	2,343	5,174	8,019	3,428	10,588	11,409	8,084	11,263	4,621	4,811	2,229	3,984	6,773	4,806	5,131	194,978
Arroyo Valle	*1,439*	*4,320*	*1,875*	*1,300*	*3,002*	*5,886*	*4,541*	*6,328*	*2,442*	*0*	*0*	*0*	*0*	*0*	*0*	*139*	*304*	*82*	*412*	*1,182*	*798*	*179*	*144*	*1,827*	*413*	*1,181*	*890*	*1,476*	*1,831*	*1,547*	*1,670*	*2,277*	*1,216*	*2,879*	*2,229*	*2,104*	*2,459*	*768*	*1,556*	*59,139*
Arroyo Mocho	*1,670*	*1,830*	*3,220*	*1,290*	*2,840*	*5,780*	*5,270*	*5,130*	*3,290*	*901*	*0*	*0*	*0*	*0*	*1,172*	*4,181*	*4,184*	*3,178*	*502*	*4,439*	*7,085*	*4,493*	*2,824*	*3,487*	*1,930*	*3,993*	*7,129*	*1,930*	*8,755*	*9,862*	*6,414*	*8,698*	*3,205*	*1,932*	*0*	*1,880*	*4,314*	*3,671*	*3,434*	*130,481*
Arroyo las Positas	*400*	*600*	*600*	*600*	*600*	*600*	*400*	*460*	*220*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*22*	*2*	*0*	*0*	*288*	*200*	*0*	*0*	*0*	*0*	*367*	*141*	*5,359*
Injection Well Recharge	**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**	**1,524**	**1,146**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**70**	**2,670**
Rainfall Recharge[1]	**3,031**	**2,523**	**0**	**0**	**4,398**	**2,002**	**3,891**	**967**	**11,423**	**16,357**	**3,110**	**1,249**	**9,008**	**290**	**398**	**283**	**141**	**1,838**	**1,760**	**10,761**	**1,242**	**13,243**	**8,176**	**8,634**	**12,502**	**7,164**	**7,391**	**5,423**	**5,808**	**7,331**	**4,236**	**9,338**	**8,975**	**3,463**	**5,206**	**5,064**	**6,782**	**8,104**	**5,303**	**201,512**
Applied Water Recharge[1]	**2,738**	**2,477**	**3,158**	**3,022**	**2,795**	**3,041**	**2,727**	**2,089**	**1,360**	**1,344**	**2,162**	**1,884**	**1,904**	**1,860**	**2,004**	**1,630**	**1,694**	**602**	**1,766**	**1,440**	**1,621**	**1,480**	**2,007**	**2,221**	**1,727**	**1,760**	**1,979**	**1,999**	**2,146**	**1,962**	**2,166**	**2,047**	**1,989**	**2,236**	**2,379**	**2,352**	**2,208**	**2,195**	**2,057**	**78,168**
Urban - Municipal	1,074	766	1,354	1,375	1,087	1,179	810	1,284	668	690	1,253	1,027	998	1,328	1,377	1,053	1,025	222	1,288	1,108	1,252	1,060	1,467	1,632	1,421	1,490	1,676	1,703	1,816	1,683	1,853	1,759	1,691	1,920	2,057	1,997	1,831	1,788	1,344	51,061
Urban - Recycled Water	0	0	27	16	26	13	21	7	12	8	16	6	12	8	5	14	5	2	0	11	14	13	18	21	15	12	21	19	30	10	14	15	26	24	7	52	84	133	19	738
Agricultural - Municipal (SBA)	74	109	157	124	95	118	147	182	140	165	208	182	232	245	289	240	265	242	279	177	192	257	347	401	156	113	127	117	132	131	127	123	124	122	134	133	131	120	175	6,656
Agricultural - Groundwater	384	280	513	525	352	388	281	241	174	139	198	210	190	137	152	140	153	109	133	96	100	92	100	109	30	15	17	16	17	17	17	16	16	16	18	18	17	16	143	5,441
Golf Courses - Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	65	73	74	79	74	81	77	74	83	89	87	80	78	28	1,070
Golf Courses - Recycled Water	0	0	64	68	75	73	73	60	54	63	62	55	61	47	63	60	64	26	66	48	63	58	75	58	50	65	66	69	72	47	75	58	59	71	74	66	64	59	59	2,229
Others	1,206	1,322	1,042	915	1,160	1,270	1,394	315	312	279	425	404	411	95	118	123	182	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	289	10,973
Subsurface Basin Inflow[1]	**1,000**	**1,000**	**1,010**	**1,790**	**1,230**	**990**	**650**	**630**	**630**	**430**	**650**	**750**	**740**	**770**	**920**	**1,160**	**1,260**	**1,680**	**1,570**	**1,330**	**1,090**	**990**	**920**	**680**	**810**	**750**	**906**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**983**	**37,336**
DEMAND	**18,618**	**15,929**	**15,432**	**14,636**	**12,871**	**15,819**	**15,727**	**19,349**	**18,349**	**26,220**	**19,750**	**18,506**	**22,550**	**14,575**	**17,176**	**16,143**	**15,896**	**21,210**	**17,213**	**13,462**	**15,479**	**16,036**	**20,683**	**25,574**	**25,349**	**25,698**	**27,193**	**27,747**	**23,730**	**21,077**	**24,802**	**19,426**	**16,426**	**19,501**	**20,367**	**24,594**	**21,327**	**20,404**	**19,601**	**744,847**
Municipal Pumpage	**11,806**	**9,881**	**7,782**	**6,721**	**7,022**	**8,207**	**6,982**	**7,361**	**7,281**	**7,965**	**8,473**	**7,990**	**8,652**	**8,152**	**9,431**	**10,393**	**11,224**	**17,287**	**13,307**	**9,039**	**6,475**	**4,566**	**6,324**	**8,824**	**10,264**	**11,832**	**15,520**	**17,806**	**19,307**	**17,123**	**19,635**	**14,686**	**11,697**	**12,681**	**13,516**	**18,022**	**16,064**	**13,430**	**11,124**	**422,731**
Zone 7 (includes for DSRSD[2])	5,403	3,090	1,292	309	776	816	41	0	0	25	348	1,199	1,163	480	2,017	3,213	3,327	8,119	5,136	2,215	213	368	2,388	1,565	1,682	4,912	6,140	9,864	11,047	8,379	11,820	6,858	3,802	4,791	6,855	10,084	8,919	6,264	3,814	144,921
DSRSD	*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*	*0*	*0*	*0*	*645*	*645*	*645*	*645*	*645*	*645*	*645*	*645*	*646*	*153*	*5,806*
City of Pleasanton[2]	2,264	2,497	1,707	3,271	2,640	3,273	2,961	3,089	3,565	3,886	3,486	3,056	3,705	3,310	3,548	3,316	3,856	4,164	3,368	3,252	2,578	1,262	1,333	3,208	3,935	2,563	4,558	3,112	3,579	3,674	3,688	3,604	3,587	3,638	2,387	3,660	3,280	3,435	3,192	121,296
