10 Groundwater Storage Management for Sustainability

10.1 Groundwater Storage Calculation Methods

This section describes how Zone 7 calculates groundwater storage for the Main Basin and presents the groundwater storage estimate at the end of the 2014 WY (October 1, 2013 through September 30, 2014).

Groundwater Storage is the approximate amount of water stored in the Main Basin at the end of the water year. Zone 7 quantifies the total groundwater storage (Average Storage) by averaging the values computed by two independent methods:

- Groundwater Elevation (GWE)
- Hydrologic Inventory (HI)

Results and details for the two methods are presented in the following two sections: *Sections 10.2* and *10.3*, respectively. Operational or "Available" Storage, which is the approximate amount of water in storage available for production above the historical low groundwater surface, is calculated by subtracting the historical low storage value (128 thousand acre-feet [TAF]) from the current average total storage value.

The two groundwater storage calculation methods tended to give results that were relatively close in value until about the 2000 WY; they then began to diverge, with the GWE method resulting in values that were consistently higher than the HI method. Since the HI method is based on a running total, the difference between the two methods grew as time advanced beyond 2000. Starting in the 2008 WY, Zone 7 revisited the calculations and has since implemented refinements to both methods that are believed to increase their accuracies. Specifically, for the GWE method, each node was divided into an upper and lower aquifer, and better attention is paid to whether the aquifer is confined or unconfined when calculating the storage for each node. Also, the average water levels for each node are now determined using the groundwater elevation map and *ArcGIS Spatial Analyst*. For the HI method, the areal recharge model was improved and now runs with daily time-steps. The HI method now also includes estimated recharge from leaking water and sewer pipelines, which currently adds approximately 1 TAF per year to the HI total.

The improvements have resulted in the year-to-year storage from the two methods agreeing much more closely; with the exception of the 2005 and 2009 WYs (*Section 10.3*: *Figure 10-7* and *Figure 10-8*). The difference in each of these two years is about 10 TAF, and the total difference between the two methods is about 25 TAF apart at the end of the 2014 WY. Staff is continuing to investigate if there is any relationship between these three years (e.g., rainfall,

evaporation, groundwater pumping) that may be leading the GWE method to overestimate or the HI Method to underestimate the actual storage.

10.2 Groundwater Elevation Method

In the GWE method of calculating groundwater storage, the Main Basin is divided into polygonal areas referred to as nodes (*Figure 10-1*). Each node has its own set of hydrogeologic parameters, such as storage coefficient, nodal thickness, and nodal area (*Figure 10-2*). 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.

GWE storage calculations before 1992 were calculated assuming a constant storage coefficient for the entire node. *Figure 10-3* shows GWE groundwater elevations and storage volumes for the 1963 WY to the 1991 WY. *Figure 10-4* shows the groundwater elevations and storage volumes for water years 1992 to 2014 using the newer GWE method. *Figure 10-1* shows the upper and lower aquifer groundwater elevations used to calculate the GWE method storage for the 2014 WY and includes the mean groundwater elevations for each node, calculated using *ArcGIS Spatial Analyst*.

The GWE method resulted in a calculated drop of total storage of about 8 TAF, from 221 TAF at the end of the 2013 WY to 213 TAF at the end of the 2014 WY.

10.3 Hydrologic Inventory Method

10.3.1 Overview

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 to (or subtracted from) the previous year's ending storage value to arrive at the current year's ending storage value. The calculations assumed 212 TAF of storage at the beginning of the 1974 WY (from *DWR, 1974*). The groundwater supply and demand components of the hydrologic inventory are shown in *Figure 10-A* below:

Figure 10-A: Groundwater Supply and Demand Components

SUPPLIES	DEMANDS
Stream Recharge *(10.3.2.1)*	**Municipal Pumping** • Zone 7 *(10.3.3.1)* • By Others *(10.3.3.2)*
Rainfall Recharge *(10.3.2.2)*	
Applied Water Recharge *(10.3.2.2)*	
Subsurface Groundwater Inflow *(10.3.2.3)*	**Agricultural Pumping** *(10.3.3.2)*
Pipe Leakage *(10.3.2.4)*	**Mining Use** *(10.3.3.3)*
	Groundwater Basin Overflow *(10.3.2.3)*

Numbers in Parentheses are Section Numbers with additional details

The supply and demand components, described in more detail in the sub-sections below, are taken directly from the monitoring program results or calculated using the results of a monitoring program. The results of the HI method for the 2014 WY are shown in *Figure 10-5* and *Figure 10-6*. Historical HI method results from water years 1974 to 2014 are shown on *Figure 10-7* and *Figure 10-8*.

The HI method resulted in a calculated drop of total storage of about 12 TAF, from 200 TAF at the end of the 2013 WY to 188 TAF at the end of the 2014 WY versus the 8 TAF drop calculated using the GWE method (see *Section 10.2*). A possible explanation for this difference is more induced subsurface inflow. This is caused by the decreased water levels in the Main Basin which creates an increased differential head between the fringe and Main Basin.

10.3.2 Supply Components

10.3.2.1 Stream Recharge

Stream recharge is broken down into the following three components:

- **Natural stream recharge** - rain runoff into the streams, including both urban and rural runoff from the watershed, which naturally recharges the basin's aquifers through the streambeds.

- **Artificial stream recharge** – Zone 7-contracted SWP water released from the SBA or from Lake Del Valle (both operated by DWR) into the arroyos for the purpose of augmenting the natural stream recharge, maintaining habitat along Arroyo del Valle, or as an alternate method of delivering water to ACWD.

- **Arroyo Valle Prior Rights recharge** – SWP or local water released from the SBA or Lake Del Valle to generate the recharge along Arroyo del Valle that would have occurred if Lake Del Valle had not been constructed. This is only required when Zone 7 and ACWD have local water stored in the lake.

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 along which recharge occurs. Recharge typically is calculated as the difference between upstream inflows and downstream outflows. Stream recharge volumes for the 2014 WY are presented in *Figure 10-B* below.

Figure 10-B: Stream Recharge Components

SOURCE	2014 WY (AF)	SUSTAINABLE AVERAGE (AF/Yr)
Natural Stream Recharge	1,059	5,700
Arroyo Valle Prior Rights	0	900
Artificial Stream Recharge	3,832	5,300
TOTAL RECHARGE	4,891	18,800

Natural stream recharge was low and Arroyo Valle Prior Rights was zero because of low rainfall and runoff for the 2014 WY. Artificial stream recharge was limited to the low volume of imported water available for most of the year (*Section 11.3.1*).

A set of synoptic discharge measurements performed on the Arroyo Las Positas in the 2012 WY indicated that the maximum recharge rate was about 1.5 cfs, which is about half of what had been previously estimated. As a result, the stream recharge from the Arroyo Las Positas was re-calculated using this revised value for the 2002 to 2014 WYs.

10.3.2.2 Areal Recharge

Prompted by the significant departure between the groundwater storage results derived from the GWE and HI methods (*Sections 10.2 and 10.3*) staff revamped the areal recharge spreadsheet model, particularly with respect to the method for estimating rainfall runoff, in an effort to more accurately calculate areal recharge (*Zone 7, 2013*).

The updated areal recharge spreadsheet model was used to calculate rainfall and applied water recharge for the 2014 WY. The resulting annual recharge volumes are shown in *Figure 10-C* below.

Figure 10-C: Areal Recharge Components

SOURCE	2014 WY (AF)	SUSTAINABLE AVERAGE (AF/Yr)
Rainfall Recharge	1,169	4,300
Applied Water Recharge	1,989	1,600
TOTAL RECHARGE	3,158	5,900

Rainfall recharge was very low this year because of the low local rainfall. The low rainfall can give rise to increased application of irrigation water which, in turn, leads to more applied water recharge than average. However, it should be noted that Zone 7's areal recharge spreadsheet model could possibly be overestimating applied water recharge values over the last two years because the model does not account for outdoor conservation during drought years. Zone 7 staff will reevaluate how these land use constants are used in the spreadsheet model, and will recalculate the numbers as appropriate.

10.3.2.3 Subsurface Groundwater Flow

Subsurface inflow, which occurs primarily in the upper aquifer from the fringe basins to the Main Basin, is estimated based on gradients across the Main Basin boundaries, aquifer structure, and the hydraulic conductivities of the aquifer sediments. Subsurface inflow into the Main Basin is only thought to be significant from the Dublin and Camp fringe basins; although there may be additional subsurface flow into the Main Basin across the southern Bernal Subbasin boundary from the Livermore Uplands fringe basins. This becomes more significant when the Main Basin levels are low. For the annual HI, it has been assumed to be a constant 1,000 AF per year since the 2000 WY. Prior to 2000, water levels were used to create rough estimates of hydraulic conditions across boundaries.