Cal. Water Service[2]	2,612	2,852	2,781	1,312	1,964	2,358	2,489	2,695	2,286	2,660	3,035	2,788	2,774	3,276	2,761	2,850	3,073	3,966	3,744	2,570	2,626	2,053	1,551	2,947	3,595	3,271	3,567	3,707	3,458	3,979	2,911	3,166	3,106	2,971	3,143	3,123	2,844	2,673	2,883	109,539
Camp Parks[2]	769	808	980	925	796	881	819	808	713	630	647	40	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	232	8,819
SFWD[2]	302	242	495	374	397	413	372	402	348	321	378	353	484	491	472	443	362	408	410	414	396	370	411	477	460	380	532	472	448	423	481	436	467	494	492	446	417	442	419	15,924
Fairgrounds[2]	200	200	200	200	200	200	200	267	217	242	281	272	280	280	280	280	280	346	336	282	325	285	343	342	230	333	369	318	423	327	365	284	441	443	289	335	284	301	292	11,081
Domestic[2]	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	113	113	116	116	117	117	113	116	109	109	134	134	167	131	93	96	109	123	112	107	109	4,145
Golf Courses[2]	156	92	227	230	149	166	0	0	52	101	198	182	146	215	253	191	226	184	198	193	221	111	182	169	249	256	245	223	218	208	203	207	199	249	241	250	208	208	184	7,005
3S/1E 1P3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*15*	*33*	*12*	*45*	*12*	*13*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*129*
Castlewood	*156*	*92*	*227*	*230*	*149*	*166*	*0*	*0*	*52*	*101*	*198*	*182*	*146*	*215*	*253*	*191*	*211*	*151*	*186*	*131*	*186*	*82*	*159*	*146*	*236*	*235*	*223*	*193*	*193*	*193*	*173*	*191*	*177*	*222*	*213*	*222*	*188*	*187*	*170*	*6,456*
Tri-Valley Golf	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*17*	*23*	*16*	*23*	*23*	*13*	*21*	*22*	*30*	*25*	*15*	*30*	*16*	*22*	*27*	*28*	*28*	*20*	*21*	*11*	*420*
Agricultural Pumpage[2]	**3,744**	**2,217**	**4,596**	**4,970**	**3,191**	**3,711**	**2,628**	**2,433**	**1,295**	**1,342**	**1,556**	**1,914**	**1,911**	**1,470**	**1,476**	**1,166**	**1,360**	**556**	**355**	**213**	**218**	**150**	**212**	**266**	**80**	**88**	**239**	**235**	**127**	**101**	**100**	**96**	**96**	**95**	**104**	**103**	**102**	**93**	**1,174**	**44,608**
SFWD	500	0	62	304	252	365	168	513	150	549	107	410	543	663	493	359	430	194	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	160	6,071
Concannon	6	15	20	20	20	70	250	112	0	0	68	0	60	26	59	0	0	11	0	0	0	0	0	0	0	0	140	143	25	0	2	0	0	0	0	0	0	0	28	1,047
Calculated	3,238	2,202	4,514	4,646	2,919	3,276	2,210	1,808	1,145	793	1,381	1,504	1,308	781	924	807	930	351	346	213	218	150	212	266	80	88	99	91	102	101	99	96	96	95	104	103	102	93	987	37,490
Mining Use[2]	**3,068**	**3,831**	**3,054**	**2,945**	**2,658**	**3,751**	**5,586**	**9,005**	**7,613**	**13,953**	**7,481**	**7,402**	**11,387**	**4,353**	**5,869**	**4,484**	**3,312**	**3,367**	**3,551**	**4,210**	**8,786**	**11,120**	**13,381**	**15,724**	**14,255**	**13,416**	**11,310**	**9,706**	**4,295**	**3,853**	**5,067**	**4,645**	**4,633**	**5,804**	**5,542**	**6,275**	**5,161**	**6,882**	**6,861**	**260,735**
Stream Export	1,219	2,200	690	470	800	2,000	3,480	6,530	6,050	12,760	4,340	4,265	8,858	558	2,443	1,808	665	639	712	2,219	6,070	9,071	10,577	12,661	12,617	10,082	7,827	5,461	143	0	163	150	487	594	523	1,493	1,996	4,277	3,866	146,897
Evaporation	1,149	931	1,664	1,775	1,158	1,051	1,406	1,775	863	493	2,441	2,437	1,829	3,095	2,726	1,976	1,947	2,028	2,139	1,291	2,016	1,349	2,104	2,363	938	2,634	2,783	3,545	3,682	3,303	4,218	3,795	3,446	4,510	4,319	4,082	2,465	1,905	2,306	87,632
Production	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	470	550	686	700	700	700	700	700	700	700	690	26,206
Subsurface Basin Overflow[1]	**0**	**0**	**0**	**0**	**0**	**150**	**530**	**550**	**2,160**	**2,960**	**2,240**	**1,200**	**600**	**600**	**400**	**100**	**0**	**0**	**0**	**0**	**0**	**200**	**766**	**760**	**750**	**362**	**125**	**0**	**0**	**0**	**0**	**0**	**0**	**921**	**1,205**	**194**	**0**	**0**	**441**	**16,773**
NET RECHARGE (AF)	**-509**	**5,471**	**-4,355**	**-6,004**	**11,882**	**6,324**	**8,021**	**-623**	**11,484**	**9,068**	**-4,342**	**-9,877**	**-1,853**	**-8,090**	**-9,306**	**-5,190**	**-5,776**	**-8,744**	**-6,870**	**14,782**	**313**	**12,735**	**1,529**	**-1,755**	**3,294**	**-3,688**	**-2,930**	**-10,557**	**1,752**	**11,253**	**-4,185**	**14,588**	**9,485**	**-5,093**	**-3,886**	**-5,630**	**4,613**	**4,909**	**585**	**22,242**
INVENTORY STORAGE (AF)	**211,491**	**216,962**	**212,607**	**206,603**	**218,485**	**224,809**	**232,830**	**232,207**	**243,691**	**252,759**	**248,417**	**238,540**	**236,687**	**228,597**	**219,291**	**214,101**	**208,325**	**199,581**	**192,711**	**207,493**	**207,806**	**220,541**	**222,070**	**220,315**	**223,609**	**219,921**	**216,991**	**206,434**	**208,186**	**219,439**	**215,254**	**229,842**	**239,327**	**234,234**	**230,348**	**224,718**	**229,331**	**234,240**	**222,337**	