Subsurface basin overflow, which also occurs primarily in the upper aquifer, tends to discharge into the Arroyo De La Laguna and flows out of the basin to the San Francisco Bay through Alameda Creek when water levels are above elevation 295 feet in this portion of the Bernal Subbasin. For the entire water year, water levels in wells near the Arroyo De La Laguna remained below 295 feet. Consequently, there was an assumption that there was no basin overflow from the upper aquifer into the Arroyo De La Laguna during the 2014 WY.

Subsurface Groundwater flow volumes for the 2014 WY are presented in *Figure 10-D* below.

Figure 10-D: Subsurface Groundwater Flow

SOURCE	**2014 WY (AF)**	**AVERAGE (AF/Yr)**
Subsurface Inflow (estimated)	1,000	1,000
Basin Overflow	0	-100
TOTAL SUBSURFACE FLOW	1,000	900

10.3.2.4 Pipe Leakage

Starting in the 2012 WY, Zone 7 staff estimated the volume of water leaking from all underground water pipes into the Main Basin. Zone 7 estimates pipe leakage from water supply and sewage pipes into the Main Basin by using the following formula:

Leakage [gpd] = Pipe length [mile] x (50 [gpd/mile/yr] x Pipe Age [yr] – 500).

where pipe age is between 10 and 70 years old. The formula is based on the assumption that pipe leakage does not start until the pipe is at least 10 years old, after which it leaks at a rate of 50 gallons per day per mile (gpd/mi) for each year above 10 years old, up to a maximum of 3000 gpd/mi; see discussion in *Section 4.2.5* of *Zone 7, 2013*.

For the 2014 WY total pipe leakage into the Main Basin is estimated to be approximately 1,100 AF.

10.3.3 Demand Components

10.3.3.1 Zone 7 Groundwater Pumping

Figure 10-9 shows monthly groundwater pumping volumes for all municipal wells in the Valley for the 2014 WY. *Figure 10-10* shows historical groundwater pumping from all sources and the percentages from Zone 7. Historically, Zone 7's annual groundwater pumping has varied with the availability of imported surface water and the capacity to treat that surface water. In general, Zone 7 operates its nine municipal supply wells for salt management, demand peaks, and whenever a shortage or interruption occurs in its surface water supply or treatment. The decision of which well(s) to pump first is based on pumping costs, pressure zone needs, delivered aesthetic water quality issues, salt management needs, local groundwater levels, and demineralization facility capacity. Although reduced groundwater pumping may have a positive impact on groundwater storage and delivered water quality, increased groundwater pumping has a beneficial impact on the basin's salt loading because much of the salt in the pumped groundwater eventually leaves the basin as wastewater export.

In the 2014 WY Zone 7 pumped 8,753 AF of groundwater (including 645 AF for DSRSD, more than half of all municipal groundwater pumped from the Main Basin (17,269 AF). The majority of groundwater that Zone 7 pumped came from the Amador Subbasin (6,919 AF) with the remainder coming from the Bernal Subbasin (1,829 AF).

The following summarizes Zone 7's groundwater pumping for the 2014 WY:

Figure 10-E: Zone 7 Groundwater Pumping

ZONE 7 PUMPING BY WELLFIELD	2014 WY (AF)
Amador Subbasin	**6,919**
Mocho wellfield[*]	*4,227*
COL wellfield	*1,098*
Stoneridge Well	*1, 593*
Bernal Subbasin	**1,829**
Hopyard wellfield	*1,829*
TOTAL PUMPING	**8,753**

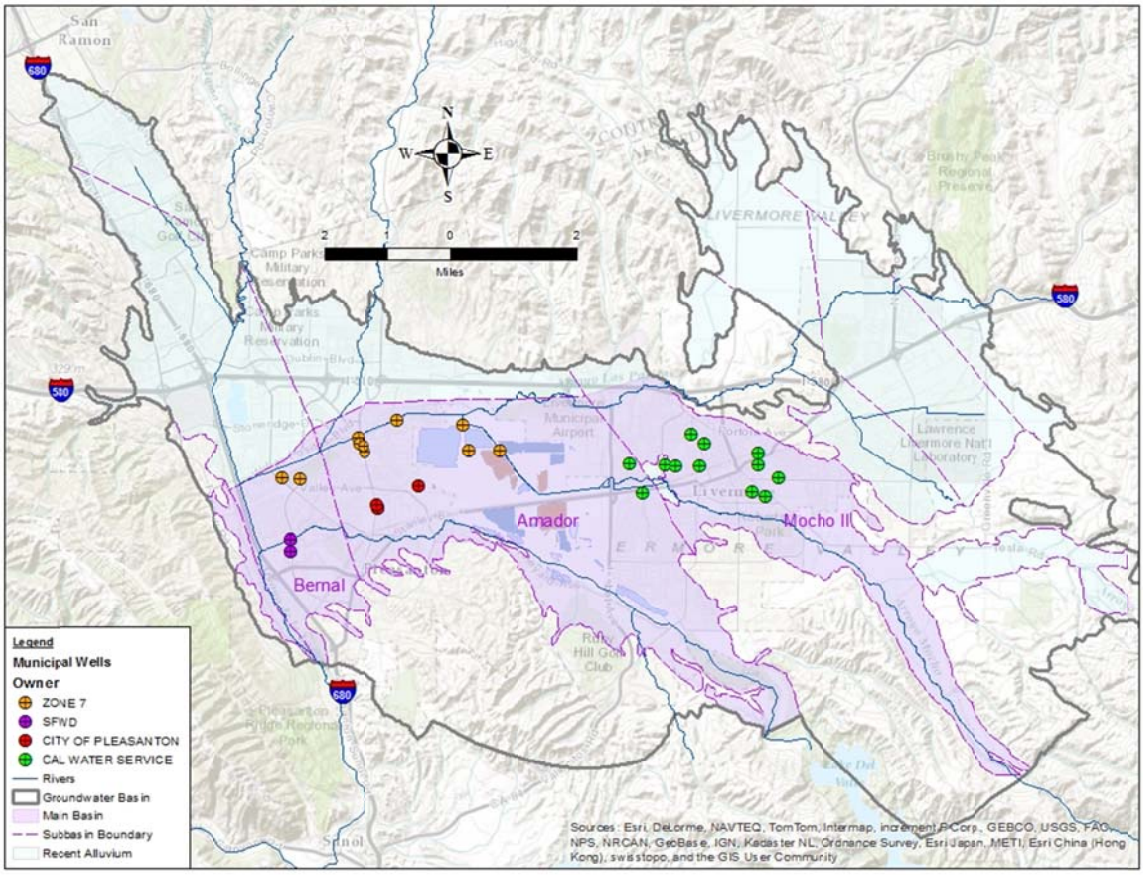
[*] Includes 645 AF of groundwater pumped for DSRSD

10.3.3.2 Groundwater Pumping by Others

Zone 7 collects and compiles data for all large capacity pumping wells within the Main Basin. This includes daily and monthly pumping totals from the retailers. Records of other pumping wells are obtained from well owners when available. Pumping volumes from significant wells without meters are estimated from utility records or from the associated land use (e.g. crop type and number of acres irrigated).

In addition to Zone 7's nine municipal supply wells in Pleasanton (discussed above in *Section 10.3.3.1*), CWS operated 12 wells in the Livermore area, and the City of Pleasanton operated three wells and SFPUC operated two wells in Pleasanton in 2014. The relative locations of the municipal supply wells are shown in *Figure 10-F* below:

Figure 10-F: Map of Municipal Wells



Production volumes from the municipal and other supply wells (total pumped minus the discharge-to-waste during well start-ups) for the 2014 WY are presented in *Figure 10-9*. The volumes of groundwater pumped from non-Zone 7 municipal supply and other supply wells are summarized in *Figure 10-G* below:

Figure 10-G: Groundwater Pumping By Others

PUMPING BY OTHERS	2014 WY (AF)	AVERAGE (AF/Yr)
City of Pleasanton	3,740	3,500*
Cal Water Service	3,085	3,069*
DSRSD†	645	645*
SFPUC	398	450
Fairgrounds	286	310
Domestic Wells**	115	200
Golf Courses**	257	227
Agricultural Pumping**	636	400
TOTAL PUMPING	**9,162**	**8,801**

*Average based on annual Groundwater Production Quota (*Section 11.2.1*)
** Estimated
† Pumped by Zone 7 for DSRSD

10.3.3.3 Mining Area Losses

Mining area losses for the 2014 WY totaled about 5,200 AF (*Figure 10-H*). Mining area evaporation (3,832 AF) accounts for a large portion of the losses and is second only to "Municipal Pumping" as a "Demand" component in the annual HI calculation. Zone 7 calculates the total monthly evaporative losses for the water bodies exposed to the atmosphere by mining operations (also referred to as mining ponds in this report) using the net difference between total rainfall and estimated evaporation over the total pond area.