[1] Sustainable Yield - Natural Recharge

[2] Sustainable Yield - Demand Components

STORAGE CALCULATION	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
INVENTORY (Rounded to TAF)	211	217	213	207	218	225	233	232	244	253	248	239	237	229	219	214	208	200	193	207	208	221	222	220	224	220	217	206	208	219	215	230	239	234	230	225	229	234
GW ELEVATIONS (Rounded to TAF)	213	215	226	216	210	228	239	246	241	254	258	250	240	231	217	214	210	195	182	207	214	224	222	221	224	220	220	202	210	219	212	234	236	230	230	233	234	235
AVERAGE STORAGE (TAF)	**212**	**216**	**219**	**211**	**214**	**226**	**236**	**239**	**243**	**254**	**253**	**244**	**239**	**230**	**218**	**214**	**209**	**198**	**187**	**207**	**211**	**222**	**222**	**220**	**224**	**220**	**219**	**204**	**209**	**219**	**213**	**232**	**237**	**232**	**230**	**229**	**231**	**235**
AVAILABLE STORAGE (TAF)	**84**	**88**	**91**	**83**	**86**	**98**	**108**	**111**	**115**	**126**	**125**	**116**	**111**	**102**	**90**	**86**	**81**	**70**	**59**	**79**	**83**	**94**	**94**	**92**	**96**	**92**	**91**	**76**	**81**	**91**	**85**	**104**	**109**	**104**	**102**	**101**	**103**	**107**

Table 4.3-1
Main Basin Salt Loading Calculations
2011 Water Year

INFLOW COMPONENTS	SURFACE WATER			RECHARGED WATER			SALT LOAD
	Volume Applied (AF)	TDS Conc (mg/L)	% Recharged	Volume Recharged (AF)	TDS Conc (mg/L)	Salt Load (Tons)	(Tons per TAF of Rch)
NATURAL STREAM RECHARGE	**48,732**	**480**	**15%**	**7,441**	**480**	**4,939**	**660**
Arroyo Valle	**24,303**	**227**	**12%**	**2,914**	**227**	**983**	**340**
Flood releases recharge	12,879	175	5%	633	175	150	240
Natural inflow (above AVNL)	279	765	30%	84	765	87	1,040
Natural inflow (below AVNL)	11,145	250	20%	2,197	250	746	340
Arroyo Mocho	8,248	660	36%	**3,008**	**660**	**2,697**	**900**
Arroyo Las Positas	16,181	610	9%	**1,519**	**610**	**1,259**	**830**
ARROYO VALLE PRIOR RIGHTS	**28,634**	**160**	**6%**	**1,768**	**160**	**384**	**220**
ARTIFICIAL STREAM RECHARGE	**9,139**	**141**	**53%**	**4,806**	**141**	**920**	**190**
Arroyo Valle	3,905	160	20%	**768**	**160**	**167**	**220**
Arroyo Mocho	4,113	140	89%	**3,671**	**140**	**698**	**190**
Arroyo Las Positas	1,121	110	33%	**367**	**110**	**55**	**150**
INJECTION WELL RECHARGE	**0**	**0**	**0%**	**0**	**0**	**0**	**0**
RAINFALL RECHARGE	**211,713**	**0**	**4%**	**8,104**	**0**	**0**	**0**
APPLIED WATER RECHARGE	**12,646**	**266**	**17%**	**2,195**	**1,531**	**4,563**	**2,080**
Urban - Municipal	8,941	249	20%	1,788	1,247	3,029	1,690
Urban - Recycled Water	665	600	20%	133	3,001	542	4,080
Agricultural - Municipal (SBA)	2,259	159	5%	120	2,981	487	4,050
Agricultural - Groundwater	93	583	17%	16	3,434	74	4,680
Golf Courses - Groundwater	390	355	20%	78	1,777	188	2,410
Golf Courses - Recycled Water	298	600	20%	59	3,015	243	4,100
SUBSURFACE BASIN INFLOW				**1,000**	**1,490**	**2,024**	**2,020**
TOTAL INFLOW				**25,314**	**371**	**12,830**	**510**

OUTFLOW COMPONENTS	WATER EXTRACTED			SALT REMOVED
	Volume Removed (AF)	TDS Conc (mg/L)	Salt Removed (Tons)	(Tons/TAF of Export)
MUNICIPAL PUMPAGE	**13,430**	**546**	**9,960**	**740**
Zone 7 Wells - Hop, Stone, COL	**1,899**	**468**	**1,207**	**640**
Zone 7 Wells - Mocho	**4,366**	**681**	**4,040**	**930**
Demin Salts Exported from Valley (subset of Zone 7 - Mocho)	*429*	*3,445*	*2,006*	*4680*
Other	**7,165**	**484**	**4,713**	**660**
AGRICULTURAL PUMPAGE (all salt is reapplied)	**93**	**583**	**74**	**800**
MINING USE	**6,882**	**295**	**2,756**	**400**
Stream Export	4,277	408	2,368	550
Evaporation	1,905	0	0	0
Processing Losses	700	408	388	550
GROUNDWATER BASIN OVERFLOW	**0**	**510**	**0**	**0**
TOTAL OUTFLOW	**20,404**	**461**	**12,790**	**630**

NET RECHARGE IN 2011 WY (acre-feet)	**4,909**
NET SALT LOADING IN 2011 WY (tons)	**40**

Table 4.3-2
Zone 7 Water Agency
Historical Salt Loading (in tons)
1974 to 2011 Water Years