Figure 10-H: Mining Area Demand Components

DEMAND COMPONENT	2014 WY (AF)	AVERAGE (AF/Yr)
Mining discharges to stream	850	700
Mining area evaporation	3,648	3,200
Gravel mining operations	700	700
TOTAL MINING AREA LOSSES	**5,198**	**4,600**

Mining activity losses also include groundwater lost due to export of moist gravels and groundwater that has been pumped from the quarry pits and discharged into a stream without subsequent recharge. The volume of this exported groundwater varies over time depending on the stage of mining in any given pit and the demand for aggregate resources. When the permitted gravel extraction is complete (currently estimated in 2058), the associated operational groundwater losses (i.e. pit dewatering, gravel washing, and moisture export) will be eliminated.

Vulcan Materials extended their discharge pipeline to Cope Lake in December 2013. This allowed Zone 7 to capture about 5,420 AF of the Vulcan discharge water in Cope Lake during the 2014 WY. About 1,970 AF of this water was used to fill Cope Lake, about 580 AF was lost to evaporation, and about 1,990 AF of this water recharged the groundwater basin, primarily through the southeastern wall of Cope Lake where the clay sedimentation lining was excavated as part of Cope Lake slope repairs. Zone 7 also installed a pipeline in May 2014 from Cope Lake to Lake I to convey the Vulcan mining water captured in Cope Lake into Lake I which has a much higher capacity for aquifer recharge. When Cope Lake was filled above the pipeline inlet, about 880 AF of water was diverted into Lake I and subsequently recharged.

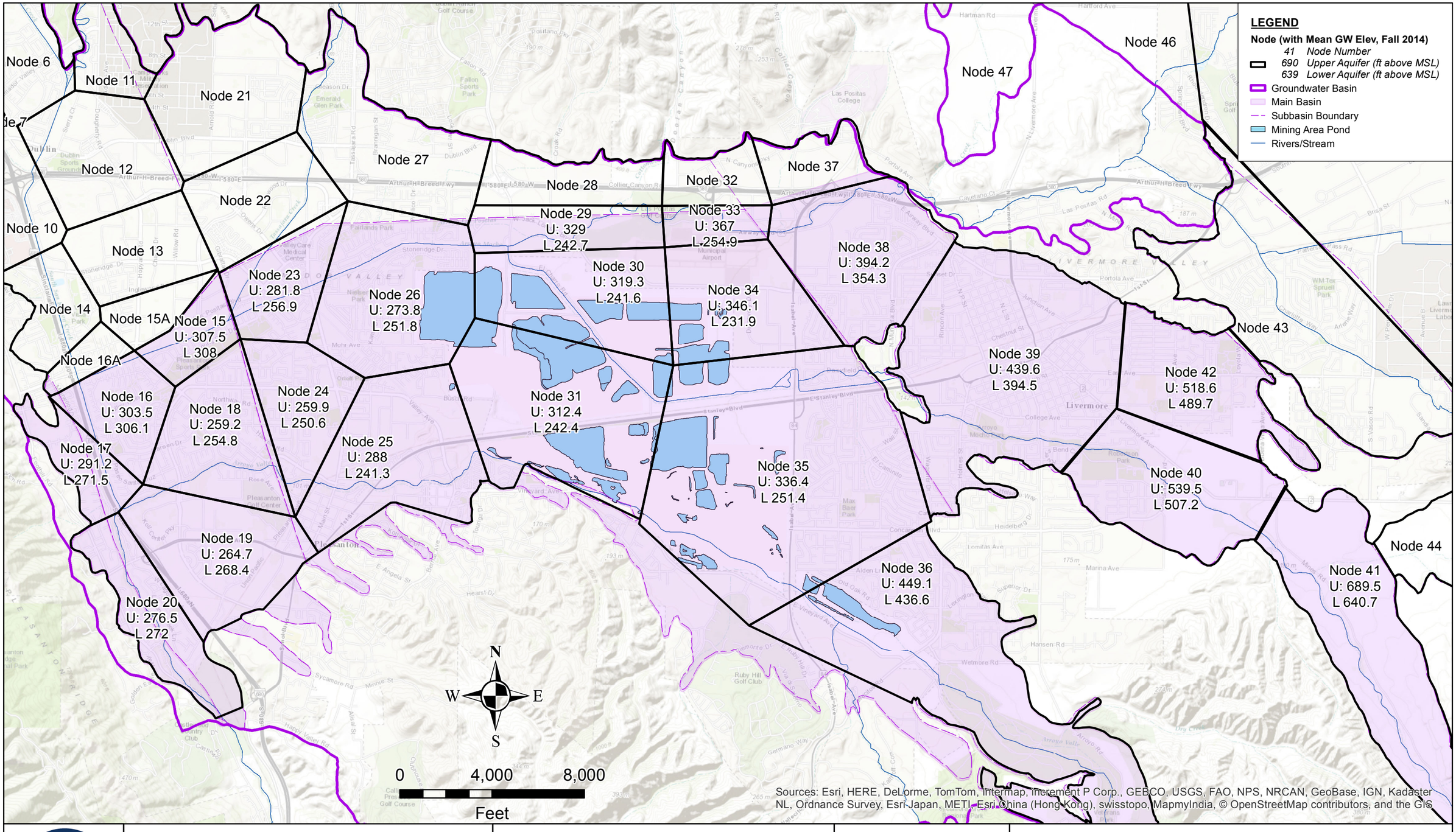
10.4 Total Operational Storage

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 considered accessible. "Operational" or "Available" Storage is the approximate amount of storage available above the historical low groundwater surface. The remainder (approximately 128 TAF) is estimated reserves stored below historical lows. Stored groundwater at the end of the 2014 WY was 198 TAF, with 72 TAF groundwater available as operational storage (see *Figure 10-I* below), which is about 57% of the estimated historical maximum (based on 126 TAF estimated for the 1983 WY).

Figure 10-I: Groundwater Storage Summary (in Thousand AF)

Storage Calculation Method	**2013 WY**	**Change in 2014 WY**	**2014 WY**
Groundwater Elevations (GWE)	221	-8	213
Hydrologic Inventory (HI)	200	-12	188
Total Storage (avg of GWE & HI)	**210**	**-10**	**200**
OPERATIONAL STORAGE*	**82**	**-10**	**72**

* Operational Storage = Total Storage –Storage Below Historical Lows (128 TAF)



ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

DRAWN: TR	SCALE: 1 in = 4,000 ft
REVIEWED: TR	DATE: Mar 30, 2015
FILE: E:\MONITOR\GWStorage\2014wy\AnnualReport2014\Fig10-01-MapNodalGWE14.mxd	

Figure 10-1
Mean Groundwater Elevation By Node
Upper and Lower Aquifers, Fall 2014
Storage - Groundwater Elevation Method