SALT INFLOW COMPONENTS YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
NATURAL STREAM RECHARGE	**3,210**	**3,464**	**874**	**581**	**4,638**	**1,723**	**2,706**	**1,513**	**4,803**	**7,657**	**5,286**	**3,058**	**4,941**	**2,852**	**2,610**	**2,782**	**2,480**	**3,356**	**3,665**	**5,743**	**2,544**	**4,376**	**4,331**
Total Arroyo Valle	**1,018**	**1,041**	**391**	**315**	**957**	**707**	**777**	**579**	**1,048**	**1,433**	**936**	**375**	**779**	**232**	**372**	**187**	**206**	**575**	**743**	**1,083**	**300**	**1,034**	**400**
Flood releases recharge	100	344	0	0	216	0	128	0	271	624	20	0	415	0	0	0	0	98	0	528	0	472	336
Non Flood Natural Inflow	918	697	391	315	741	707	649	579	777	809	916	375	364	232	372	187	206	477	743	555	300	562	64
Arroyo Mocho	**1,717**	**2,043**	**293**	**76**	**3,206**	**636**	**1,358**	**478**	**2,614**	**4,626**	**2,508**	**932**	**2,269**	**458**	**490**	**440**	**233**	**1,023**	**814**	**2,174**	**995**	**1,580**	**2,627**
Arroyo Las Positas	**475**	**380**	**190**	**190**	**475**	**380**	**571**	**456**	**1,141**	**1,598**	**1,842**	**1,751**	**1,893**	**2,162**	**1,748**	**2,155**	**2,041**	**1,758**	**2,108**	**2,486**	**1,249**	**1,762**	**1,304**
AV PRIOR RIGHTS	**361**	**418**	**31**	**0**	**494**	**267**	**386**	**251**	**502**	**381**	**236**	**328**	**286**	**283**	**325**	**356**	**125**	**290**	**151**	**276**	**321**	**306**	**87**
ARTIFICIAL STREAM RECHARGE	**986**	**2,201**	**1,914**	**2,289**	**3,286**	**3,699**	**2,897**	**3,238**	**1,617**	**184**	**0**	**0**	**0**	**0**	**525**	**1,585**	**1,809**	**1,590**	**410**	**1,953**	**2,795**	**1,026**	**491**
Arroyo Valle	293	1,174	509	883	1,427	1,599	1,234	1,719	663	0	0	0	0	0	0	51	132	36	185	385	293	49	31
Arroyo Mocho	340	497	875	876	1,350	1,570	1,432	1,394	894	184	0	0	0	0	525	1,534	1,677	1,554	225	1,568	2,502	977	460
Arroyo Las Positas	353	530	530	530	509	530	231	125	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INJECTION WELL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
RAINFALL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
APPLIED WATER RECHARGE	**7,670**	**7,218**	**9,123**	**10,675**	**8,352**	**8,304**	**7,175**	**5,507**	**4,709**	**4,723**	**5,046**	**5,938**	**6,632**	**5,558**	**6,834**	**6,015**	**6,541**	**6,918**	**5,793**	**5,109**	**4,989**	**3,323**	**4,071**
Urban - Municipal	3,359	3,508	3,457	4,607	3,858	3,434	3,115	3,035	3,076	3,064	3,183	3,592	4,100	3,810	4,791	4,498	4,850	6,023	4,884	4,370	4,221	2,700	3,207
Urban - Recycled Water	1,815	1,930	2,232	1,937	1,928	2,119	1,966	400	322	375	410	413	386	316	402	334	339	162	368	363	392	352	460
Agricultural - Municipal (SBA)	202	304	437	890	485	331	416	519	427	332	438	512	718	434	598	367	445	370	311	234	246	183	274
Agricultural - Groundwater	2,294	1,476	2,997	3,241	2,081	2,420	1,678	1,553	884	952	1,015	1,421	1,428	998	1,043	816	907	363	230	142	130	88	130
Golf Courses - Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golf Courses - Recycled Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUBSURFACE BASIN INFLOW	**2,038**	**2,038**	**2,058**	**3,648**	**2,506**	**2,017**	**1,325**	**1,284**	**1,284**	**876**	**1,325**	**1,528**	**1,508**	**1,569**	**1,875**	**2,364**	**2,568**	**3,423**	**3,199**	**2,710**	**2,221**	**2,017**	**1,875**
	14,265	**15,339**	**14,000**	**17,193**	**19,276**	**16,010**	**14,489**	**11,793**	**12,915**	**13,821**	**11,893**	**10,852**	**13,367**	**10,262**	**12,169**	**13,102**	**13,523**	**15,577**	**13,218**	**15,791**	**12,870**	**11,048**	**10,855**