FIGURE 10-2
GROUNDWATER STORAGE PROGRAM
NODAL CONSTANTS FOR STORAGE CALCULATIONS

	Data from 1963 to 1992 - One Aquifer					Data from 1992 to Present - Two Aquifers											
							Upper Aquifer						Lower Aquifer				
MAIN BASIN NODE	Area (ft^2)	Top (ft MSL)	Bottom (ft MSL)	Thick (ft)	Storage Coef	Area (ft^2)	Surface (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	47	0.07	0.0024	205	33	172	0.20	0.0012
NODE 16	466	321	33	288	0.08	320	325	281	235	46	0.05	0.0024	195	33	162	0.20	0.0002
NODE 17	301	363	63	300	0.06	301	336	283	222	61	0.09	0.0024	179	63	116	0.20	0.00005
NODE 18	679	337	33	304	0.08	679	334	283	228	55	0.11	0.0024	196	33	163	0.20	0.0012
NODE 19	703	323	53	270	0.08	703	328	268	222	46	0.11	0.0024	199	53	146	0.20	0.0002
NODE 20	534	333	73	260	0.06	534	332	265	229	36	0.05	0.0024	215	73	142	0.20	0.00001
NODE 23	414	340	63	277	0.11	414	340	297	243	54	0.13	0.0024	191	63	128	0.20	0.0018
NODE 24	503	343	73	270	0.08	503	343	300	230	70	0.14	0.0024	196	73	123	0.20	0.0003
NODE 25	883	343	73	270	0.075	883	360	330	242	88	0.17	0.0024	222	73	149	0.20	0.0007
NODE 26	953	348	3	345	0.1	953	353	303	226	77	0.17	0.0024	182	3	179	0.20	0.0003
NODE 29	388	365	243	122	0.05	388	363	333	278	55	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	47	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

Surface Ground surface
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

FIGURE 10-3
GROUNDWATER STORAGE PROGRAM - NODAL GROUNDWATER ELEVATION METHOD
GROUNDWATER ELEVATIONS (ft) AND STORAGE (Acre-Feet)
1963 TO 1991 WATER YEARS

WATER	NODE 15		NODE 16		NODE 17		NODE 18		NODE 19		NODE 20		NODE 23		NODE 24		NODE 25		NODE 26		NODE 29	
YEAR	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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

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

FIGURE 10-3
GROUNDWATER STORAGE PROGRAM - NODAL GROUNDWATER ELEVATION METHOD
GROUNDWATER ELEVATIONS (ft) AND STORAGE (Acre-Feet)
1963 TO 1991 WATER YEARS

WATER	NODE 30		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	GWE	Storag	w/N41	(Rounded)
MAX_83_SPR	330.5	14,390	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	237.5	9,047	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	253.0	9,937	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	252.2	9,891	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	241.9	9,300	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	257.7	10,207	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	247.5	9,621	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	237.9	9,070	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	232.5	8,760	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	234.2	8,857	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	238.6	9,110	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	250.9	9,816	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	253.0	9,937	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	256.0	10,109	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	266.0	10,684	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	259.0	10,282	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	255.0	10,052	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	263.0	10,512	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	282.0	11,603	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	283.0	11,660	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	281.0	11,545	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	289.0	12,005	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	292.0	12,177	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	288.0	11,948	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	276.2	11,270	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	274.2	11,155	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	252.4	9,903	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	244.5	9,449	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	238.6	9,110	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	239.4	9,156	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

FIGURE 10-4
GROUNDWATER STORAGE - NODAL GROUNDWATER ELEVATION METHOD
GROUNDWATER ELEVATIONS (ft MSL) AND STORAGE (Acre-Feet)
1992 TO 2014 WATER YEARS

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
2012	289.1	647	282.4	747	297.0	1,501	273.4	3,224	278.6	3,797	282.6	917	287.5	2,453	276.9	3,146	299.2	8,855	285.6	9,900	331.6	4,599	321.7	7,237	318.6	8,921
2013	281.1	535	272.0	600	293.8	1,499	265.4	2,649	271.8	3,784	279.8	913	281.7	2,129	269.6	2,660	290.4	7,483	279.4	8,884	331.8	4,620	321.5	7,216	315.1	8,402
2014	307.5	670	303.5	763	291.2	1,497	259.2	2,205	264.7	3,488	276.5	909	281.8	2,136	259.9	2,010	288.0	7,120	273.8	7,949	329.0	4,373	319.3	6,957	312.4	7,991

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
2012	282.8	1,772	276.5	2,654	280.3	1,602	274.4	5,466	282.9	5,581	282.4	3,656	277.8	2,818	272.6	2,994	268.6	6,988	274.6	8,926	271.4	2	270.1	5,736	268.1	15,014
2013	278.6	1,771	269.3	2,654	272.7	1,602	262.5	5,457	268.9	5,579	272.0	3,656	270.4	2,812	262.1	2,993	255.1	6,979	265.9	8,923	261.7	1	258.6	5,735	258.8	15,010
2014	308.0	1,778	306.1	2,656	271.5	1,602	254.8	5,451	268.4	5,579	272.0	3,656	256.9	2,802	250.6	2,991	241.3	6,970	251.8	8,919	242.7	0	241.6	5,732	242.4	15,004

Groundwater elevations (GWE) from 1992 - 2006 compiled from program wells in each node. GWE > 2006 calculated using ArcGIS to calculate Mean GWE 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.

FIGURE 10-4
GROUNDWATER STORAGE - NODAL GROUNDWATER ELEVATION METHOD
GROUNDWATER ELEVATIONS (ft MSL) AND STORAGE (Acre-Feet)
1992 TO 2014 WATER YEARS

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
2012	369.7	661	349.9	2,818	353.3	11,607	449.7	10,861	396.1	4,916	450.0	10,064	539.9	10,806	688.6	10,605	520.3	7,472	125,755	126,000
2013	368.3	639	348.8	2,755	342.9	8,831	449.7	10,863	396.1	4,915	449.7	10,011	540.5	10,930	690.4	10,889	521.6	7,647	118,856	119,000
2014	367.0	620	346.1	2,610	336.4	7,107	449.1	10,752	394.2	4,703	439.6	8,146	539.5	10,727	689.5	10,747	518.6	7,250	110,728	111,000

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
2012	274.7	479	260.9	5,618	305.8	22,780	447.1	1	367.4	1,628	409.8	4,251	513.1	2,267	640.2	2	504.1	1,759	101,990	102,000
2013	270.7	479	247.4	5,618	259.7	22,775	446.1	1	369.3	1,629	410.4	4,251	517.1	2,267	639.0	1	508.7	1,759	101,951	102,000
2014	254.9	479	231.9	5,618	251.4	22,775	436.6	1	354.3	1,618	394.5	4,242	507.2	2,267	640.7	2	489.7	1,758	101,899	102,000

Groundwater elevations (GWE) from 1992 - 2006 compiled from program wells in each node. GWE > 2006 calculated using ArcGIS to calculate Mean GWE 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.

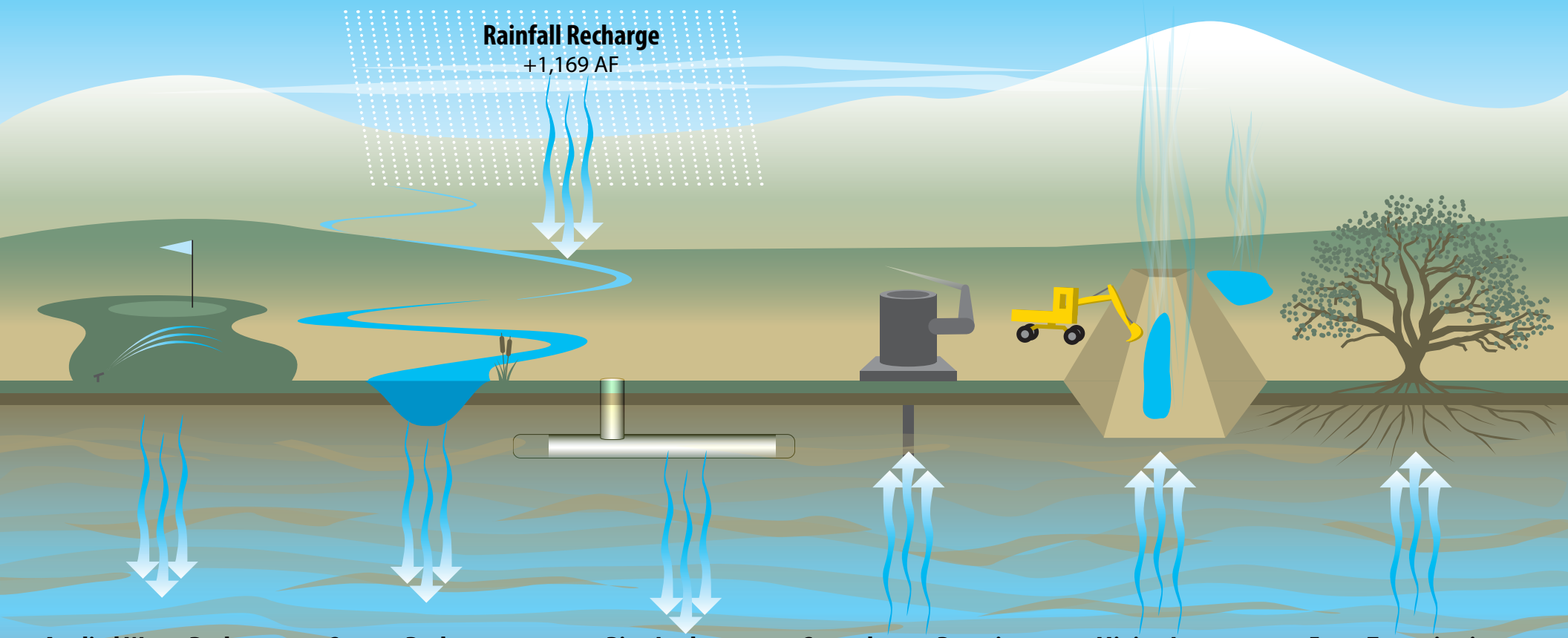
TABLE 10-5
GROUNDWATER STORAGE
HYDROLOGIC INVENTORY (HI) METHOD
2014 WATER YEAR (in Acre-Feet, except where indicated)