OUTFLOW COMPONENTS YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
MUNICIPAL PUMPAGE	**-7,217**	**-6,577**	**-5,074**	**-4,382**	**-4,579**	**-5,351**	**-4,458**	**-4,700**	**-4,748**	**-5,410**	**-5,525**	**-5,752**	**-6,465**	**-5,537**	**-6,662**	**-6,918**	**-7,166**	**-11,272**	**-8,858**	**-6,017**	**-3,870**	**-2,667**	**-3,877**
Zone 7 Wells - Hop, Stone, COL	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-57**	**-442**	**-1,981**	**-1,308**	**-866**	**-103**	**-90**	**-757**
Zone 7 Wells - Mocho	**-3,303**	**-2,057**	**-842**	**-201**	**-506**	**-532**	**-26**	**0**	**0**	**-17**	**-227**	**-863**	**-869**	**-326**	**-1,425**	**-2,082**	**-1,683**	**-3,313**	**-2,111**	**-609**	**-24**	**-125**	**-767**
Demin Salts Exported from Valley	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Pumpage	**-3,914**	**-4,520**	**-4,232**	**-4,181**	**-4,073**	**-4,819**	**-4,432**	**-4,700**	**-4,748**	**-5,393**	**-5,298**	**-4,889**	**-5,595**	**-5,211**	**-5,237**	**-4,779**	**-5,042**	**-5,978**	**-5,439**	**-4,542**	**-3,743**	**-2,453**	**-2,353**
AGRICULTURAL PUMPAGE	**-2,289**	**-1,476**	**-2,997**	**-3,241**	**-2,081**	**-2,420**	**-1,678**	**-1,553**	**-844**	**-912**	**-1,015**	**-1,378**	**-1,428**	**-998**	**-1,043**	**-776**	**-868**	**-363**	**-236**	**-142**	**-130**	**-88**	**-130**
MINING USE	**-1,126**	**-1,725**	**-802**	**-668**	**-869**	**-1,603**	**-2,508**	**-4,372**	**-4,161**	**-7,834**	**-2,857**	**-2,814**	**-6,011**	**-839**	**-2,301**	**-1,728**	**-918**	**-970**	**-1,007**	**-2,134**	**-4,928**	**-6,883**	**-7,507**
Stream Export	-745	-1,345	-422	-287	-489	-1,223	-2,127	-3,992	-3,781	-7,454	-2,476	-2,433	-5,535	-364	-1,825	-1,253	-443	-495	-532	-1,658	-4,453	-6,408	-7,041
Evaporation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Processing Losses	-380	-380	-380	-380	-380	-380	-380	-380	-380	-380	-380	-380	-475	-475	-475	-475	-475	-475	-475	-475	-475	-475	-466
GROUNDWATER BASIN OVERFLOW	**0**	**0**	**0**	**0**	**-173**	**-612**	**-635**	**-2,494**	**-3,418**	**-2,587**	**-1,386**	**-693**	**-693**	**-462**	**-122**	**0**	**0**	**0**	**0**	**-226**	**-968**
	-10,632	**-9,778**	**-8,873**	**-8,291**	**-7,529**	**-9,547**	**-9,256**	**-11,260**	**-12,247**	**-17,574**	**-11,984**	**-11,330**	**-14,597**	**-8,067**	**-10,468**	**-9,544**	**-8,952**	**-12,605**	**-10,101**	**-8,293**	**-8,928**	**-9,864**	**-12,482**

NET SALT INFLOW (Tons)	**3,633**	**5,561**	**5,127**	**8,902**	**11,747**	**6,463**	**5,233**	**533**	**668**	**-3,753**	**-91**	**-478**	**-1,230**	**2,195**	**1,701**	**3,558**	**4,571**	**2,972**	**3,117**	**7,498**	**3,942**	**1,184**	**-1,627**
CUMULATIVE SALT INFLOW (Tons)*	**3,633**	**9,194**	**14,321**	**23,223**	**34,970**	**41,433**	**46,666**	**47,199**	**47,867**	**44,114**	**44,023**	**43,545**	**42,315**	**44,510**	**46,211**	**49,769**	**54,340**	**57,312**	**60,429**	**67,927**	**71,869**	**73,053**	**71,426**

TDS Concentration Calculations	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Net Basin Recharge (AF)		-509	5,471	-4,355	-6,004	11,882	6,324	8,021	-623	11,484	9,068	-4,342	-9,877	-1,853	-8,090	-9,306	-5,190	-5,776	-8,744	-6,870	14,782	313	12,735	1,529
Basin Storage (HI Method)(AF)	212,000	211,491	216,962	212,607	206,603	218,485	224,809	232,830	232,207	243,691	252,759	248,417	238,540	236,687	228,597	219,291	214,101	208,325	199,581	192,711	207,493	207,806	220,541	222,070
Total Salt in Main Basin (tons)	129,598	133,231	138,792	143,919	152,821	164,568	171,031	176,264	176,797	177,465	173,712	173,621	173,143	171,913	174,108	175,809	179,367	183,938	186,910	190,027	197,525	201,467	202,651	201,024
Main Basin TDS Concentration (mg/L)	450	464	471	498	544	554	560	557	560	536	506	514	534	535	561	590	617	650	689	726	701	714	676	666
Cumulative Increase in TDS Conc (mg/L)**		**14**	**21**	**48**	**94**	**104**	**110**	**107**	**110**	**86**	**56**	**64**	**84**	**85**	**111**	**140**	**167**	**200**	**239**	**276**	**251**	**264**	**226**	**216**

* Basinwide salt buildup since 1973

** Basinwide TDS concentration increase relative to 1973 value of 450 mg/L

Table 4.3-2
Zone 7 Water Agency
Historical Salt Loading (in tons)
1974 to 2011 Water Years

SALT INFLOW COMPONENTS YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	AVG	TOTAL
NATURAL STREAM RECHARGE	**4,639**	**5,704**	**3,727**	**3,409**	**3,856**	**3,615**	**7,745**	**3,527**	**6,375**	**5,528**	**2,195**	**3,647**	**4,169**	**5,024**	**4,939**	**3,876**	**147,292**
Total Arroyo Valle	**1,450**	**1,661**	**1,361**	**956**	**1,823**	**1,399**	**2,833**	**1,081**	**3,652**	**2,274**	**493**	**1,781**	**1,902**	**2,318**	**983**	**1,091**	**41,455**
Flood releases recharge	183	524	0	55	0	193	302	0	731	0	0	327	0	1,383	150	195	7,400
Non Flood Natural Inflow	1,267	1,137	1,361	901	1,823	1,206	2,531	1,081	2,921	2,274	493	1,454	1,902	935	833	896	34,055
Arroyo Mocho	**1,741**	**2,292**	**996**	**857**	**575**	**886**	**2,996**	**838**	**1,241**	**1,813**	**531**	**504**	**456**	**826**	**2,697**	**1,391**	**52,839**
Arroyo Las Positas	**1,448**	**1,751**	**1,370**	**1,596**	**1,458**	**1,330**	**1,916**	**1,608**	**1,482**	**1,441**	**1,171**	**1,362**	**1,811**	**1,880**	**1,259**	**1,395**	**52,998**
AV PRIOR RIGHTS	**93**	**188**	**149**	**175**	**224**	**399**	**416**	**383**	**80**	**524**	**219**	**100**	**407**	**0**	**384**	**268**	**10,202**
ARTIFICIAL STREAM RECHARGE	**1,325**	**500**	**1,352**	**2,276**	**1,351**	**3,503**	**2,811**	**2,480**	**1,970**	**1,271**	**1,359**	**727**	**1,248**	**1,690**	**920**	**1,560**	**59,278**
Arroyo Valle	472	107	321	242	501	647	399	476	619	330	782	727	686	635	167	468	17,774
Arroyo Mocho	853	393	1,031	2,034	839	2,855	2,412	2,004	1,300	914	577	0	562	1,055	698	999	37,961
Arroyo Las Positas	0	0	0	0	11	1	0	0	51	27	0	0	0	0	55	93	3,543
INJECTION WELL RECHARGE	**0**	**0**	**497**	**498**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**26**	**995**
RAINFALL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
APPLIED WATER RECHARGE	**4,887**	**4,367**	**3,702**	**4,601**	**5,348**	**5,947**	**4,893**	**5,360**	**5,078**	**3,474**	**5,381**	**6,724**	**6,550**	**5,405**	**4,563**	**5,855**	**222,503**
Urban - Municipal	3,927	3,744	2,732	3,356	4,058	4,385	3,736	4,056	3,972	2,420	4,199	5,044	4,897	3,843	3,029	3,846	146,140
Urban - Recycled Water	385	274	40	83	79	136	44	60	40	107	96	30	202	327	542	583	22,166
Agricultural - Municipal (SBA)	420	280	491	616	628	772	600	613	595	505	465	960	843	655	487	484	18,403
Agricultural - Groundwater	155	69	50	79	72	78	80	84	62	62	62	67	67	66	74	774	29,414
Golf Courses - Groundwater	0	0	168	204	227	243	230	231	256	140	270	311	284	265	188	79	3,017
Golf Courses - Recycled Water	0	0	221	263	284	333	203	316	153	240	289	312	257	249	243	89	3,363
Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
SUBSURFACE BASIN INFLOW	**1,386**	**1,651**	**1,528**	**1,846**	**1,970**	**1,970**	**1,970**	**1,970**	**2,513**	**2,309**	**2,174**	**2,214**	**2,106**	**1,997**	**2,024**	**2,023**	**76,884**
	12,330	**12,410**	**10,955**	**12,805**	**12,749**	**15,434**	**17,835**	**13,720**	**16,016**	**13,106**	**11,328**	**13,412**	**14,480**	**14,116**	**12,830**	**13,609**	**517,154**