	Total for Water Year	Sustainable Average	Percent of Sust Avg
INDICES			
Rainfall at Livermore (inches)	6.80	14.41	47%
8 Station Rainfall Index (Northern CA)(inches)	31.31	49.51	63%
Evaporation at Lake Del Valle (inches)	78.28	66.73	117%
Arroyo Valle Stream flow (AF)	272	21,087	1%
SUPPLY TOTAL (AF)	**10,149**	**19,800**	**51%**
Stream Recharge	**4,891**	**11,900**	**41%**
[1] Natural Stream Recharge	1,059	5700*	19%
Arroyo Valle	*429*	*1800*	*24%*
Arroyo Mocho	*121*	*2,600*	*5%*
Arroyo Las Positas	*509*	*1,300*	*39%*
[1] Arroyo Valle Prior Rights	0	900*	0%
[3] Artificial Stream Recharge	3,832	5,300	72%
Arroyo Valle	*930*	*1,600*	*58%*
Arroyo Mocho	*2,844*	*3,570*	*80%*
Arroyo Las Positas	*58*	*130*	*45%*
[1] **Rainfall Recharge**	**1,169**	**4300***	**27%**
[1] *Lake Recharge*	2,428	NA	NA
Pipe Leakage	**1,100**	**1,000**	**110%**
[1] **Applied Water Recharge**	**1,989**	**1600***	**124%**
Urban - Municipal	1,568	1,280	123%
Urban - Recycled Water	220	26	846%
Agricultural - Municipal (SBA)	56	92	61%
Agricultural - Groundwater	20	12	167%
Golf Courses - Groundwater	52	146	36%
Golf Courses - Recycled Water	73	44	166%
[1] **Subsurface Inflow**	**1,000**	**1000***	**100%**
DEMAND TOTAL (AF)	**22,467**	**18,800**	**120%**
Municipal Pumping	**16,633**	**13,700**	**121%**
[4] Zone 7	8,753	5,940	147%
[2] *Zone 7 pumping for DSRSD*	*645*	*645**	*100%*
GW through Demin Membranes	*973*	-	-
Demin Permeate to Z7 Distribution System	*761*	-	-
[2] City of Pleasanton	3,740	3500*	107%
[2] California Water Service	3,085	3069*	101%
[2] SFWD	398	450*	88%
[2] Fairgrounds	286	310*	92%
[2] Domestic	115	200*	58%
[2] Golf Courses	257	227*	113%
3S1E_1P3	*0*	*0*	*0%*
GWP_Castle	*227*	*203*	*112%*
Tri Valley Golf	*30*	*24*	*125%*
[2] **Agricultural Pumping**	**636**	**400***	**159%**
SFWD	0	0	0%
Concannon	0	0	0%
Calculated	636	400	159%
[2] **Mining Use**	**5,198**	**4600***	**113%**
Mining Discharges (Export) to Stream	850	700	121%
Evaporation	3,648	3,200	114%
Processing	700	700	100%
[1] **Subsurface Overflow**	**0**	**100***	**0%**
SUBTOTALS (AF)			
Sustainable Yield - Natural Recharge [sum of [1]]	7,645	13,400	57%
Sustainable Yield - Demand Components [sum of [2]]	14,359	13,400	107%
Zone 7 - Artificial Recharge (Stream) [sum of [3]]	3,832	5,300	72%
Zone 7 - Municipal Pumping [sum of [4]]	8,753	5,300	165%
NET RECHARGE (Supply - Demand)	**-12,318**	**1,000**	**-1231%**
TOTAL STORAGE (AF)	**2014 WY**	**2013 WY**	**Δ Storage**
Hydrologic Inventory (HI)	187,599	199,917	-12,318
Nodal GW Elevations (NGE)	212,627	220,806	-8,179
Average Storage: (HI + NGE)/2	200,113	210,362	-10,249
Available Storage: Avg Storage - Reserve (128K AF)	72,113	82,362	-10,249

Sustainable average includes original estimates for Sustainable Yield components (shown with *)

Figure 10-6
Groundwater Supply and Demand
2014 Water Year

Total Inflow: +10,149 AF
Total Outflow: -22,467AF
Change in Basin Storage: -12,318 AF



Applied Water Recharge
+1,989 AF

Stream Recharge
Natural: +1,059 AF
Artificial: +3,832 AF

Pipe Leakage
+1,100 AF

Groundwater Pumping
Zone 7: -8,753 AF
Others: -7,880 AF
Agricultural: -636 AF

Mining Losses
-1,550 AF

EvapoTranspiration
-3,648 AF

Subsurface Inflow
+1,000 AF

Subsurface Outflow
0 AF

OPERATIONAL STORAGE
72,000 AF

FIGURE 10-7
HISTORICAL GROUNDWATER STORAGE
HYDROLOGIC INVENTORY (HI) METHOD
1974-2014 WATER YEARS (in Acre-Feet, except where indicated)

	WATER YEAR (Oct - Sep)																					
COMPONENTS	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
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
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
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
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
SUPPLY	**18,165**	**21,464**	**11,153**	**8,719**	**24,854**	**22,259**	**23,880**	**18,876**	**30,002**	**35,478**	**15,616**	**8,860**	**20,948**	**6,758**	**8,165**	**11,270**	**10,459**	**12,827**	**10,727**	**28,652**	**16,225**	**29,230**
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**
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
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*
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*
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*
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
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
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*
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*
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*
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**
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**
Pipe Leakage	**56**	**64**	**75**	**87**	**101**	**116**	**133**	**150**	**169**	**189**	**209**	**230**	**251**	**273**	**295**	**316**	**338**	**360**	**384**	**408**	**433**	**459**
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**
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
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
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
Agricultural - Groundwater	384	280	513	525	352	388	281	241	174	139	198	210	190	137	152	140	153	109	133	96	100	92
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
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
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
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**
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**
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**
Zone 7 (includes for DSRSD)	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
DSRSD[2]	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
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
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
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
SFWD[2]	302	242	495	374	397	413	372	402	348	321	378	353	484	491	472	443	362	408	410	414	396	370
Fairgrounds[2]	200	200	200	200	200	200	200	267	217	242	281	272	280	280	280	280	280	346	336	282	325	285
Domestic[2]	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	113	113	116	116
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
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*
Castlewood	*156*	*92*	*227*	*230*	*149*	*166*	*0*	*0*	*52*	*101*	*198*	*182*	*146*	*215*	*253*	*191*	*211*	*151*	*186*	*131*	*186*	*82*
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*
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**
SFWD	500	0	62	304	252	365	168	513	150	549	107	410	543	663	493	359	430	194	9	0	0	0
Concannon	6	15	20	20	20	70	250	112	0	0	68	0	60	26	59	0	0	11	0	0	0	0
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
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**
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
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
Production	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700
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**
NET RECHARGE (AF)	**-452**	**5,535**	**-4,280**	**-5,917**	**11,983**	**6,440**	**8,154**	**-473**	**11,653**	**9,258**	**-4,133**	**-9,647**	**-1,602**	**-7,817**	**-9,011**	**-4,873**	**-5,438**	**-8,384**	**-6,486**	**15,190**	**746**	**13,194**
INVENTORY STORAGE (AF)	**211,548**	**217,083**	**212,803**	**206,886**	**218,869**	**225,309**	**233,463**	**232,990**	**244,643**	**253,901**	**249,768**	**240,121**	**238,519**	**230,702**	**221,691**	**216,818**	**211,380**	**202,996**	**196,510**	**211,700**	**212,446**	**225,640**