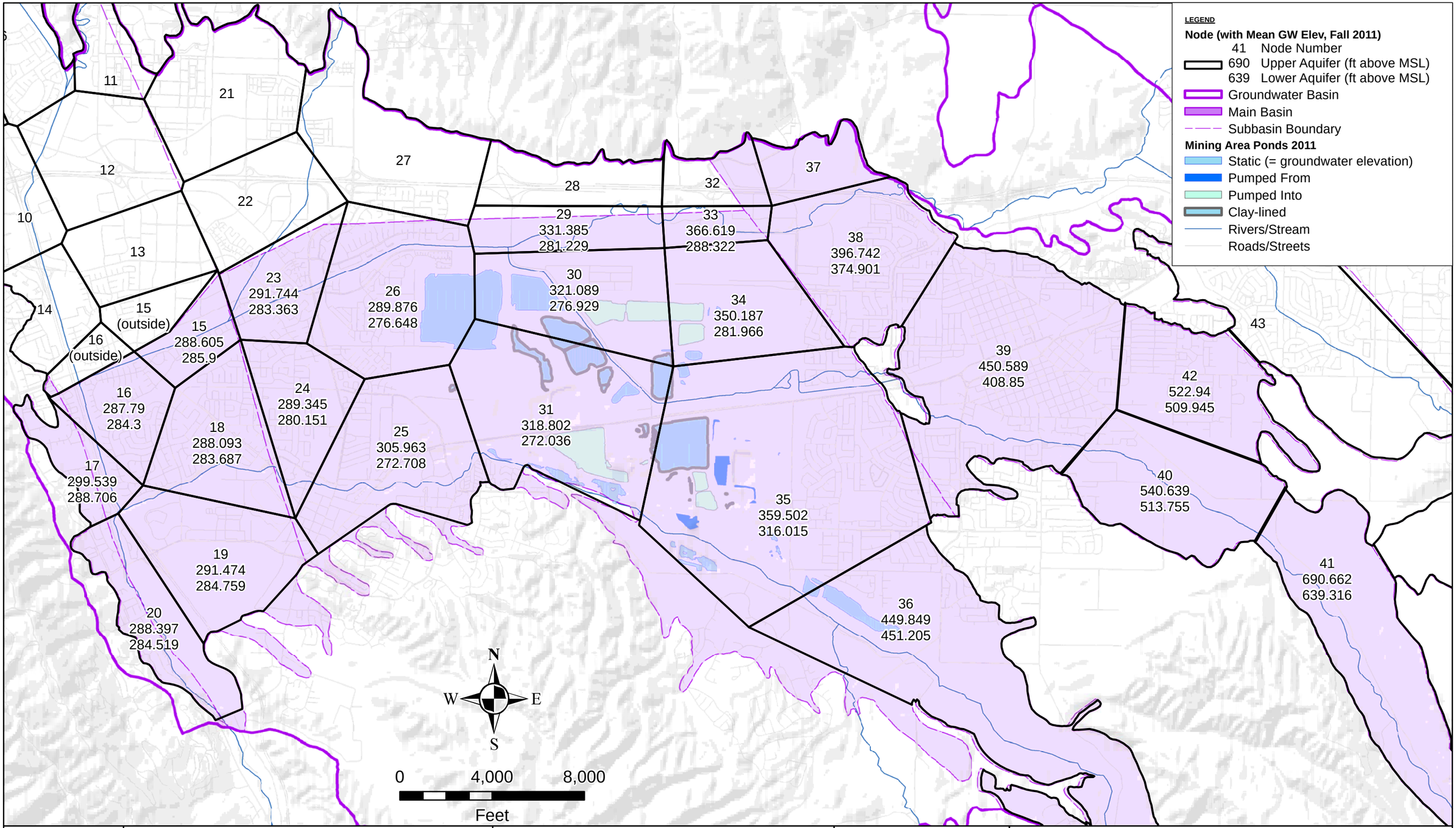
OUTFLOW COMPONENTS YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	AVERAGE	TOTAL
MUNICIPAL PUMPAGE	**-5,197**	**-6,510**	**-6,108**	**-8,561**	**-10,617**	**-12,103**	**-11,156**	**-12,488**	**-10,091**	**-5,573**	**-8,441**	**-9,279**	**-14,626**	**-12,613**	**-9,961**	**-9,993**	**-246,131**
Zone 7 Wells - Hop, Stone, COL	**-275**	**-517**	**-2,368**	**-2,553**	**-4,018**	**-3,732**	**-3,420**	**-4,266**	**-1,893**	**-1,398**	**-1,357**	**-3,226**	**-3,969**	**-1,294**	**-1,207**	**-2,633**	**-34,234**
Zone 7 Wells - Mocho	**-682**	**-397**	**-167**	**-783**	**-1,745**	**-3,322**	**-2,271**	**-3,762**	**-3,003**	**-1,170**	**-1,976**	**-1,402**	**-5,448**	**-6,563**	**-4,040**	**-2,710**	**-35,231**
Demin Salts Exported from Valley	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*-798*	*-2,760*	*-2,006*	*-146*	*-5,564*
Other Pumpage	**-4,240**	**-5,596**	**-3,572**	**-5,224**	**-4,855**	**-5,049**	**-5,465**	**-4,459**	**-5,196**	**-3,005**	**-5,107**	**-4,651**	**-5,208**	**-4,756**	**-4,713**	**-4,649**	**-176,666**
AGRICULTURAL PUMPAGE	**-155**	**-51**	**-50**	**-195**	**-188**	**-100**	**-80**	**-86**	**-87**	**-50**	**-46**	**-73**	**-74**	**-79**	**-74**	**-776**	**-29,475**
MINING USE	**-9,983**	**-9,588**	**-8,642**	**-5,792**	**-4,520**	**-475**	**-276**	**-438**	**-94**	**-218**	**-274**	**-714**	**-1,341**	**-1,428**	**-2,756**	**-2,976**	**-113,095**
Stream Export	-9,460	-9,084	-8,081	-5,316	-4,006	-111	0	-84	-94	-218	-274	-305	-913	-1,057	-2,368	-2,583	-98,152
Evaporation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Processing Losses	-523	-504	-561	-475	-514	-364	-276	-354	0	0	0	-409	-428	-371	-388	-393	-14,943
GROUNDWATER BASIN OVERFLOW	**-960**	**-998**	**-482**	**-175**	**0**	**0**	**0**	**0**	**0**	**0**	**-738**	**-1,080**	**-171**	**0**	**0**	**-502**	**-19,073**
	-16,295	**-17,147**	**-15,282**	**-14,723**	**-15,325**	**-12,678**	**-11,512**	**-13,012**	**-10,272**	**-5,841**	**-9,499**	**-11,146**	**-16,212**	**-14,120**	**-12,791**	**-11,528**	**-438,057**