[1] Sustainable Yield - Natural Recharge
[2] Sustainable Yield - Demand
* Sustainable Average

STORAGE CALCULATION	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
INVENTORY (Rounded to TAF)	212	217	213	207	219	225	233	233	245	254	250	240	239	231	222	217	211	203	197	212	212	226
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
AVERAGE STORAGE (TAF)	**213**	**216**	**219**	**211**	**214**	**226**	**236**	**239**	**243**	**254**	**254**	**245**	**240**	**231**	**219**	**216**	**210**	**199**	**189**	**209**	**213**	**225**
AVAILABLE STORAGE (TAF)	**85**	**88**	**91**	**83**	**86**	**98**	**108**	**111**	**115**	**126**	**126**	**117**	**112**	**103**	**91**	**88**	**82**	**71**	**61**	**81**	**85**	**97**

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FIGURE 10-7
HISTORICAL GROUNDWATER STORAGE
HYDROLOGIC INVENTORY (HI) METHOD
1974-2014 WATER YEARS (in Acre-Feet, except where indicated)

	WATER YEAR (Oct - Sep)																			1974 - 2014		
COMPONENTS	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**AVG**	**SUST***	**TOTAL**
INDICES																						
Rainfall at Livermore (in)	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	8.8	10.71	6.8	14		
8 Station Rain Index (N. CA)(in)	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	41.53	46.25	31.31	52		
Evap at Lake Del Valle (in)	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	73.23	73.93	78.28	66		
Arroyo Valle Stream flow (AF)	51058	54115	87819	15169	18949	8156	7848	19648	11410	26930	28325	2027	18059	11231	12914	28634	1557	7801	272	24804		1,016,982
SUPPLY	**22,698**	**24,333**	**27,357**	**20,942**	**23,379**	**15,864**	**24,240**	**30,023**	**19,966**	**31,215**	**24,160**	**13,608**	**15,634**	**17,716**	**23,406**	**22,634**	**16,942**	**18,533**	**10,148**	**19,448**	**19,800**	**797,383**
Stream Recharge	**11,109**	**12,284**	**13,603**	**10,813**	**12,842**	**8,601**	**16,205**	**21,483**	**12,885**	**21,025**	**13,418**	**7,558**	**7,612**	**10,088**	**14,943**	**12,684**	**10,997**	**11,589**	**4,891**	**11,442**	**11,900**	**469,139**
Natural Stream Recharge[1]	7,743	6,607	10,533	5,091	4,178	4,512	4,486	8,462	3,458	9,589	6,905	1,940	5,077	4,857	8,170	6,361	1,618	2,332	1,059	5,290	5700*	216,870
Arroyo Valle	*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*	*581*	*839*	*429*	*2,073*	*1,800*	*84,989*
Arroyo Mocho	*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*	*583*	*921*	*121*	*2,293*	*2,600*	*94,019*
Arroyo las Positas	*1,091*	*1,184*	*1,572*	*1,462*	*1,250*	*1,111*	*949*	*1,085*	*929*	*755*	*758*	*737*	*806*	*1,090*	*915*	*439*	*454*	*572*	*509*	*923*	*1,300*	*37,862*
Arroyo Valle Prior Rights[1]	398	362	727	548	644	660	1,131	1,612	1,343	293	1,930	807	306	1,247	0	1,768	601	1,370	0	907	900*	37,202
Artificial Stream Recharge[2]	2,968	5,314	2,343	5,174	8,019	3,428	10,588	11,409	8,084	11,143	4,583	4,811	2,229	3,984	6,773	4,555	8,778	7,887	3,832	5,246	5,300	215,066
Arroyo Valle	*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*	*3,613*	*1,916*	*930*	*1,600*	*1,600*	*65,598*
Arroyo Mocho	*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*	*5,059*	*5,961*	*2,844*	*3,521*	*3,570*	*144,345*
Arroyo las Positas	*0*	*0*	*0*	*0*	*0*	*22*	*2*	*0*	*0*	*168*	*162*	*0*	*0*	*0*	*0*	*116*	*106*	*10*	*58*	*125*	*130*	*5,124*
Injection Well Recharge	**0**	**0**	**0**	**1,524**	**1,146**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**65**	**0**	**2,670**
Rainfall Recharge[1]	**8,176**	**8,634**	**10,692**	**5,540**	**5,924**	**3,644**	**4,239**	**4,899**	**3,192**	**6,378**	**6,969**	**1,987**	**3,782**	**3,375**	**4,315**	**5,771**	**1,462**	**2,708**	**1,169**	**4,409**	**4300***	**180,771**
Pipe Leakage	**486**	**514**	**542**	**572**	**602**	**634**	**667**	**701**	**736**	**773**	**810**	**848**	**887**	**926**	**967**	**1,007**	**1,048**	**1,090**	**1,100**	**488**	**1,000**	**20,007**
Applied Water Recharge[1]	**2,007**	**2,221**	**1,709**	**1,743**	**1,960**	**1,985**	**2,129**	**1,940**	**2,153**	**2,039**	**1,962**	**2,214**	**2,353**	**2,327**	**2,181**	**2,172**	**2,435**	**2,147**	**1,988**	**2,060**	**1600***	**84,460**
Urban - Municipal	1,467	1,632	1,472	1,549	1,743	1,770	1,888	1,749	1,926	1,834	1,747	1,983	2,124	2,064	1,894	1,849	2,061	1,750	1,568	1,399	1,280	57,347
Urban - Recycled Water	18	21	15	12	21	19	30	10	14	15	26	24	7	52	84	133	159	189	220	32	26	1,305
Agricultural - Municipal (SBA)	347	401	104	57	64	59	67	66	64	63	63	62	68	68	67	61	68	64	56	146	92	5,986
Agricultural - Groundwater	100	109	26	11	12	11	13	12	12	12	12	12	13	13	12	11	13	7	20	132	12	5,415
Golf Courses - Groundwater	0	0	42	49	55	56	60	56	61	58	56	63	68	65	60	59	65	62	52	24	146	986
Golf Courses - Recycled Water	75	58	50	65	66	69	72	47	75	58	59	71	74	66	64	59	70	75	73	60	44	2,447
Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	268	0	10,973
Subsurface Basin Inflow[1]	**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**	**1,000**	**1,000**	**984**	**84 14**	**40,336**
DEMAND	**20,683**	**25,574**	**25,342**	**25,691**	**27,185**	**27,740**	**23,722**	**21,069**	**24,794**	**19,419**	**16,418**	**19,494**	**20,358**	**24,586**	**21,319**	**20,397**	**28,880**	**25,700**	**22,466**	**20,044**	**18,800**	**827,205**
Municipal Pumpage	**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**	**20,463**	**16,823**	**16,633**	**11,626**	**13,700**	**476,650**
Zone 7 (includes for DSRSD)	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	12,105	9,555	8,753	4,276	5,940	175,335
DSRSD[2]	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*645*	*645*	*645*	*645*	*645*	*645*	*645*	*645*	*646*	*656*	*645*	*631*	*189*	*645**	*7,738*
City of Pleasanton[2]	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	3,900	3,301	3,740	3,225	3500*	132,238
Cal. Water Service[2]	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	3,333	2,770	3,085	2,896	3069*	118,727
Camp Parks[2]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	215	0	8,819
SFWD[2]	411	477	460	380	532	472	448	423	481	436	467	494	492	446	417	442	482	482	398	422	450*	17,286
Fairgrounds[2]	343	342	230	333	369	318	423	327	365	284	441	443	289	335	284	301	318	350	286	294	310*	12,034
Domestic[2]	117	117	113	116	109	109	134	134	167	131	93	96	109	123	112	107	90	105	115	109	200*	4,455
Golf Courses[2]	182	169	249	256	245	223	218	208	203	207	199	249	241	250	208	208	236	260	257	189	227*	7,758
3S/1E 1P3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*0*	*129*
Castlewood	*159*	*146*	*236*	*235*	*223*	*193*	*193*	*193*	*173*	*191*	*177*	*222*	*213*	*222*	*188*	*187*	*214*	*233*	*227*	*174*	*203*	*7,130*
Tri-Valley Golf	*23*	*23*	*13*	*21*	*22*	*30*	*25*	*15*	*30*	*16*	*22*	*27*	*28*	*28*	*20*	*21*	*22*	*27*	*30*	*12*	*24*	*499*
Agricultural Pumpage[2]	**212**	**266**	**73**	**81**	**231**	**227**	**119**	**93**	**92**	**88**	**88**	**87**	**96**	**95**	**94**	**85**	**95**	**486**	**636**	**1,115**	**400***	**45,717**
SFWD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	148	0	6,071
Concannon	0	0	0	0	140	143	25	0	2	0	0	0	0	0	0	0	0	0	0	26	0	1,047
Calculated	212	266	73	81	91	84	94	93	91	88	88	87	96	95	94	85	95	486	636	941	400	38,599
Mining Use[2]	**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**	**8,322**	**8,391**	**5,198**	**6,894**	**4600***	**288,065**
Stream Export	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	4,676	4,796	850	3,835	700	157,219
Evaporation	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	2,946	2,895	3,648	2,369	3,200	97,120
Production	700	700	700	700	700	700	470	550	686	700	700	700	700	700	700	700	700	700	700	690	700	28,306
Subsurface Basin Overflow[1]	**766**	**760**	**750**	**362**	**125**	**0**	**0**	**0**	**0**	**0**	**0**	**921**	**1,205**	**194**	**0**	**0**	**0**	**0**	**0**	**409**	**100***	**16,773**
NET RECHARGE (AF)	**2,015**	**-1,242**	**2,015**	**-4,750**	**-3,806**	**-11,876**	**518**	**8,953**	**-4,828**	**11,797**	**7,742**	**-5,886**	**-4,724**	**-6,870**	**2,087**	**2,237**	**-11,938**	**-7,167**	**-12,318**	**-595**	**1,000**	**-24,403**
INVENTORY STORAGE (AF)	**227,655**	**226,413**	**228,428**	**223,678**	**219,872**	**207,996**	**208,514**	**217,467**	**212,639**	**224,436**	**232,178**	**226,292**	**221,568**	**214,698**	**216,785**	**219,022**	**207,084**	**199,917**	**187,599**	**220,440**	**13,400**	

[1] Sustainable Yield - Natural Recharge
[2] Sustainable Yield - Demand
* Sustainable Average

STORAGE CALCULATION	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
INVENTORY (Rounded to TAF)	228	226	228	224	220	208	209	217	213	224	232	226	222	215	217	219	207	200	188
GW ELEVATIONS (Rounded to TAF)	222	221	224	220	220	202	210	219	212	234	236	230	230	233	234	235	228	221	213
AVERAGE STORAGE (TAF)	**225**	**223**	**226**	**222**	**220**	**205**	**210**	**218**	**212**	**229**	**234**	**228**	**226**	**224**	**225**	**227**	**217**	**210**	**200**
AVAILABLE STORAGE (TAF)	**97**	**95**	**98**	**94**	**92**	**77**	**82**	**90**	**84**	**101**	**106**	**100**	**98**	**96**	**97**	**99**	**89**	**82**	**72**

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4/27/2015

FIGURE 10-8
GRAPHS OF HISTORICAL GROUNDWATER STORAGE
1974 TO 2014 WATER YEARS

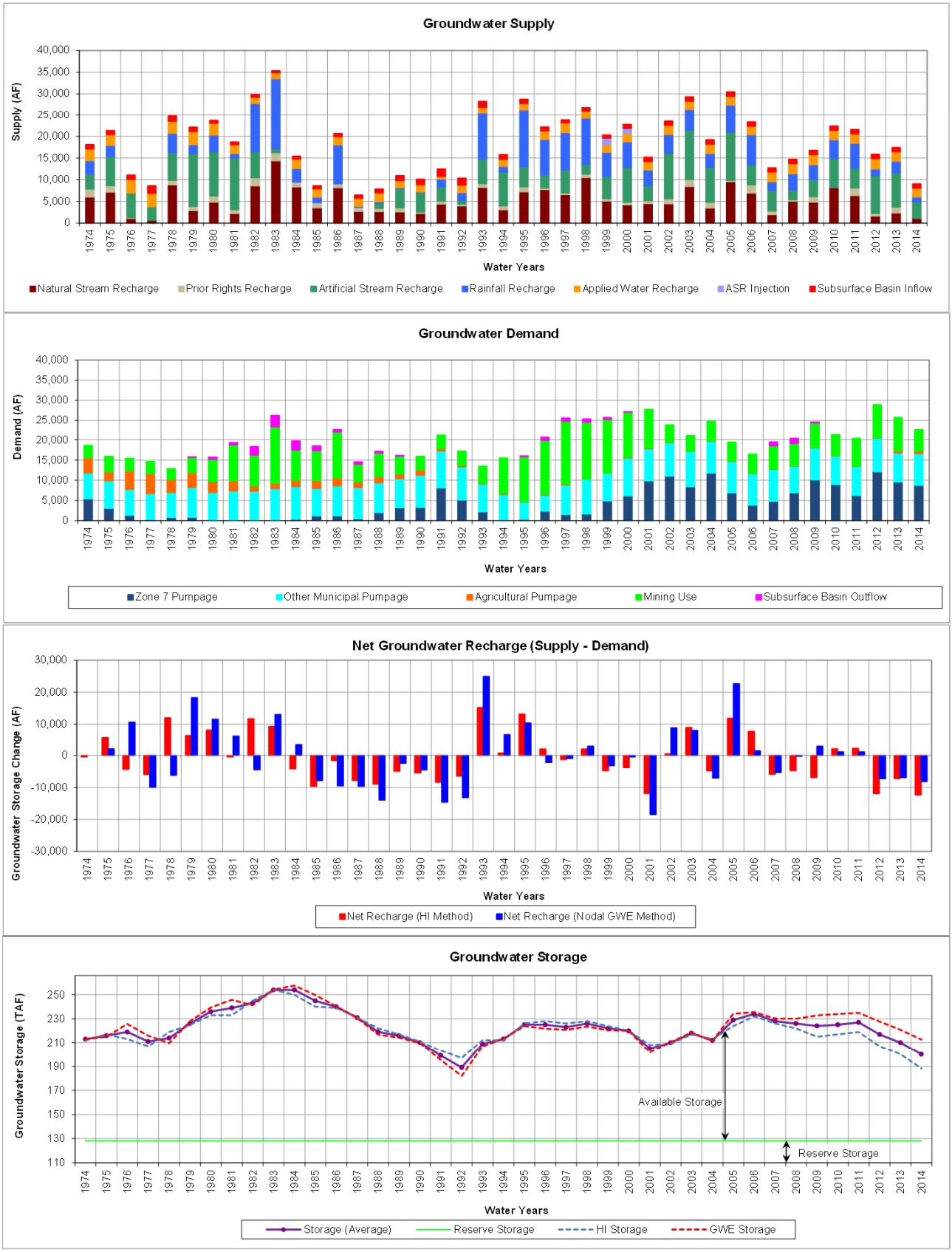

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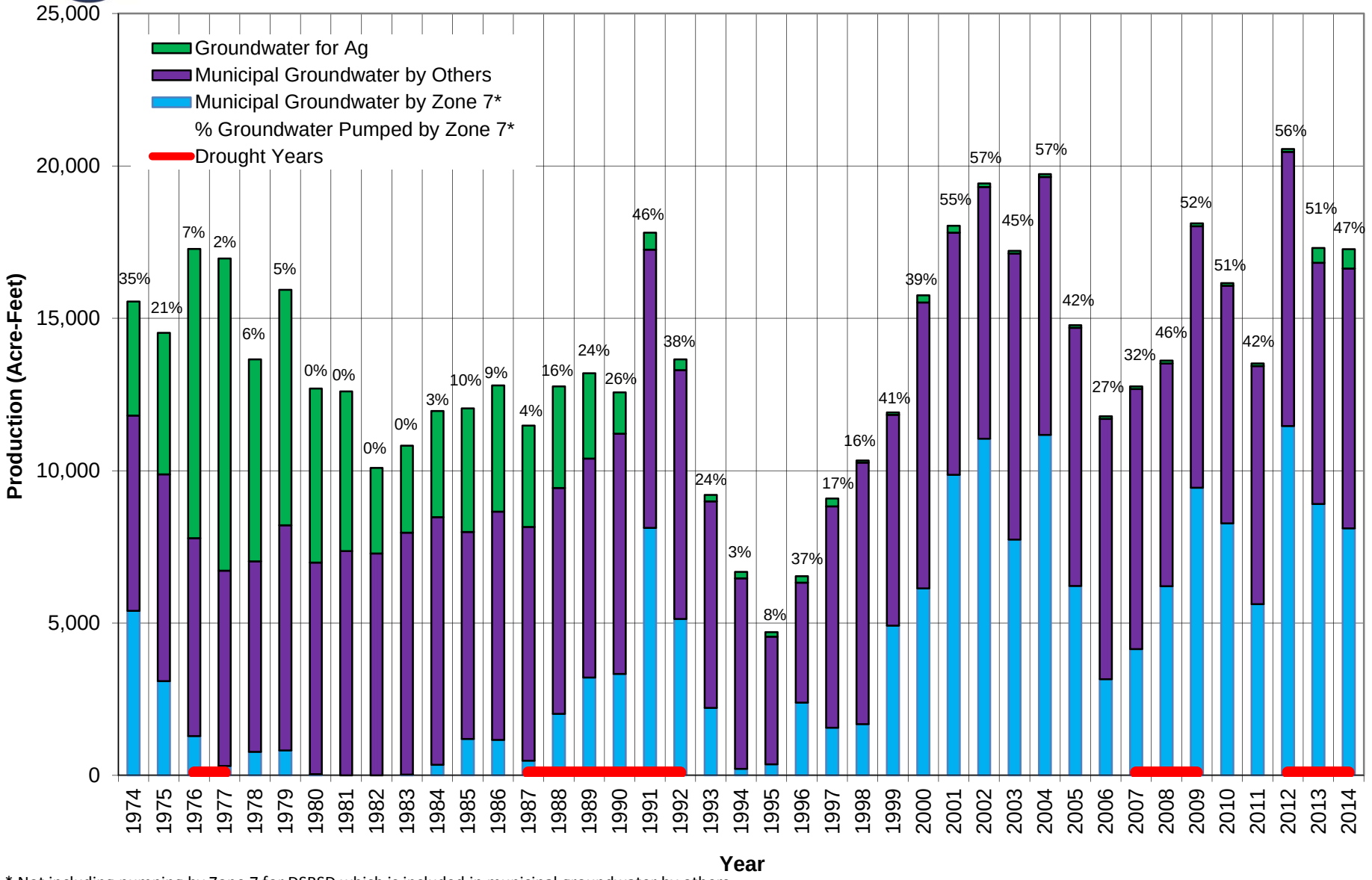
Figure 10-8

FIGURE 10-9
GROUNDWATER PRODUCTION FROM MUNICIPAL AND OTHER SUPPLY WELLS
2014 WATER YEAR (in Acre-feet)

Station ID	Well	Common Name	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	WY*	CY**
Owner: Zone 7																
COL 1	3S/1E 10K 3	COL 1	2.3	38.6	17.6	84.0	1.0	1.0	8.0	21.0	129.0	60.0	28.0	1.0	**391.5**	**339**
COL 2	3S/1E 11M 3	COL 2	21.1	63.1	36.7	141.0	8.0	4.0	21.0	59.0	170.0	86.0	86.0	11.0	**706.9**	**661**
COL 5	3S/1E 10B15	COL 5	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**	**51**
HOP 6	3S/1E 18A 6	Hopyard 6	90.3	158.0	54.9	217.0	17.0	17.0	96.0	166.0	314.0	223.0	144.0	55.0	**1552.2**	**1423**
HOP 9	3S/1E 17D12	Hopyard 9	12.8	26.6	4.4	42.0	4.0	0.0	23.0	18.0	61.0	42.0	33.0	10.0	**276.8**	**233**
MOCHO 1	3S/1E 9M 2	Mocho 1	150.3	175.7	170.1	251.0	70.0	24.0	2.0	87.0	311.0	50.0	0.0	1.0	**1292.1**	**799**
MOCHO 2	3S/1E 9M 3	Mocho 2	189.2	185.5	0.9	156.0	85.0	61.0	27.0	77.0	61.0	154.0	108.0	64.0	**1168.6**	**922**
MOCHO 3	3S/1E 9M 4	Mocho 3	8.4	0.4	147.1	223.0	0.0	2.0	3.0	18.0	118.0	94.0	135.0	56.0	**804.9**	**730**
MOCHO 4	3S/1E 8H18	Mocho 4	0.4	0.3	0.0	60.0	0.0	0.0	13.0	276.0	185.0	164.0	252.0	11.0	**961.7**	**1007**
STONERIDGE_1	3S/1E 9B 1	Stoneridge	41.7	183.9	133.0	336.0	66.0	19.0	48.0	47.0	210.0	356.0	123.0	30.0	**1593.6**	**1552**
TOTALS															**8748.3**	**7717**
Owner: Pleasanton																