NET SALT INFLOW (Tons)	**-3,965**	**-4,737**	**-4,327**	**-1,918**	**-2,576**	**2,756**	**6,323**	**708**	**5,744**	**7,265**	**1,829**	**2,266**	**-1,732**	**-4**	**39**	**2,082**	**79,097**
CUMULATIVE SALT INFLOW (Tons)*	**67,461**	**62,724**	**58,397**	**56,479**	**53,903**	**56,659**	**62,982**	**63,690**	**69,434**	**76,699**	**78,528**	**80,794**	**79,062**	**79,058**	**79,097**		

TDS Concentration Calculations	1973	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Net Basin Recharge (AF)		-1,755	3,294	-3,688	-2,930	-10,557	1,752	11,253	-4,185	14,588	9,485	-5,093	-3,886	-5,630	4,613	4,909
Basin Storage (HI Method)(AF)	212,000	220,315	223,609	219,921	216,991	206,434	208,186	219,439	215,254	229,842	239,327	234,234	230,348	224,718	229,331	234,240
Total Salt in Main Basin (tons)	129,598	197,059	192,322	187,995	186,077	183,501	186,257	192,580	193,288	199,032	206,297	208,126	210,392	208,660	208,656	208,695
Main Basin TDS Concentration (mg/L)	450	658	633	629	631	654	659	646	661	637	635	654	672	684	670	656
Cumulative Increase in TDS Conc (mg/L)**		**208**	**183**	**179**	**181**	**204**	**209**	**196**	**211**	**187**	**185**	**204**	**222**	**234**	**220**	**206**

* Basinwide salt buildup since 1973

** Basinwide TDS concentration increase relative to 1973 value of 450 mg/L



ZONE 7 WATER AGENCY 100 North Canyons Parkway Livermore, CA	DRAWN: TR	SCALE: 1 in = 4,000 ft	**Figure 4.2-1** **Mean Groundwater Elevation By Node** **Upper and Lower Aquifers, Fall 2011** **Storage - Groundwater Elevation Method**
	REVIEWED: TR	DATE: May 28, 2012	
	FILE: E:\MONITOR\GWStorage\2011wy\Fig4.2-1-NodalGWE11.mxd		

Figure 4.2-2
Graphs of Historical Main Basin Hydrologic Inventory
1974 to 2011 Water Years

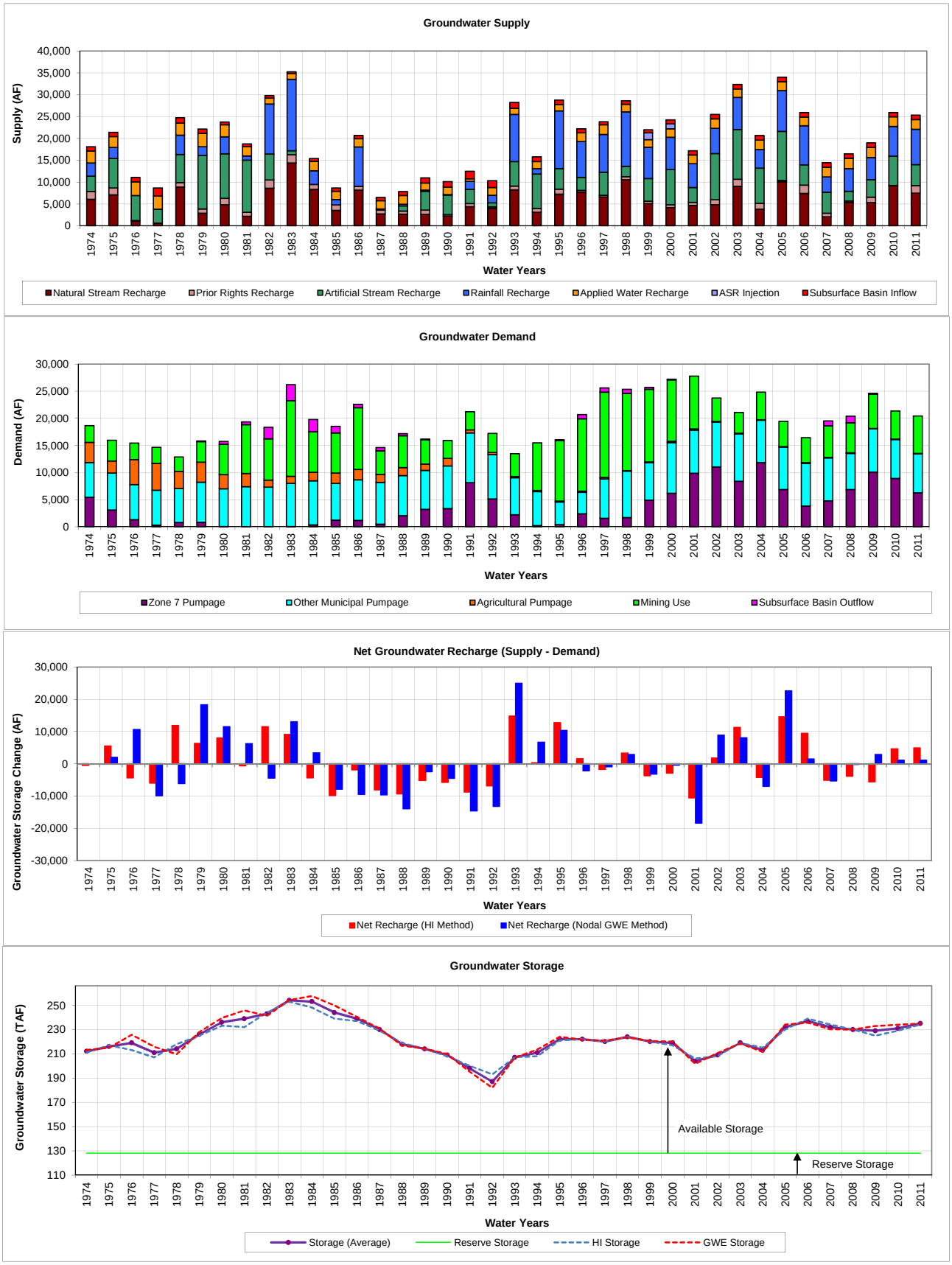


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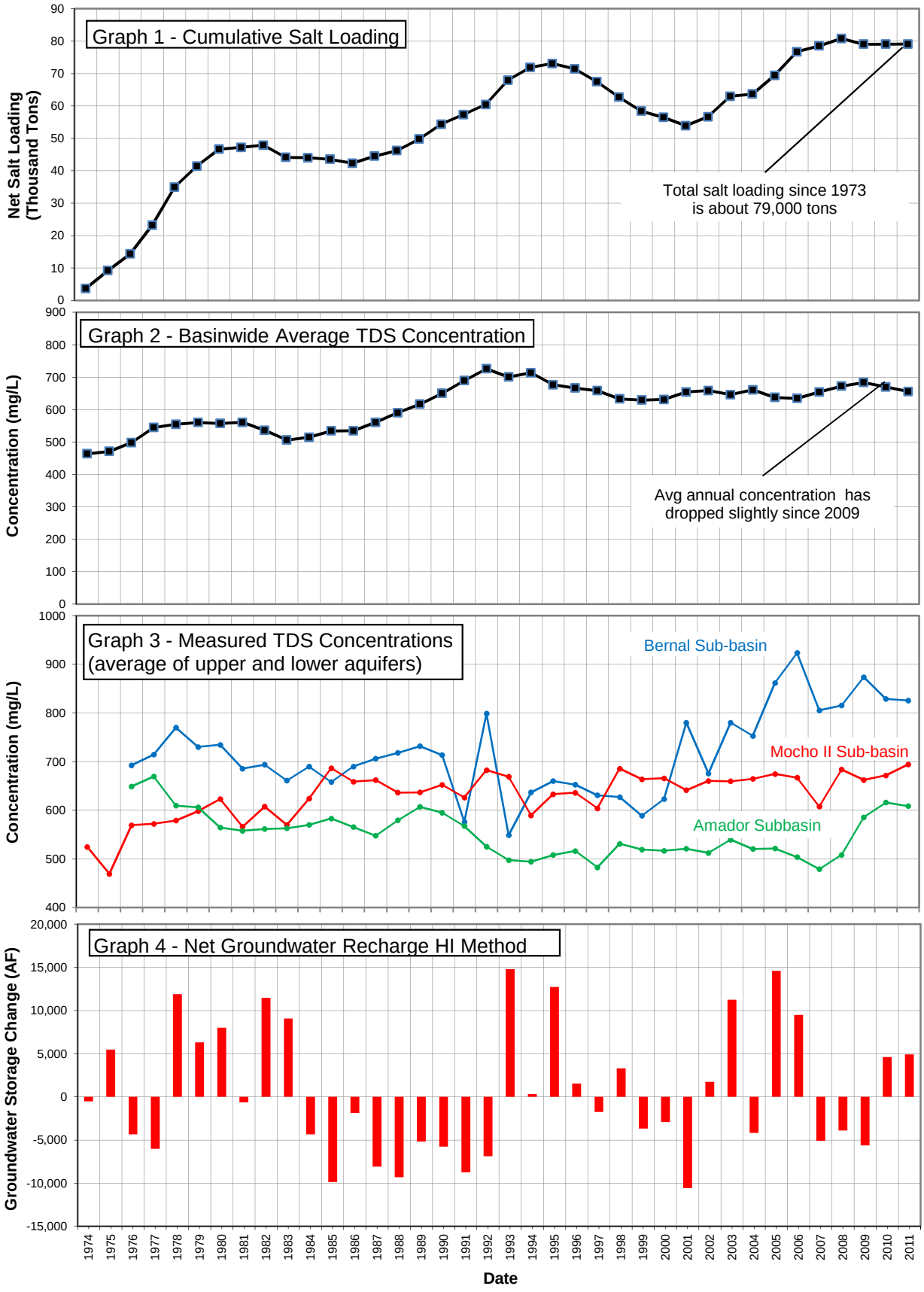
Figure 4.3-1
Graphs of Salt Loading and Salt Concentrations
1974-2011 Water Years



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6/25/2012