PLEAS #5	3S/1E 16L 5	Pleas 5	36.4	55.4	45.9	88.1	0.0	0.0	1.7	59.8	209.2	218.5	214.4	186.3	**1115.6**	**1107.8**
PLEAS #6	3S/1E 16L 7	Pleas 6	83.2	54.5	59.7	54.6	27.7	0.0	1.6	61.9	207.9	235.7	223.2	193.7	**1203.6**	**1143.7**
PLEAS #8	3S/1E 16A 2	Pleas 8	141.7	33.6	64.8	0.0	0.0	1.5	0.0	205.5	249.5	263.1	254.9	206.2	**1420.8**	**1235**
TOTALS															**3740.1**	**3486.6**
Owner: Other																
GWP_SFWD	3S/1E 19A11	SFWD North (A)	30.0	11.0	16.0	17.0	13.0	15.0	11.0	37.0	64.0	75.0	52.0	57.0	**398**	**408**
TOTALS															**398**	**408**
Owner: California Water Service																
CWS# 5(16B1)	3S/2E 16B 1	CWS STA 5	0.0	3.7	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**6.2**	**0**
CWS# 8(8P 1)	3S/2E 8P 1	CWS STA 8	38.7	37.8	8.6	14.9	34.9	37.9	22.8	36.5	34.4	33.8	33.5	7.8	**341.5**	**256.5**
CWS# 9(9Q 1)	3S/2E 9Q 1	CWS STA 9	0.3	12.6	33.9	45.5	38.7	55.0	50.5	46.3	53.0	48.9	57.4	51.3	**493.4**	**490.9**
CWS#10 (8F1)	3S/2E 8F 1	CWS STA 10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.6	40.2	48.6	47.2	39.5	**216.1**	**309.7**
CWS#12 (9P1)	3S/2E 9P 1	CWS STA 12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	**0.2**	**0.2**
CWS#14 (8N2)	3S/2E 8N 2	CWS STA 14	0.0	27.7	79.7	10.3	6.6	48.3	60.7	75.3	88.9	88.4	78.0	66.6	**630.5**	**609.7**
CWS#15 (16C1)	3S/2E 16C 1	CWS STA 15	21.1	0.0	0.0	0.0	32.0	10.6	15.0	50.9	41.0	42.0	6.7	0.0	**219.1**	**198.1**
CWS#17 (9L1)	3S/2E 9L 1	CWS STA 17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**0**
CWS#19 (8G1)	3S/2E 8G 1	CWS STA 19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**0**
CWS#20 (18B1)	3S/2E 18B 1	CWS STA 20	40.1	35.7	31.9	36.3	37.8	38.0	37.0	48.2	40.6	37.3	10.1	0.0	**392.8**	**285.2**
CWS#24 (7P3)	3S/2E 7P 3	CWS STA 24	51.2	47.0	30.8	43.0	35.0	27.9	30.1	32.5	17.1	43.5	30.0	0.0	**388.1**	**259.2**
CWS#31 (7R3)	3S/2E 7R 3	CWS STA 31	0.0	10.1	20.9	5.5	3.3	24.8	54.3	41.3	54.9	64.5	63.3	53.8	**396.7**	**411.7**
TOTALS															**3084.5**	**2821.1**

* Water Year - from October 2013 to September 2014;
** Calendar Year - from January 2014 to December 2014;
Does not include pumped volume to waste.

FIGURE 10-10
MAIN BASIN GROUNDWATER PRODUCTION
1974 TO 2014 WATER YEARS



* Not including pumping by Zone 7 for DSRSD which is included in municipal groundwater by others

\\ZONE7-FILE\working_files\WRE\MONITOR\GWStorage\2014wy\AnnualReport2014\Fig10-10-GrphGWPercentages14.XLS
7/2/2015